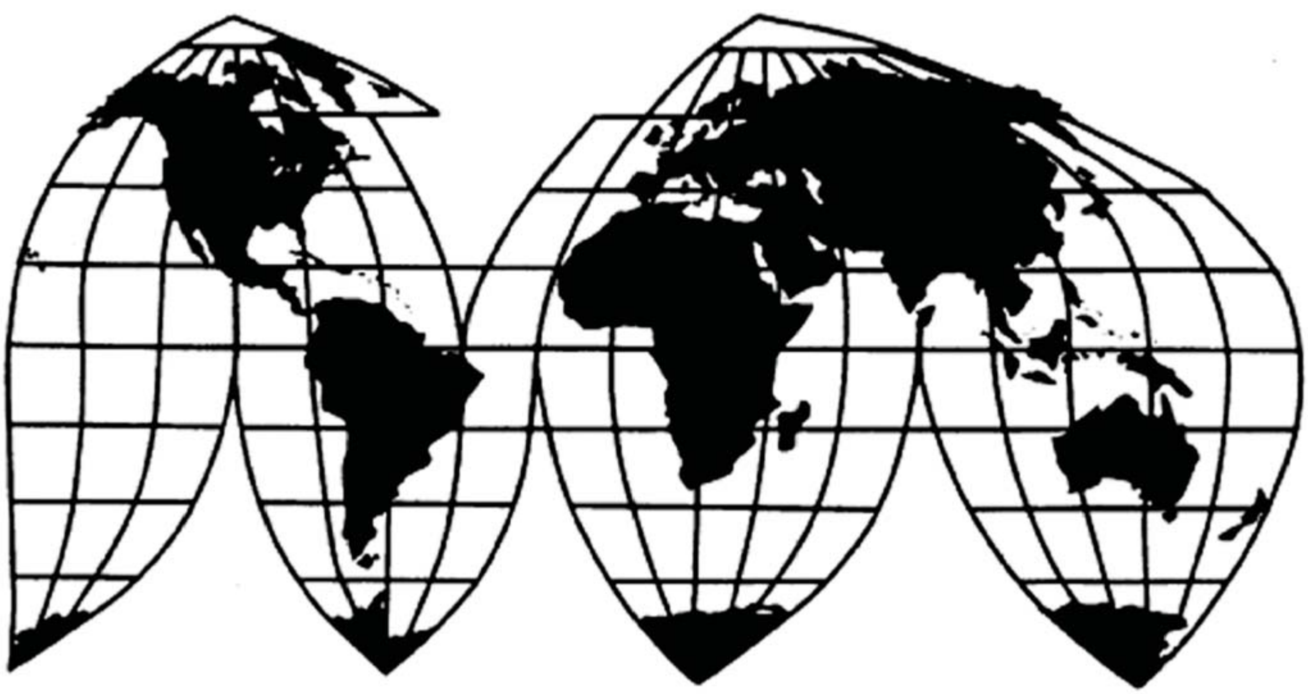
Crystalline Silicon Photovoltaic Cells (Whether or not Partially or Fully Assembled into Other Products)

Investigation No. TA-201-75

VOLUME I: DETERMINATION AND VIEWS OF COMMISSIONERS

Publication 4739 **November 2017**

U.S. International Trade Commission



Washington, DC 20436

U.S. International Trade Commission

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Note.—Information that would reveal confidential operations of individual concerns may not be published and therefore has been deleted. Such deletions are indicated by asterisks.

UNITED STATES INTERNATIONAL TRADE COMMISSION

Investigation No. TA-201-75

Crystalline Silicon Photovoltaic Cells
(Whether or Not Partially or Fully Assembled into Other Products)

DETERMINATION

On the basis of information developed in the subject investigation, the Commission determined pursuant to section 202(b) of the Trade Act of 1974 that crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) ("CSPV products") are being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing an article like or directly competitive with the imported article.

Having made an affirmative injury determination pursuant to section 202(b) of the Trade Act of 1974, the Commission was required to make certain additional findings under the implementing statutes of certain free trade agreements ("FTAs") or under statutory provisions related to certain preferential trade programs. Under section 311(a) of the NAFTA Implementation Act (19 U.S.C. § 3371(a)), the Commission found that imports of CSPV products from Mexico account for a substantial share of total imports and contribute importantly to the serious injury caused by imports. Under 19 U.S.C. § 3371(a), the Commission also found, with Chairman Rhonda K. Schmidtlein dissenting, that imports of CSPV products from Canada do not account for a substantial share of total imports and do not contribute importantly to the serious injury caused by imports. The Commission further found that imports of CSPV products from Korea are a substantial cause of threat of serious injury, but that imports of CSPV products from Australia, the U.S.-Dominican Republic – Central America Free Trade Agreement ("CAFTA-DR") countries, Colombia, Jordan, Panama, Peru, and Singapore, individually, are not a substantial cause of serious injury or threat thereof, under the respective implementing legislation for the FTAs with these countries. *See* 19 U.S.C. § 2112 note (Jordan); 19 U.S.C. § 3805 note (Australia, Colombia, Korea, Panama, Peru, Singapore); 19 U.S.C. § 4101 (CAFTA-DR). The Commission also found that the serious injury substantially caused by imports to the domestic industry producing a like or directly competitive article does not result from the reduction or elimination of any duty provided for under the U.S.-Israel Free Trade Agreement or from duty-free treatment provided for under the Caribbean Basin Economic Recovery Act ("CBERA") provisions of the Caribbean Basin Initiative Trade Program or the Generalized System of Preferences ("GSP") program. 19 U.S.C. § 2112 note (Israel); 19 U.S.C. § 2703(e) (CBERA); 19 U.S.C. § 2253(e)(6) (GSP).

REMEDY RECOMMENDATIONS

In order to address the serious injury to the domestic industry producing CSPV products and be most effective in facilitating the efforts of the domestic industry to make a positive adjustment to import competition, the Commission recommended a series of actions.

With regard to CSPV cells, Chairman Schmidtlein recommends a tariff-rate quota with an in-quota tariff rate of 10 percent ad valorem and an in-quota volume level of 0.5 gigawatts. For U.S. imports of cells that exceed the 0.5 gigawatts volume level, she recommends a tariff rate of 30 percent ad valorem. Chairman Schmidtlein recommends that this tariff-rate quota be implemented for four years and that the in-quota level be incrementally raised and the tariff rate be incrementally reduced during the remedy period. With regard to CSPV modules, she recommends an ad valorem tariff rate of 35 percent to be incrementally reduced during the 4-year remedy period. Chairman Schmidtlein also recommends that the President initiate international negotiations to address the underlying cause of the increase in imports of CSPV products and alleviate the serious injury thereof. Having made findings that U.S. imports from Australia, the CAFTA-DR countries, Colombia, Israel, Jordan, Panama, Peru, Singapore, and the beneficiary countries under CBERA were not a substantial cause of the serious injury experienced by the domestic industry, Chairman Schmidtlein recommends to the President that U.S. imports from these countries be excluded from the remedy.

Chairman Schmidtlein's Recommended Remedy				
	Year 1	Year 2	Year 3	Year 4
Cells: Tariff rate Quota				
In-Quota Tariff Rate	10%	9.5%	9.0%	8.5%
In-Quota Volume Level	0.5 gigawatts	0.6 gigawatts	0.7 gigawatts	0.8 gigawatts
Out-of-Quota Tariff Rate	30%	29%	28%	27%
Modules: Tariff (Ad Valorem)	35%	34%	33%	32%

Vice Chairman David S. Johanson and Commissioner Irving A. Williamson recommend that for a 4-year period the President impose (1) a tariff-rate quota on imports of CSPV products in cell form, and (2) increased rates of duty on imports of CSPV products in module form. For imports of CSPV products in cell form, they recommend an additional 30 percent ad valorem tariff on imports in excess of 1 gigawatt. In each subsequent year, they recommend that this tariff rate decrease by five percentage points and that the in-quota amount increase by 0.2 gigawatts. The rate of duty on in-quota CSPV products in cell form will remain unchanged. For imports of CSPV products in module form, Vice Chairman Johanson and Commissioner Williamson recommend an additional 30 percent ad valorem tariff, to be phased down by five percentage points per year in each of the subsequent years. Having made a negative finding with respect to imports from Canada under section 311(a) of the North American Free Trade Agreement Implementation Act, they recommend that such imports be excluded from the above tariff-rate quota and increased rates of duty. Further, Vice Chairman Johanson and Commissioner Williamson recommend that the above tariff-rate quota and increased rates of duty not apply to imports from the following countries with which the United States has FTAs: Australia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Nicaragua, Panama, Peru, and Singapore. They also recommend that the tariff-rate quota and increased rates of duty not apply to imports from the CBERA beneficiary countries. Vice Chairman Johanson and Commissioner Williamson recommend that the President direct the United States Department of Labor and the United States Department of Commerce to provide expedited consideration of any application for trade adjustment assistance for workers and/or firms that are affected by subject imports. They recommend the President's consideration of the product exclusions requested by Respondents to which Petitioners have not objected and have indicated they would work to draft appropriate product-specific exclusions. Finally, they recommend that the President also consider any appropriate funding mechanisms that may facilitate a positive adjustment to import competition.

Commissioner Meredith M. Broadbent recommends that the President impose a quantitative restriction on imports of CSPV products into the United States, including cells and modules, for a four-year period, administered on a global basis. She recommends that the quantitative restriction be set at 8.9 gigawatts in the first year and increase by 1.4 gigawatts each subsequent year. In accordance with section 1102 of the Trade Agreements Act of 1979 (19 U.S.C. § 2581) and the President's authority in section 203(a)(3)(F) of the Trade Act of 1974 (19 U.S.C. § 2253(a)(3)(F)), she also recommends that the President administer these quantitative restrictions by selling import licenses at public auction at a minimum price of one cent per watt. She recommends that the President, to the extent permitted by law, authorize the use of funds equal to the amount generated by import license auctions to provide development assistance to domestic CSPV product manufacturers for the duration of the remedy period, such as through authorized programs at the United States Department of Energy (DOE). Commissioner Broadbent also recommends that the President implement other appropriate adjustment measures, including the provision of trade adjustment assistance by the United States Department of Labor and the United States Department of Commerce to workers and firms affected by import competition. Having made an affirmative finding with respect to imports from Mexico under section 311(a) of the NAFTA Implementation Act, she recommends that the President allocate no less than 720 megawatts to Mexico during the first year within the global quantitative restriction, which would expand by 115 megawatts each year. Having made a negative finding with respect to imports from Canada under section 311(a) of the NAFTA Implementation Act, Commissioner Broadbent recommends that such imports be excluded from the quantitative restriction. Furthermore, she recommends that this quantitative restriction not apply to imports from Australia, the CAFTA-DR countries, Colombia, Israel, Jordan, Panama, Peru, Singapore, and the CBERA beneficiary countries.

Commission's Views on Injury

Based on the facts in this investigation, we determine pursuant to section 202(b) of the Trade Act of 1974 ("Trade Act")[1] that crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) ("CSPV products") are being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing an article like or directly competitive with the imported article.[2] Having made an affirmative determination in this global safeguard investigation, we are required to make certain additional findings under the implementing statutes of certain free trade agreements ("FTAs") or under statutory provisions related to certain preferential trade programs.[3] We find that imports of CSPV products from Mexico account for a substantial share of total imports and contribute importantly to the serious injury caused by imports.[4] We also find that imports of CSPV products from Canada do not account for a substantial share of total imports and do not contribute importantly to the serious injury caused by imports.[5] We find

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[1] 19 U.S.C. § 2252(b).

[2] The Commission's affirmative serious injury determination is unanimous, reflecting the views of Chairman Rhonda K. Schmidtlein, Vice Chairman David S. Johanson, and Commissioners Irving A. Williamson and Meredith M. Broadbent.

[3] Specifically, the Commission is required to make certain additional findings under the implementing statutes for the North American Free Trade Agreement ("NAFTA") (Canada and Mexico), the U.S.-Dominican Republic – Central America Free Trade Agreement ("CAFTA-DR") (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and the Dominican Republic), the U.S.-Australia Free Trade Agreement, the U.S.-Korea Free Trade Agreement ("KORUS"), the U.S.-Colombia Trade Promotion Agreement, the Agreement between the United States of America and the Hashemite Kingdom of Jordan on the Establishment of a Free Trade Area, the U.S.-Panama Trade Promotion Agreement, the U.S.-Peru Free Trade Agreement, the U.S.-Singapore Free Trade Agreement, and the U.S./Israel Free Trade Agreement or under statutory provisions related to preferential trade programs (Caribbean Basin Economic Recovery Act ("CBERA") and Generalized System of Preferences ("GSP")). *See* 19 U.S.C. § 2112 note (Jordan, Israel); 19 U.S.C. § 2253(e)(6) (GSP); 19 U.S.C. § 2703(e) (CBERA); 19 U.S.C. § 3371 (NAFTA); 19 U.S.C. § 3805 note (Australia, Colombia, KORUS, Panama, Peru, Singapore); 19 U.S.C. § 4101 (CAFTA-DR).

[4] The Commission's finding regarding imports of CSPV products from Mexico under section 311(a) of the NAFTA Implementation Act (19 U.S.C. § 3371(a)) reflects the views of Chairman Schmidtlein, Vice Chairman Johanson, and Commissioners Williamson and Broadbent. As discussed in more detail in section III below, in this investigation, we measured U.S. imports from Canada and Mexico using questionnaire data based on the module assembly location and measured imports from all other sources based on adjusted U.S. importer questionnaire data that are based on the manufacturing location of the CSPV cell.

[5] The Commission's finding regarding imports of CSPV products from Canada under section 311(a) of the NAFTA Implementing Act (19 U.S.C. § 3371(a)) reflects the views of Vice Chairman Johanson and Commissioners Williamson and Broadbent. As explained below, Chairman Schmidtlein does not join section V.A.1 of these Views. She finds under section 311(a) of the NAFTA Implementation (Continued…)

that imports of CSPV products from Korea are a substantial cause of threat of serious injury, but that imports of CSPV products from Australia, CAFTA-DR countries, Colombia, Jordan, Panama, Peru, and Singapore, individually, are not a substantial cause of serious injury or threat thereof, under the respective implementing legislation.[6] We also find that the serious injury substantially caused by imports to the domestic industry producing a like or directly competitive article does not result from the reduction or elimination of any duty provided for under the U.S.-Israel Free Trade Agreement[7] or from duty-free treatment provided for under the Caribbean Basin Economic Recovery Act provisions of the Caribbean Basin Initiative Trade Program or the GSP program.[8]

I. Background

Effective May 17, 2017, the Commission instituted this investigation, Inv. No. 201-TA-75, in response to a petition, as amended and properly filed on May 17, 2017 by Suniva, Inc. ("Suniva"), a producer of crystalline silicon photovoltaic ("CSPV") cells and CSPV modules in the United States.[9] On May 25, 2017, SolarWorld publicly stated its support for the petition as a co-petitioner.[10]

(…Continued)
Act (19 U.S.C. § 3371(a)) that imports of CSPV products from Canada account for a substantial share of total imports and contribute importantly to the serious injury caused by imports.

[6] The Commission's findings regarding imports of CSPV products from Australia, CAFTA-DR countries, Colombia, Jordan, Korea, Panama, Peru, and Singapore reflect the views of Chairman Schmidtlein, Vice Chairman Johanson, and Commissioners Williamson and Broadbent.

[7] 19 U.S.C. § 2112 note, U.S./Israel FTA Implementing Act §§ 403(b), 403(d).

[8] 19 U.S.C. §§ 2253(e)(6), 2703e(2), 2703e(4). The Commission's findings regarding imports from Israel, CBERA countries, and GSP trade preference countries reflect the views of Chairman Schmidtlein, Vice Chairman Johanson, and Commissioners Williamson and Broadbent.

[9] 82 Fed. Reg. 25331 (June 1, 2017). Suniva initially submitted a petition on April 26, 2017. On May 1, 2017, Commission staff issued a letter requesting that Suniva clarify its description of the imported articles intended to be covered by the petition, provide more details concerning whether Suniva was "representative of an industry" within the meaning of 19 U.S.C. § 2252(a)(1), and supply additional data on the performance indicators for the industry producing an article like or directly competitive with the imported article. On May 12, 2017, Suniva provided additional information to support its allegations (including an affidavit indicating that *** supported the petition). Suniva's May 12, 2017 response at Exhibit 6. On May 17, 2017, Suniva further amended its petition and provided a revised description of the imported articles. The Commission determined that the petition, as amended, was properly filed as of May 17, 2017.

[10] Confidential Report, Memorandum INV-PP-119 (Sept. 11, 2017), as corrected by Memorandum INV-PP-139 (Oct. 31, 2017) ("CR") at I-1; Public Report, *Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products)*, Inv. No. 201-TA-75, USITC Pub. 4739 (Nov. 2017) ("PR") at I-1. Together the two petitioners accounted for the vast majority (*** percent of U.S. CSPV cell production by kW in 2016, and for a large majority (*** percent) of module assembly during the January 1, 2012 to December 31, 2016 period of investigation ("POI"). CR at III-22, III-23; PR at III-11; CR/PR at Table III-5, Table III-7, Table III-8.

Pursuant to the scheduling notice published in the *Federal Register* on June 1, 2017, the Commission held a public hearing on injury issues on August 15, 2017,[11] and voted with respect to injury issues on September 22, 2017.[12] The Commission held a public hearing on remedy issues on October 3, 2017, voted with respect to remedy issues on October 31, 2017, and transmitted its report to the President on November 13, 2017.

Parties and Non-Parties to the Investigation. Representatives of co-petitioners Suniva and SolarWorld appeared at the hearings on injury and remedy issues accompanied by counsel, and they submitted prehearing and posthearing briefs on injury and remedy.

Several respondent interested parties also participated in the investigation. The five sets of interested parties that appeared at the injury and remedy hearings with counsel and submitted prehearing and posthearing briefs on injury and remedy issues included the following: Canadian Solar Solutions, Inc. ("Canadian Solar"), Silfab Solar Inc. ("Silfab Solar"), and Heliene Inc. ("Heliene") (collectively "Canadian respondents");[13] the Solar Energy and Photovoltaic Products Branch of the China Chamber of Commerce for Import and Export of Machinery and Electronic Products ("CCCME");[14] the Korea Photovoltaic Industry Association ("KOPIA");[15] REC Solar Pte. Ltd. and REC Americas, LLC ("REC Americas") (collectively "REC Solar");[16] and SunPower Corp., SunPower Corporation Systems, SunPower North America, LLC, SunPower Corp. Mexico, S. de R.L. de C.V., SunPower Philippines Manufacturing Ltd., and SunPower Solar Malaysia Sdn. Bhd. (collectively "SunPower").[17] A sixth group of interested

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[11] *See* Transcript of Commission's August 15, 2017 Hearing on Injury Issues ("Injury Hearing Tr.").

[12] 82 Fed. Reg. 25331 (June 1, 2017).

[13] Canadian Solar, Silfab Solar, and Heliene are producers and exporters of CSPV cells and CSPV modules from Canada. Canadian respondents' Prehearing Injury Brief at 4.

[14] CCCME members produce CSPV cells and CSPV modules in China. CCCCME's Prehearing Injury Brief at 1, Exhibit 1.

[15] Hanwha Q CELLS America, Inc. ("Hanwha America") submitted prehearing and posthearing briefs on injury issues. Hanwha America is an importer with affiliates that manufacture CSPV cells and/or CSPV modules in Canada, China (including Hong Kong), Germany, Korea, and Malaysia. CR/PR at Tables IV-18 to IV-19; Hanwha America's Prehearing Injury Brief at 9-10.

[16] REC Solar and REC Americas are a foreign producer/exporter and an importer of CSPV products from Singapore. REC Solar's Prehearing Injury Brief at 8.

[17] SunPower reports that it invests in U.S. research and development to support the manufacture of CSPV cells and CSPV modules, manufactures CSPV cells in Malaysia and the Philippines, assembles CSPV cells into modules in Mexico, and at the beginning of the POI assembled modules in the Philippines from a Chinese toll producer (***). SunPower's Prehearing Injury Brief at 2-3. SunPower recently entered into a CSPV cell and CSPV module manufacturing joint venture in China that it reports will be entirely dedicated to non-U.S. markets. SunPower's Posthearing Injury Brief at 11, Appendix at vii. Additionally, SunPower invested $25 million in a U.S. CSPV cell and CSPV module facility in San Jose, CA where it began production in May 2017 with the stated intention to serve residential and commercial applications. SunPower's Posthearing Injury Brief, Appendix at i. It previously partnered with Flextronics to manufacture CSPV modules in Milpitas, CA, but that facility was not adequately scaled, so SunPower determined it was more cost advantageous to integrate the knowledge developed at the Milpitas facility into its other manufacturing locations. *Id*. at ii.

parties (Vina Solar Technology Co. Ltd. ("Vina Solar"); Boviet Solar USA Ltd. ("Boviet USA"); and Boviet Solar Technology Co., Ltd. ("Boviet") (collectively "Vietnamese Respondents")) submitted joint prehearing briefs on injury and prehearing and posthearing briefs on remedy.[18] Seven interested parties submitted prehearing and posthearing briefs on remedy (Auxin Solar,[19] Changzhou Trina,[20] Goal Zero LLC,[21] Mission Solar,[22] NextEra Energy Inc.,[23] Solatube International Inc.,[24] and the Taiwan Photovoltaic Industry Association ("TPVIA")),[25] and two other interested parties (Sunrun and Tesla) submitted posthearing briefs on remedy.[26]

Except as otherwise indicated, the following eleven foreign governments filed prehearing injury and remedy submissions and delivered oral statements at the Commission's hearings on injury and remedy: Brazil, Canada (also filed posthearing submissions on injury and remedy); China (only filed posthearing injury and remedy submissions); European Commission; Indonesia (also filed a posthearing injury submission); Korea (also filed a posthearing remedy submission); Mexico (also filed a posthearing injury submission); Singapore (only filed a prehearing injury submission); Thailand (only filed a prehearing injury submission and a posthearing remedy submission); Taiwan (also filed a posthearing remedy submission); and Vietnam (only filed a posthearing remedy submission).

Forty-nine firms, industry groups, or other organizations that are not interested parties and/or are not parties to the investigation also filed submissions on injury and/or remedy issues.[27] One of them, SEIA, which is not an interested party association,[28] filed joint

[18] Vina Solar, Boviet USA, and Boviet are foreign producers or importers of merchandise from Vietnam. CR/PR at Table I-3, Table IV-68.

[19] Auxin Solar is a U.S. producer of CSPV products. CR/PR at Table III-3.

[20] Changzhou Trina Solar is a foreign producer of CSPV products.

[21] Goal Zero is an importer of CSPV products. CR/PR at Table II-3.

[22] Mission Solar is a U.S. producer and importer of CSPV products. CR/PR at Table I-2, Table I-3.

[23] NextEra Energy is an importer of CSPV products. CR/PR at Table II-3.

[24] Solatube is an importer of CSPV products. CR/PR at Table II-3.

[25] TPIA is an association, a majority of which are producers and exporters from Taiwan.

[26] Sunrun is an importer of CSPV products, and Tesla is an importer, producer, and purchaser.

[27] Each of the following firms, groups, or other organizations submitted statements on injury and/or remedy: Advanced Energy Buyers Group (coalition of large energy buyers); Alliance for American Manufacturing (domestic labor/business partnership); Almond Alliance of California; American Council on Renewable Energy (non-profit organization representing renewable energy developers, manufacturers, financial institutions, corporate end users, utilities, and grid technology providers); Arcadia Power (renewable energy software and technology company); Blue Green Energy LLC Carolina Solar Energy (developer of utility solar projects in North Carolina and Virginia); California Citrus Mutual; California Cotton Ginners and Growers Association; California Fresh Fruit Association; California Poultry Association; Center for Biological Diversity; Coalition for Prosperous America (coalition of manufacturers, agricultural, worker, consumer and citizen interests); Colorado Cleantech Industries Association; Complete Solar (designer and installer); Duke Energy (energy provider); DuPont Photovoltaic and Advanced Materials (manufacturer of paste and film raw materials and photovoltaic system owner and user); Electrical Reliability Coordinating Council (coalition of power-generating companies); David Ellis; Energy Trade Action Coalition; Enerparc Inc. (engineering services provider);
(Continued…)

submissions on injury issues with one of its importer/foreign producer members (SunPower); many respondent interested parties expressly support most, if not all, of SEIA's arguments, so its arguments may be referred to herein as "respondents' arguments."

Data Coverage. U.S. industry data are based on questionnaire responses from 16 firms that are estimated to have accounted for all known U.S. production of CSPV cells and 63.9 percent of U.S. production of CSPV modules in 2015.[29] U.S. import data are based on questionnaire responses of 56 firms that are estimated to have accounted for 82.6 percent of U.S. imports of CSPV cells and CSPV modules in 2016.[30] The Commission also received questionnaire responses from 100 foreign producers/exporters of CSPV products.[31]

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Enphase Energy, Inc. (U.S. producer of solar microinverters); First Solar (former producer of CSPV products, thin film producer, project developer, engineering, procurement, construction, operation, and management services provider); Georgia Chamber of Commerce; Gigawatt (developer, distributor, installer); Henry Hielsmair (consultant); Heritage Foundation (non-profit research institution); Hunter Humphrey (solar developer); Inovateus Solar (project developer); Mounting System Manufacturers; National Electrical Contractors Association; National Grid (energy provider); Onyx Solar Energy (developer, manufacturer of architectural photovoltaic glass); PG&E Corp. and Edison International (utilities); PT Sky Energy Indonesia (foreign producer/exporter from Indonesia); R Street (think tank); RECOM AG (module manufacturer in Europe, power distributor); Dan Reicher; Seminole Financial Services; Sigora Solar (designer and installer); SKC (manufacturer of ethyl vinyl acetate sheets); Solar Energy Industries Association ("SEIA") (non-profit trade association of installers, project developers, contractors, and financers); Shanghai BYD Co. and BYD (Shanghai) Industrial Co. Ltd. (foreign producer); Steel Manufacturers Association; Sunfolio & One Planet Infrastructure (developer); SunTegra (developer and seller of smaller, low-wattage solar products); Technet (network of technology chief executive officers and senior executives); U.S. polysilicon industry (Hemlock Semiconductor Operations LLC, Wacker Polysilicon North America LLC, and REC Silicon Inc.); Western Agricultural Processors Association; and 8minutenergy Renewables ("8minutenergy") (project developer) (supported by non-party utility solar developers 174 Power Global Corporation, Cypress Creek Renewables, and Intersect Power).

[28] Interested parties include, among others, foreign manufacturers, producers, exporters, or U.S. importers of an article which is the subject of an investigation, foreign governments, U.S. manufacturers, producers, or wholesalers, and certified unions or recognized unions or groups of workers that are representative of a domestic industry. Certain associations are also interested parties, if a majority of their members is composed of interested parties. 19 C.F.R. § 206.17(a)(3)(iii). A majority of SEIA's members, however, is not composed of interested parties, so it is not an interested party. EDIS Doc. 612890.

[29] CR at I-4; PR at I-3.

[30] CR at I-5; PR at I-3. Respondents state that importer questionnaire data represent "the vast bulk of imports of subject merchandise into the U.S. market." SEIA's Posthearing Injury Brief, Appendix A at 107-108 (attributing at least a portion of the differential between importer questionnaire data and official import statistics to out-of-scope thin film).

[31] Foreign producer responses and the estimated coverage for each country are as follows: Brazil (1 firm accounting for less than *** percent of module production capacity); Canada (5 firms accounting for approximately 89 percent of 2016 module capacity); China (35 firms accounting for approximately 57 percent of CSPV cell production and 67 percent of module production in 2016);
(Continued…)

II. Domestic Industry Producing a Product that is Like or Directly Competitive with the Imported Article

A. Like or Directly Competitive Domestic Product

In making determinations in global safeguard investigations, the Commission examines three statutory criteria. Specifically, to make an affirmative determination, the Commission must find –

> (1) an article is being imported into the United States in increased quantities;
> (2) the domestic industry producing an article that is like or directly competitive with the imported article is seriously injured or threatened with serious injury; and
> (3) the article is being imported in such increased quantities as to be a substantial cause of serious injury or threat of serious injury to the domestic industry.[32]

Before considering whether the three statutory criteria are satisfied, the Commission first defines the domestic industry. The statute defines the term "domestic industry" as "the producers as a whole of the like or directly competitive article or those producers whose collective production of the like or directly competitive article constitutes a major proportion of the total domestic production of such article."[33] The Commission defines the domestic industry

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Germany (6 firms accounting for all known CSPV cell capacity and 51 percent of module production capacity in 2016); India (5 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of module production capacity); Indonesia (3 firms accounting for approximately *** percent of module production capacity); Japan (1 firm accounting for approximately *** percent of CSPV cell production and *** percent of module production in 2016); Korea (4 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of module production capacity in 2016); Malaysia (10 firms accounting for all known CSPV cell capacity and 93 percent of module capacity in 2015); Mexico (3 firms accounting for approximately *** percent of CSPV cell capacity and approximately *** percent of module capacity in 2016); Netherlands (1 firm accounting for all known production); Philippines (1 firm accounting for all known production); Singapore (1 firm accounting for all known production); Taiwan (15 firms accounting for approximately 82 percent of CSPV cell capacity and 31 percent of module capacity in 2016); Thailand (4 firms accounting for approximately 52 percent of CSPV cell production capacity in 2016 and 44 percent of module capacity in 2016); Vietnam (5 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of module capacity in 2016). CR at I-5 to I-7; PR at I-3 to I-5. Respondents state that to the extent that data from any major CSPV exporting country were missing, the Commission's Prehearing Report provided adequate coverage of such countries using alternative data sources. SEIA's Posthearing Injury Brief, Appendix 1 at 107-108.

[32] *See* 19 U.S.C. § 2252(b)(1)(A).

[33] 19 U.S.C. § 2252(c)(6)(A)(1).

in terms of each like or directly competitive product and evaluates the impact of the pertinent imports on the facilities and workers producing each article.[34]

The legislative history distinguishes between products that are "like" and products that are "directly competitive" with the imported articles, explaining that "like" articles are those which are "substantially identical in inherent or intrinsic characteristics (*i.e.*, materials from which made, appearance, quality, texture, etc.)," whereas "directly competitive" articles are those which, "are substantially equivalent for commercial purposes, that is, are adapted to the same uses and are essentially interchangeable therefor."[35]

In determining what constitutes the like or directly competitive product, the Commission has considered a number of factors. The list of factors considered is not fixed, and the weight given to any one factor may vary from case to case depending upon the facts.[36] The list, which derives from Commission practice, has included the physical properties of the article, its customs treatment, its manufacturing process (where and how it is made, *e.g.*, in a separate facility, using certain machines and labor skills), the product's uses, and the marketing channels through which the product is sold.[37] The statute does not prescribe these specific factors nor does it limit the factors that the Commission may consider in making its determination. Thus, in conducting its analysis, the Commission (1) considers the list of factors, (2) evaluates the factors in terms of the facts in the investigation, and (3) looks for clear dividing lines between products, disregarding minor variations.[38]

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[34] *See, e.g.*, *Steel*, Inv. No. 201-TA-73, USITC Pub. 3479 at 29 n.25 (Dec. 2001); *Extruded Rubber Thread*, Inv. No. 201-TA-72, USITC Pub. 3375 at I-8 (Dec. 2000); *Crabmeat from Swimming Crabs*, Inv. No. 201-TA-71, USITC Pub. 3349 at I-8 to I-9 (Aug. 2000); *Circular Welded Carbon Quality Pipe*, Inv. No. 201-TA-70, USITC Pub. 3261 at I-12 to I-13 (Dec. 1999); *Certain Steel Wire Rod*, Inv. No. 201-TA-69, USITC Pub. 3207 at I-10, I-36 (Jul. 1997).

[35] H.R. Rep. No. 571, 93rd Cong., 1st Sess. 45 (1973); Senate Finance Committee, Report on Trade Reform Act of 1974 H.R. 10710, S. Rep. No. 1298, 93rd Cong., 2d Sess. at 121-22 (1974). *See, e.g.*, *Mushrooms*, Inv. No. 201-TA-43, USITC Pub. 1089 at 8, 11-12 (Aug. 1980) ("the intent of the drafting committees was that 'like' has to do with the physical identity of the articles themselves, while 'directly competitive' relates more to the notion of commercial interchangeableness"); *see also United Shoe Workers of Am. v. Bedell*, 506 F.2d 174, 185-86, 190-91 (D.C. Cir. 1974) (discussing meaning of "like" and "directly competitive" in the context of a request for adjustment assistance under the Trade Expansion Act).

[36] *See, e.g.*, *Certain Steel Wire Rod*, Inv. No. 201-TA-69, USITC Pub. 3207 at I-8 (Jul. 1999); *Lamb Meat*, Inv. No. 201-TA-68, USITC Pub. 3176 at I-10 (Apr. 1999); *Wheat Gluten*, Inv. No. 201-TA-67, USITC Pub. 3088 at I-9 (Mar. 1998).

[37] *See, e.g.*, *Extruded Rubber Thread*, Inv. No. 201-TA-72, USITC Pub. 3375 at I-5 to I-6 (Dec. 2000); *Circular Welded Carbon Quality Line Pipe*, Inv. No. 201-TA-70, USITC Pub. 3261 at I-10 (Dec. 1999); *Apple Juice*, Inv. No. 201-TA-69, USITC Pub. 1861 at 3-10 (June 1986); *Fresh Winter Tomatoes*, Inv. No. 201-TA-64 (Provisional Relief Phase), USITC Pub. 2881 at I-7 (Apr. 1995) (Views of Watson, Crawford, and Bragg); *Broom Corn Brooms*, Inv. No. 302-NAFTA-1 (Provisional Relief Phase), USITC Pub. 2963 at I-14 (May 1996).

[38] *See, e.g.*, *Stainless Steel Table Flatware*, Inv. No. 201-TA-49, USITC Pub. 1536 at 3-4 (June 1984).

The notice of institution described the imported articles under investigation as follows: CSPV cells, whether or not partially or fully assembled into other products, including, but not limited to modules, laminates, panels, and building-integrated materials. The investigation covers crystalline silicon photovoltaic cells of a thickness equal to or greater than 20 micrometers, having a p/n junction (or variant thereof) formed by any means, whether or not the cell has undergone other processing, including, but not limited to cleaning, etching, coating, and/or addition of materials (including, but not limited to, metallization and conductor patterns) to collect and forward the electricity that is generated by the cell.

Included in the scope of the investigation are photovoltaic cells that contain crystalline silicon in addition to other photovoltaic materials. This incudes, but is not limited to passivated emitter rear contact ("PERC") cells, heterojunction with intrinsic thin-layer ("HIT") cells, and other so-called "hybrid" cells.

Articles under consideration also may be described at the time of importation as components for final finished products that are assembled after after importation, including, but not limited to, modules, laminates, panels, and panels, and building-integrated materials.[39]

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[39] CSPV cells, whether or not partially or fully assembled into other products, are excluded from the scope of the investigation if the CSPV cells were manufactured in the United States. Also excluded from the investigation are thin film photovoltaic products produced from amorphous silicon ("a-Si"), cadmium telluride ("CdTe"), or copper indium gallium selenide ("CIGS"). Also excluded from the scope of the investigation are crystalline silicon photovoltaic cells, not exceeding 10,000 mm^2 in surface area, that are permanently integrated into a consumer good whose function is other than power generation and that consumes the electricity generated by the integrated crystalline silicon photovoltaic cell. Where more than one cell is permanently integrated into a consumer good, the surface area for purposes of this exclusion shall be the total combined surface area of all cells that are integrated into the consumer good. 82 Fed. Reg. 25332 (June 1, 2017). The Commission noted that for Customs purposes, the CSPV cells covered by the investigation are provided for under Harmonized Tariff Schedule of the United States ("HTSUS") subheading 8541.40.60. Within that 8-digit subheading, CSPV cells that are assembled into modules or panels are imported under HTSUS statistical reporting number 8541.40.6020, while CSPV cells that are not assembled into modules and are presented separately are imported under statistical reporting number 8541.40.6030. Inverters or batteries with CSPV cells attached are provided for under HTSUS subheadings 8501.61.00 and 8507.20.80, respectively. In addition, CSPV cells covered by the investigation may also be classifiable as DC generators of subheading 8501.31.80, when such generators are imported with CSPV cells attached. While HTSUS provisions are provided for convenience, the written scope is dispositive. *Id*.

The investigation's scope covers the non-cell portion of a finished CSPV module (such as the aluminum frame), assuming that the CSPV cells are covered.[40]

We find that domestically manufactured CSPV cells, whether or not partially or fully assembled into other products, are like imported CSPV cells, whether or not partially or fully assembled into other products. Specifically, domestically produced CSPV cells are "like" the imported CSPV cells and domestically produced CSPV modules are "like" imported CSPV modules within the scope of the investigation.

During the POI, both U.S. producers and importers supplied a wide variety of overlapping CSPV products to the U.S. market, including mono- and multicrystalline products, passivated emitter rear contact ("PERC") products, heterojunction with intrinsic thin-layer ("HIT") products, and hybrid products.[41] These imported and domestic CSPV products were available in similar forms, including cells, laminates, and modules (also called panels), with most in the form of modules.[42] Imported and U.S.-manufactured CSPV products were sold in a range of wattages and conversion efficiencies, and modules were sold in 60-cell and 72-cell forms.[43] Imported and U.S.-manufactured CSPV products also were sold in similar channels of distribution to overlapping segments of the market, primarily for use as part of solar power systems that convert sunlight into electricity.[44] The foreign and U.S. producers utilized similar manufacturing facilities and processes to manufacture CSPV products.[45] Additionally, most U.S. producers, importers, and purchasers reported that U.S.-produced CSPV products were interchangeable with imported CSPV products.[46] For all of these reasons, we find that domestically produced CSPV products are "like" the imported CSPV products.

We further find a single domestic product consisting of all forms of CSPV cells, whether or not partially or fully assembled into other products. The vast majority of imports and domestic production involved CSPV cells or CSPV modules.[47] Although CSPV modules are not "like" CSPV cells, the facts in this investigation indicate that they are "directly competitive"

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[40] According to petitioners, since the scope does not contain an explicit exclusion for the non-cell portions of the module (such as aluminum frames), they are covered by the scope. Petitioners explain that the overwhelming majority of CSPV cells are imported as permanently integrated parts of CSPV modules, which cannot be removed from the modules; they argue that the non-cell portions of the module are integral parts of the module without which it would not function. Moreover, they argue, separating the value of the components from that of the cells for remedy assessment purposes would be extremely difficult and would give rise to serious enforcement issues. SolarWorld's Posthearing Injury Brief at Exhibit 1, section XV at 89-90; Suniva's Posthearing Injury Brief at Exhibit 9 at Question 10. Respondents agree. *See, e.g.*, SunPower's Posthearing Injury Brief at 3 at n.2; SEIA's Posthearing Injury Brief at Appendix A at 14-15.

[41] CR/PR at Table II-5 (imported technologies), Table III-6 (U.S.-manufactured technologies).

[42] CR/PR at Table II-4 (imported forms), Table III-11 (U.S.-manufactured forms).

[43] CR/PR at Table V-11; CR at I-19 to I-21; PR at I-14.

[44] CR/PR at Table I-1; CR at I-15; PR at I-11.

[45] CR at I-24 to I-32; PR at I-18 to I-24.

[46] CR/PR at Table V-8.

[47] CR/PR at Table II-4 (imported forms), Table III-11 (U.S.-manufactured forms).

within the meaning of the safeguard statute and that there are no clear lines differentiating them.[48] As indicated above, the imported articles are provided for in subheading 8541.40.60 (statistical reporting numbers 8541.40.6020 ("solar cells assembled into modules or made up into panels") and 8541.40.6030 ("solar cells, other")) of the HTSUS.[49] Since CSPV cells are the basic element of a CSPV module, both cells and modules share the same primary physical

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[48] In the antidumping and countervailing duty investigations conducted previously, the Commission defined a single domestic like product corresponding to the scope that included CSPV cells and CSPV modules. *Crystalline Silicon Photovoltaic Cells and Modules from China*, Inv. Nos. 701-TA-481 and 731-TA-1190 (Final), USITC Pub. 4360 at 4-12 (Nov. 2012) ("*CSPV I*"); *Crystalline Silicon Photovoltaic Products from China and Taiwan*, Inv. Nos. 701-TA-511 and 731-TA-1246 to 1247 (Final), USITC Pub. 4519 at 8-15 (Feb. 2015) ("*CSPV II*"). The Commission's domestic like product determinations in those antidumping and countervailing duty investigations are not dispositive or binding on the determination of the like or directly competitive product in this safeguard investigation for several reasons. *See, e.g.*, *Steel*, Inv. 201-TA-75, USITC Pub. 3479 at 27-32 (Dec. 2001); *Fresh Tomatoes and Bell Peppers*, Inv. No. 201-TA-66, USITC Pub. 2985 at I-7 (Aug. 1996). For example, the two statutory schemes have different purposes, with antidumping and countervailing duty investigations narrowly aimed at remedying unfairly traded imports and global safeguard investigations preventing or remedying serious injury to domestic productive resources from all imports. *Steel*, Inv. No. 201-TA-075, USITC Pub. 3479 at 30 (quoting *Stainless Steel and Alloy Tool Steel*, 201-TA-048, USITC Pub. 1377 at 16 n.21 (May 1983)). Global safeguard investigations are concerned with serious injury "to the productive resources (*e.g.*, employees, physical facilities, and capital) employed in the divisions or plants in which the article in question is produced." H.R. Rep. 93-71 at 46 (1973); *see also* H.R. Rep. 100-576 at 661-62 (1988); S. Rep. 100-71 at 46-47 (1987); H.R. Rep. 100-40 at 86-96 (1987). The statutory schemes define "domestic industry" differently. *Compare* 19 U.S.C. § 2252(c)(6)(A)(1) ("domestic producers as a whole of the like or directly competitive article …") *with* 19 U.S.C. §§ 1677(4)(A), 1677(10) (producers as a whole of a domestic like product, which is defined as "a product which is like, or in the absence of like, most similar in characteristics and uses" with the imports subject to investigation). Additionally, the scopes of the respective antidumping and countervailing duty and safeguard investigations may be broader or narrower, and/or the factual records differ due to the global versus country-specific nature of the investigations, the time periods involved, and the particular issues that parties choose to dispute in a given proceeding. Furthermore, the Commission considers different factors to analyze domestic like product questions in antidumping and countervailing duty investigations than the factors discussed above for global safeguard investigations. *See, e.g.*, *Nippon Steel Corp. v. United States*, 19 CIT 450, 455 n.4 (Apr. 3, 1995) (physical characteristics and uses; interchangeability; channels of distribution; customer and producer perceptions; common manufacturing facilities, processes, and employees; and where appropriate price); *CSPV II*, USITC Pub. 4519 at 13-15 (whether the upstream product is dedicated for use in the downstream product; whether they are sold in separate markets; differences in physical characteristics and functions; differences in value; extent of processes used to transform upstream into downstream articles).

[49] The articles also may be imported as parts or subassemblies of goods provided for in subheadings 8501.31.80, 8501.61.00 and 8507.20.80. Inverters or batteries with CSPV cells attached are provided for under HTSUS subheadings 8501.61.00 and 8507.20.80, respectively. In addition, CSPV cells covered by the investigation may also be classifiable as DC generators of subheading 8501.31.80, when such generators are imported with CSPV cells attached. CR at I-52; PR at I-38.

properties.[50] The characteristics of CSPV cells that enable them to convert sunlight into electricity are not affected by the module assembly process but are an essential function of the module in CSPV solar systems; likewise, CSPV modules cannot serve their intended function of converting sunlight into electricity without the inclusion of CSPV cells.[51] The processes used to manufacture CSPV modules from CSPV cells are technologically sophisticated, more labor intensive than manufacturing CSPV cells,[52] and add value to the product, but they enhance rather than change the basic function of the CSPV cells, which is to convert sunlight into electricity.[53] Although a number of firms are independent module assemblers with no U.S. cell

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[50] CSPV cells use mono- or multicrystalline silicon cells to convert sunlight into electricity. CR at I-15; PR at I-11. These cells are strung together, sealed, laminated, and usually framed to make CSPV modules (also known as solar panels). CR at I-15 to I-18; PR at I-11 to I-13.

[51] CR at I-15 to I-21; PR at I-11 to I-16.

[52] There are some differences in how the two main types of cells (monocrystalline and multicrystalline silicon) are manufactured, although both are manufactured from silicon that is refined typically using the Siemens method or fluidized bed reactor technology and then manufactured into a wafer. CR at I-19, I-25 to I-26; PR at I-14, I-19. To produce a monocrystalline wafer, manufacturers melt polysilicon rocks and a small amount of boron in a 2,500-degree Czochralski furnace, lower a rotating seed crystal into the furnace, and slowly raise the crystal out of the melt while growing a single long crystal. After cooling the crystal, manufacturers cut off its top and tail, cut the crystal into equal-length ingots, square the ingot (leaving rounded corners), and slice the ingots into wafers (typically using a diamond wire saw). CR at I-26 to I-27; PR at I-19 to I-21. To produce multicrystalline wafers, manufacturers load polysilicon into a crucible, load the crucible into a directional solidification systems furnace, and cast the polysilicon into ingots. They cut the ingots into blocks and slice them into square wafers using a wire saw. CR at I-28; PR at I-21. Manufacturers manufacture CSPV cells using a capital-intensive manufacturing process that requires a skilled workforce and generally involves at least seven major steps: cleaning and texturing the wafers to reduce sunlight reflection and increase light absorption; diffusing phosphorus into a thin layer of the wafer's surface at a high heat to give the wafer a negative potential electrical orientation; isolating a thin layer of silicon from the edge of the cell to separate the positive and negative layers; coating the cells with a silicon nitride antireflective coating to increase sunlight absorption; using silver paste to print thin metal fingers in strips onto the cell that will connect to the rest of the module via busbars or/and printing a thin layer (typically aluminum) on the other side of the cell; co-firing the cells in a high temperature furnace to imbed the silver paste in the surface of the silicon layer and forma reliable electrical contact; and testing and sorting the cells according to their characteristics and efficiency. CR at I-28 to I-30; PR at I-21 to I-23.

[53] To assemble CSPV cells into modules, manufacturers use automated and sophisticated yet relatively more labor-intensive processes in which they assemble into a laminate soldered strings of CSPV cells on a rectangular matrix sealed with ethyl vinyl acetate and a back sheet (commonly a plastic film composite or glass for some applications such as bifacial modules) and then attach a frame and junction box. The essential characteristic of CSPV cells to convert sunlight into electricity is enhanced when multiple CSPV cells are strung together, laminated, framed, and connected to an inverter as CSPV modules. A CSPV module generates more power than an individual CSPV cell used to make the module, the junction box permits modules to be connected to an inverter that converts the systems' direct current into alternating current for additional transmission, and lamination permits the CSPV cells to withstand the elements in order to convert sunlight into electricity over a longer useful life. The (Continued…)

manufacturing operations,[54] most production of CSPV cells and CSPV modules during the POI was performed in the United States by integrated producers that manufacture and internally consume CSPV cells for their CSPV module operations.[55] CSPV cells are dedicated for use in the production of CSPV modules.[56] Only a fraction of U.S.-manufactured CSPV cells are sold in the commercial market, and even then, CSPV cells are used to manufacture CSPV modules.[57] Both CSPV cells and CSPV modules are integrated into photovoltaic solar systems that convert sunlight into electricity for use in residential, commercial, and utility applications.[58] Finally, CSPV cells represent a substantial portion of the total cost of finished CSPV modules,[59] and prices of cells generally correlated with module prices during the POI.[60] For these reasons, we define a single domestic product corresponding to the imported products within the scope of the investigation that includes CSPV cells and CSPV modules.[61]

B. Domestic Industry

The term "domestic industry" is defined in section 202(c)(6)(A)(i) of the Trade Act to mean

> with respect to an article, the domestic producers as whole of the like or directly competitive article or those producers whose collective production of the like or

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(…Continued)
assembly process does not change the essential characteristics of the CSPV cells. CR at I-16 to I-18, I-31 to I-32; PR at I-13, I-24.

[54] The *** domestic CSPV cell producers during the POI were SolarWorld and Suniva, which together accounted for the vast majority (*** percent) of U.S. CSPV cell production by kW in 2016. *** were the largest U.S. assemblers of CSPV modules, accounting for *** percent (***), *** percent (***), and *** percent (***) of U.S. module assembly during the POI. CR at III-22, III-23; PR at III-11; CR/PR at Table III-5, Table III-7, Table III-8.

[55] CR at I-37 to I-38, III-27, III-31; PR at I-28, III-15, III-17; CR/PR at Table I-1, Table II-4, Table III-9, Table III-11.

[56] CSPV cells are sometimes used to make non-standard size modules for the very small building-integrated photovoltaic market. Building integrated photovoltaic products, such as solar shingles or solar windows, incorporate solar cells (often thin film and sometimes CSPV cells); they are integrated into the building envelope, such as the façade or roof, taking over the function of roof shingles or glass while also producing electricity. CR at I-21; PR at I-16; CR/PR at Table II-4 (imported forms), Table III-11 (U.S.-manufactured forms) (questionnaire respondents reported *** U.S. imports and *** domestic production of building integrated products).

[57] CR at I-37 to I-38, III-27, III-31; PR at I-28, III-15, III-17; CR/PR at Table I-1, Table II-4, Table III-9, Table III-11.

[58] CR at I-15, I-17, I-22 to I-23, I-33 to I-37; PR at I-11, I-12, I-17, I-28.

[59] CR at III-50; PR at III-26; CR/PR at Table III-22.

[60] CR/PR at Figure V-13.

[61] This is the definition advocated by petitioners. Moreover, in their comments on the draft questionnaires for this investigation, no party asked the Commission to collect data concerning any possible alternative definition. CR at I-14 to I-15 & n.48; PR at I-10 & n.48.

directly competitive article constitutes a major proportion of the total domestic production of such article.[62]

This definition was added by the Uruguay Round Agreements Act ("URAA") and codified existing Commission practice.[63]

The Commission has broad discretion to determine what constitutes the domestic industry producing a like or directly competitive article in global safeguard investigations, generally adhering to the principal that "{t}he industry should be defined in a manner which allows for a meaningful analysis of the statutory criteria in light of the legislative history of section 201."[64] The concept of industry employed in section 201 of the Trade Act is not the same as that used in the antidumping and countervailing duty provisions of Title VII.[65] As the Commission has stated,

> Title VII is narrowly aimed at remedying the specific advantages imports may be receiving from unfair trade practices. The purpose of section 201 either is to prevent or remedy serious injury to domestic productive resources from all imports. In light of the purpose of section 201 and in contrast to Title VII, the sharing of productive processes and facilities is a fundamental concern in defining the scope of the domestic industry under section 201.[66]

The legislative history to the Trade Act indicates that the concern in a safeguard investigation is "the question of serious injury to the productive resources (*e.g.*, employees, physical facilities, and capital) employed in the divisions or plants in which the article in question is produced."[67]

Consistent with our definition of the like or directly competitive domestic product, we define the domestic industry as all U.S. producers of CSPV cells, whether or not partially or fully

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[62] 19 U.S.C. § 2252(c)(6)(A)(i).

[63] Uruguay Round Agreements Act Statement of Administrative Action ("URAA SAA"), H. Doc. 103-316, vol. I (103rd Cong. 2nd Sess.) at 961.

[64] *Steel*, Inv. No. 201-TA-075, USITC Pub. 3479 at 30 (quoting *Stainless Steel and Alloy Tool Steel*, 201-TA-048, USITC Pub. 1377 at 12 (May 1983)).

[65] The statutory definitions of "domestic industry" are different. *Compare* 19 U.S.C. § 2252(c)(6)(A)(1) (defining the term for purposes of global safeguard investigations as "domestic producers as a whole of the like or directly competitive article …") *with* 19 U.S.C. §§ 1677(4)(A), 1677(10) (defining "domestic industry" in antidumping and countervailing duty investigations as "the producers as a whole of a domestic like product …," and in turn is defining "domestic like product" as "a product which is like, or in the absence of like, most similar in characteristics and uses" with the imports subject to investigation).

[66] *Steel*, Inv. No. 201-TA-075, USITC Pub. 3479 at 30 (quoting *Stainless Steel and Alloy Tool Steel*, 201-TA-048, USITC Pub. 1377 at 16 n.21 (May 1983)).

[67] H.R. Rep. 93-71 at 46 (1973); *see also* H.R. Rep. 100-576 at 661-62 (1988); S. Rep. 100-71 at 46-47 (1987); H.R. Rep. 100-40 at 86-96 (1987).

assembled into other products. *** of the responding firms were integrated U.S. producers of CSPV cells and CSPV modules during the POI, and a number of firms were independent module producers without integrated cell-producing operations.[68] Many of these firms, both integrated producers and independent module producers, imported CSPV cells or laminates that they then consumed in their module assembly operations, and some also imported finished CSPV modules.[69]

Petitioners advocate including independent module producers in the domestic industry, even when those firms rely entirely on imported CSPV cells for their U.S. module operations, and respondents do not disagree.[70] Had we determined not to include in the domestic industry independent module producers that relied on only imported and not U.S.-manufactured CSPV cells, the remaining producers would still account for a major proportion of total domestic production of CSPV products.[71] Nevertheless, exclusion of such independent module producers would arguably run counter to the legislative intent of considering serious injury to the productive resources in which the article is produced in the United States.[72] Such an approach also would ignore the fact that *** of the *** responding integrated U.S. producers relied on a mixture of imported and U.S.-manufactured cells for their own module operations,[73] and there was inadequate U.S. CSPV cell capacity or production to meet U.S. CSPV module capacity or production during the POI.[74] Consequently, for our analysis in this investigation, we define the domestic industry as all U.S. producers of CSPV cells (whether or not partially or fully assembled into other products), including integrated producers of CSPV cells and modules and independent module producers.[75]

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[68] CR at III-22, III-23; PR at III-11; CR/PR at Table III-5, Table III-7, Table III-8. As indicated earlier, most of the CSPV products manufactured in the United States consisted of CSPV cells or CSPV modules. Modules accounted for *** to *** percent of U.S. producers' U.S. shipments during the POI, compared to *** to *** percent for cells, *** to *** percent for laminates (mostly in 2012), and *** and *** percent for integrated building materials and off-grid portable consumer goods, respectively. CR/PR at Table III-11.

[69] CR/PR at Table II-7, Table III-8; CR at II-20; PR at II-17. A module is a joined group of CSPV cells, regardless of the number of cells or the shape of the joined group, that are capable of generating electricity. The term "module" is frequently used interchangeably with the term "panel" and for the remainder of our analysis also includes a CSPV cell that has undergone any processing, assembly, or interconnection (including, but not limited to, assembly into a laminate).

[70] Injury Hearing Tr. at 315 (Nicely) ("it doesn't matter one way or the other").

[71] *Compare* CR/PR at Table II-7 *with* CR/PR at Table III-4 and Table III-7.

[72] H.R. Rep. 93-71 at 46 (1973); *see also* H.R. Rep. 100-576 at 661-62 (1988); S. Rep. 100-71 at 46-47 (1987); H.R. Rep. 100-40 at 86-96 (1987).

[73] CR/PR at Table II-7 (imports by domestic producers), Table III-8 (domestic producers' module assembly by source of CSPV cell).

[74] *Compare* CR/PR at Table III-4 (domestic industry's production, capacity, and capacity utilization for CSPV cells) *with* CR/PR at Table C-1(b) (apparent U.S. consumption of CSPV products during the POI).

[75] As a result, we rely primarily on data in CR/PR at Table C-1(b) that include the productive resources of all U.S. producers for purposes of capacity, capacity utilization, production, and (Continued…)

III. Increased Imports

After defining the domestic industry that manufactures a product that is like or directly competitive with the imported article, the Commission next examines whether imports are entering in "increased quantities." Under section 202 of the Trade Act, imports have increased when the increase is "either actual or relative to domestic production."[76] Consistent with its usual past practice,[77] the Commission in this safeguard investigation considered import trends over the most recent five-year period as the framework for its analysis, but it may consider longer or shorter periods and may focus on the most recent period, as it deems appropriate.[78]

As a threshold matter, this investigation includes several possible data sources for measuring imports and any increase in imports, including (1) official import statistics from the Commission's DataWeb;[79] (2) questionnaire responses from importers that reported U.S. imports on the basis of the manufacturing location of the CSPV cell; and (3) alternate questionnaire data on U.S. imports from Canada and Mexico that are based on the module

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(…Continued)
employment indicators and CR/PR at Table III-2 and Table III-3 for related closures/openings. The domestic industry's U.S. shipments, by quantity, and its U.S. shipments as a share of apparent U.S. consumption include (1) modules that contain U.S.-manufactured CSPV cells, (2) U.S.-manufactured CSPV cells that are not otherwise reported by module assemblers, and (3) re-imports of U.S.-origin CSPV cells; this quantity measure excludes any CSPV modules manufactured in the United States from imported CSPV cells, as those are reported for purposes of apparent U.S. consumption as imports. The domestic industry's U.S. shipments, by value, and its U.S. shipments as a share of apparent U.S. consumption, by value, include the incremental value added in the United States to assemble imported CSPV cells into modules. CR at III-33; PR at III-17. The Commission did not ask questionnaire respondents to allocate financial data on their module operations based on the share of production assembled from U.S.-manufactured cells, because a breakout of financial information at this level of detail is not consistent with the manner in which most U.S. producers track their financial results and requesting the data on this basis would yield unreliable information. Moreover, the Commission's questionnaire sought supplemental information on the firms' reported raw material costs that would reflect whether their cells were internally produced or purchased from related or unrelated firms. This allowed the Commission to evaluate the financial data using a consistent allocation methodology for all U.S. producers. CR at III-50; PR at III-26.

[76] 19 U.S.C. § 2252(b)(1)(A) (requiring the Commission to determine whether an article is being imported into the United States in such increased quantities as to be a substantial cause of serious injury, or the threat thereof); *see also* 19 U.S.C. § 2252(c)(1)(C) (in turn requiring with respect to substantial cause, that the Commission take into account an increase in imports (either actual or relative to domestic production)).

[77] *See, e.g.*, *Steel*, Inv. No. 201-TA-73, USITC Pub. 3479 at 32-33 (Dec. 2001); *Extruded Rubber Thread*, Inv. No. 201-TA-72, USITC Pub. 3375 at I-8 (Dec. 2000).

[78] The POI in the instant global safeguard investigation (January 2012 to December 2016) overlaps with most of the time period in the *CSPV II* antidumping and countervailing duty investigations (January 2011 to June 2014) and six months of the time period in the *CSPV I* antidumping and countervailing duty investigations (January 2009 to June 2012).

[79] *See, e.g.*, CR/PR at Table C-7.

assembly location and adjusted U.S. importer questionnaire data on imports from all other sources that are based on the manufacturing location of the CSPV cell. In this investigation, we relied primarily on the third source.

Official import statistics in CR/PR at Table C-7 may be overstated to the extent that they include products that are outside the scope of this investigation, such as thin film, and they may be over- or understated to the extent that they do not necessarily define country of origin consistently with the arguments presented in this case.[80] Table C-7 does not present official import statistics by quantity as these data are collected on a less reliable basis of "units" (a term that may encompass, *e.g.*, a single cell of a given wattage, a single cell of a different wattage, a 60-cell module, and a 72-cell module). For this reason, the Commission's questionnaires instead sought consistent quantity data in terms of kilowatts ("kW").[81]

The Commission's importer questionnaires in this investigation primarily collected U.S. import data based on the location where the CSPV cell was manufactured, even if the CSPV cell was assembled into a CSPV module in a different country.[82] The Commission also collected separate data on U.S. imports of CSPV modules that were assembled in Canada and Mexico, regardless of where the CSPV cells were manufactured, consistent with arguments presented by certain respondents.[83] Under their proposal, the country of origin for U.S. imports of CSPV modules assembled in NAFTA countries would be the location where the CSPV module was assembled, regardless of where the CSPV cell was manufactured, and information on all other U.S. imports would be sourced from importer questionnaire data based on the CSPV cell manufacturing location, except that any CSPV cells used to assemble U.S. imports of modules from NAFTA countries would be subtracted from the U.S. import data for the countries where the CSPV cells were manufactured to avoid double counting.[84]

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[80] CR at II-1 at n.1; PR at II-1 at n.1. Official import statistics presented in CR/PR at Table C-7 on imports under HTSUS statistical reporting numbers 8541.40.6020 ("solar cells assembled into modules or made up into panels") and 8541.40.6030 ("solar cells, other") also may be understated, if imports enter under a different provision as parts or subassemblies of goods provided for in subheadings 8501.31.80, 8501.61.00 and 8507.20.80. *See* CR at I-52; PR at I-38.

[81] The electricity power output of CSPV cells and modules is measured in terms of wattage. A kW equals 1,000 watts, whereas one megawatt ("MW") equals 1,000 kW, and a gigawatt ("GW") equals 1,000 MW. CR at I-15, I-21; PR at I-11, I-14.

[82] *See, e.g.*, CR/PR at Table II-1, Table IV-1.

[83] *See, e.g.*, Government of Canada's Prehearing Injury Brief at 7-13; Government of Canada's Posthearing Injury Brief at 7-8; Canadian Respondents' Prehearing Injury Brief at 5, 27-35; Canadian Respondents' Posthearing Injury Brief at 12-15; Sunpower's Posthearing Injury Brief at 3-8, Exhibits 1-4; SunPower's Prehearing Injury Brief at 10-13, Exhibit 3; Government of Mexico's Prehearing Injury Brief at 4-5 (urging the Commission to consider the arguments presented by exporters from Mexico); Injury Hearing Tr. at 66-67. In addition, the Commission collected separate data on U.S. imports of CSPV modules that were assembled in China, regardless of where the CSPV cells were manufactured. CR/PR at Table II-3.

[84] As Canadian respondents explain, a headquarters ruling by U.S. Customs and Border Protection confirms that, under NAFTA rules of origin and marking rules, U.S. imports of finished (Continued…)

Although petitioners did not overtly adopt respondents' approach to country of origin for U.S. imports of modules assembled in NAFTA countries, they did not identify any flaws in the legal reasoning underpinning Canadian respondents' arguments.[85] We find the Canadian respondents' arguments persuasive, and accordingly the import data we primarily relied on for our analysis uses the country-of-origin methodology that they proposed (*i.e.*, the NAFTA rules of origin for imports from Canada and Mexico and for imports from all other countries, the country where the cell was manufactured, as adjusted to reflect cells assembled into modules in a NAFTA country).[86]

Based on these data, we find that the statutory criterion of increased imports is met. Imports of CSPV products increased by 492.4 percent between 2012 and 2016.[87] They increased each year, from 2.1 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016.[88] Imports as a ratio to domestic production also increased overall and in each year, from 733.9 percent in 2012 to 948.4 percent in 2013, 1,141.0 percent in 2014, 1,593.5 percent in 2015, and 2,276.2 percent in 2016.[89]

(…Continued)
CSPV modules assembled in a NAFTA country, even from CSPV cells originating in non-NAFTA countries, qualify as products from the NAFTA country, where the goods originate under General Note 12(b) and are accompanied by a signed and completed NAFTA certificate of origin, because the final assembly operations in the NAFTA country involve more than minor processing and require substantial investment and value added. *See, e.g.*, Canadian Respondents' Posthearing Injury Brief at 12-15; Canadian Respondents' Prehearing Injury Brief 5, 27-35 (citing HQ H266527 (Apr. 11, 2016); HTSUS, General Note 12 (NAFTA rules of origin); 19 C.F.R. § 102 (NAFTA marking rules); and 19 C.F.R. § 102.19 (NAFTA preference override rule)), Exhibit G (HQ H266527 (Apr. 11, 2016)). Moreover, Canadian respondents contend that the provision of NAFTA Article 201 defining "goods of a Party" as including "originating goods of that Party" applies to safeguard measures because NAFTA Article 309.2 creates an exception for antidumping duty and countervailing duty measures (related to enforcement of antidumping and countervailing duty orders and undertakings), but no such exception exists for safeguard measures. Canadian Respondents' Prehearing Injury Brief at 27-35, Exhibit I; Government of Canada's Prehearing Injury Brief at 12.

[85] *See, e.g.*, SolarWorld's Prehearing Injury Brief at 57-58 ("… the Commission properly included alternative data, based on module origin …"); Petition at 19 n.61 (Apr. 26, 2017).

[86] *See, e.g.*, CR/PR at Table II-2 , Table IV-3, Table C-1b (implementing the methodology and reducing U.S. imports from non-NAFTA sources to reflect reported information indicating that the CSPV cells were assembled into modules in Canada or Mexico). Because this methodology changes only the country of origin of imports, there is little difference in the total volume of imports from all countries regardless of the methodology used. *Compare* CR/PR Table C-1a and Table C-1b; CR at Table II-2 at Note, Table IV-3 at Note; CR at IV-6; PR at IV-4.

[87] CR/PR at Table II-2, Table IV-3, Table C-1b.

[88] CR/PR at Table II-2, Table IV-3, Table C-1b. The value of imports also increased over this period and from one year to the next. Imports increased from $1.9 billion in 2012 to $2.2 billion in 2013, $3.0 billion in 2014, $5.0 billion in 2015, and $7.1 billion in 2016. CR/PR at Table II-2, Table IV-3, Table C-1b.

[89] CR/PR at Table II-2, Table IV-3, Table C-1b.

Consequently, we find that imports increased both actually and relative to domestic production.

IV. Substantial Cause of Serious Injury or Threat of Serious Injury

A. Legal Standards and Statutory Requirements

The second of the three statutory criteria concerns whether the domestic industry is seriously injured or threatened with serious injury. Section 202(c)(6)(C) of the Trade Act defines the term "serious injury" as "a significant overall impairment in the position of a domestic industry," and section 202(c)(6)(D) defines the term "threat of serious injury" as "serious injury that is clearly imminent."[90]

In determining whether serious injury or threat of serious injury exists, the Commission considers "all economic factors which it considers relevant, including (but not limited to)" the following enumerated factors –

> (A) with respect to serious injury –
> (i) the significant idling of productive facilities in the domestic industry,[91]
> (ii) the inability of a significant number of firms to carry out domestic production operations at a reasonable level of profit, and
> (iii) significant unemployment or underemployment within the domestic industry … ;[92]
> (B) with respect to threat of serious injury –
> (i) a decline in sales or market share, a higher and growing inventory (whether maintained by domestic producers, importers, wholesalers, or retailers), and a downward trend in production, profits, wages, productivity, or employment (or increasing underemployment) in the domestic industry,
> (ii) the extent to which firms in the domestic industry are unable to generate adequate capital to finance the modernization of their domestic plants and equipment, or are unable to maintain existing levels of expenditures for research and development, and
> (iii) the extent to which the United States market is the focal point for the diversion of exports of the article concerned by reason of restraints on exports of such article to, or on imports of such article into, third country markets.[93]

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[90] 19 U.S.C. §§ 2252(c)(6)(C), 2252(c)(6)(D).

[91] The statute further provides that the term "significant idling of productive facilities" includes the closing of plants or the underutilization of production capacity. 19 U.S.C. § 2252(c)(3).

[92] 19 U.S.C. § 2252(c)(1)(A).

[93] 19 U.S.C. § 2252(c)(1)(B).

The presence or absence of any of these factors is not "necessarily dispositive" of whether increased imports are a substantial cause of serious injury, or threat of serious injury, to the industry.[94] As part of its analysis, the Commission must "consider the condition of the domestic industry over the course of the relevant business cycle."[95]

The third statutory criterion also requires a finding that the article is being imported in such increased quantities as to be a "substantial cause" of serious injury or threat of serious injury. Section 202(b)(1)(B) defines "substantial cause" as "a cause which is important and not less than any other cause."[96] Thus, the increased imports must be both an important cause of the serious injury or threat and a cause that is equal to or greater than any other cause.

In determining whether increased imports are a substantial cause of serious injury or threat of serious injury, the statute directs the Commission to take into account all economic factors that it finds relevant, including but not limited to – "… an increase in imports (either actual or relative to domestic production) and a decline in the proportion of the domestic market supplied by domestic producers."[97] The statute directs the Commission to consider "the condition of the domestic industry over the course of the relevant business cycle," but it provides that the Commission "may not aggregate the causes of declining demand associated with a recession or economic downturn in the United States economy into a single cause of serious injury or threat of injury."[98] The legislative history states that the provision is meant to clarify that import relief should be available during a recession or economic downturn.[99]

The statute also directs the Commission to "examine factors other than imports" that may be a cause of serious injury or threat to the domestic industry and include the results of its examination in its report.[100] Thus, the Commission is required to (1) examine factors other than increased imports and (2) make findings with respect to these other factors. The legislative history states that the purpose of this provision "is to assure that all factors injuring the domestic industry are identified."[101]

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[94] 19 U.S.C. § 2252(c)(3).

[95] 19 U.S.C. § 2252(c)(2)(A).

[96] 19 U.S.C. § 2252(b)(1)(B).

[97] 19 U.S.C. § 2252(c)(1)(C).

[98] 19 U.S.C. § 2252(c)(2)(A).

[99] Senate Finance Committee, Omnibus Trade and Competitiveness Act of 1987: Report on S. 490, Rept. 100-71, 100th Cong., 1st Sess. at 50 (1987).

[100] 19 U.S.C. § 2252(c)(2)(B).

[101] Senate Finance Committee, Omnibus Trade and Competitiveness Act of 1987: Report on S. 490, Rept. 100-71, 100th Cong., 1st Sess. at 50 (1987). The legislative history of the Trade Act includes examples of other causes "such as changes in technology or consumer tastes, domestic competition from substitute products, plant obsolescence, or poor management," which, if found to be more important causes of injury than increased imports, would require a negative determination. Senate Finance Committee, Trade Reform Act of 1974 Report on H.R. 10710, S. Rept. 1298, 93rd Cong., 2nd Sess. at 121 (1974).

B. Existing Antidumping and Countervailing Duty Orders

The United States imposed antidumping and countervailing duty orders on imports from China in December 2012 and February 2015 and an antidumping duty order on imports from Taiwan in February 2015.[102] Several past Commission global safeguard investigations have included articles covered by one or more antidumping or countervailing duty orders in the scope of the investigation, and the inclusion of such articles in the scope of existing orders, alone, did not dictate any particular outcome for the Commission's serious injury analysis.[103]

C. Conditions of Competition and the Business Cycle

The following conditions of competition inform our analysis of whether CSPV products are being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing an article like or directly competitive with the imported article.[104]

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[102] On October 19, 2011, SolarWorld filed antidumping and countervailing duty petitions regarding imports of CSPV cells and modules from China, and after the U.S. Department of Commerce and the Commission each reached affirmative determinations, the United States imposed orders on those imports effective December 7, 2012. *CSPV I*, USITC Pub. 4360; 77 Fed. Reg. 73017 (Dec. 7, 2012); 77 Fed. Reg. 73018 (Dec. 7, 2012). On December 31, 2013, SolarWorld filed countervailing and/or antidumping duty petitions regarding imports of certain crystalline silicon photovoltaic products from China and Taiwan, and after both agencies reached affirmative determinations, the United States imposed orders on those imports effective February 18, 2015. *CSPV II*, USITC Pub. 4519; 80 Fed. Reg. 8597 (Feb. 18, 2015); 80 Fed. Reg. 8596 (Feb. 18, 2015); 80 Fed. Reg. 8592 (Feb. 18, 2015). These orders collectively include imports of CSPV cells and modules from China, regardless of whether the cell or module originated in China (or both). In addition, the antidumping duty order on Taiwan covers imports of cells from Taiwan as well as imports of modules from Taiwan or any non-Chinese country that are assembled from cells originating in Taiwan.

[103] For example, the Commission's investigation in *Steel* included various types of carbon flat-rolled steel subject to existing orders. The Commission took the orders into account in its injury analysis and in fashioning its remedy proposal, including the fact that some of these measures already provided some degree of protection to the domestic industry. *Steel*, Inv. No. 201-TA-73, USITC Pub. 3479 at 364 n.59 (Dec. 2001); *Carbon and Certain Steel Alloy Products*, Inv. No. 201-TA-51, USITC Pub. 1553 at a-24 (Jul. 1984) (noting that antidumping and countervailing duty orders were already in effect on several of the products subject to the investigation and that other covered products were the subject of suspension agreements); *see also Nucor Corp. v. United States*, 318 F. Supp. 2d 1207, 1236 (Ct. Int'l Trade 2004), *aff'd*, 414 F.3d 1331 (Fed. Cir. 2005) and *Wheatland Tube Co. v. United States*, 495 F.3d 1355, 1363-67 (Fed. Cir. 2007) (recognizing in the context of antidumping and countervailing duty investigations that safeguard measures may be imposed on imports that are subject to antidumping or countervailing duty orders).

[104] We also take these conditions of competition into consideration in our analysis of imports from individual countries in section V below.

1. Demand Conditions

CSPV products are used in solar power systems that generate electricity from sunlight.[105] CSPV products account for a meaningful share of the cost of the end-use products in which they are used.[106] Demand for CSPV products is derived from the demand for solar electricity, which is influenced by factors such as cost competitiveness with traditional energy sources, environmental concerns, a desire for national energy independence, total energy consumption, and the availability of Federal, state, and local incentives.[107]

a. Conventional and Renewable Sources of Energy

Electricity providers using renewable energy sources[108] seek to achieve "grid parity" (the point at which the levelized cost of electricity ("LCOE") generated from renewable sources

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[105] CR at I-15; PR at I-11.

[106] CR at V-12 to V-16; PR at V-8 to V-10; CR/PR at Table V-2; CR/PR at Figures V-4 to V-6. In addition to the module cost, the price of an installed photovoltaic system includes non-module "balance of system" costs such as inverters, mounting hardware, labor, site assessment and design, permitting, financing, system installation, overhead, and profit margin. CR at I-33, V-13; PR at I-24 to I-25, V-8. For on-grid installations, the cost share of CSPV cells generally increases as the installation project's size increases, with questionnaire respondents reporting that CSPV cells accounted for 19 to 26 percent of the cost for residential systems, 18 to 27 percent for commercial installations, and 29 to 31 percent for utility systems. CR at V-12 to V-13; PR at V-8 to V-9; CR/PR at Table V-2. According to SEIA, the cost share of a photovoltaic module (includes thin film) ranged from 15 to 19 percent for residential systems, 26-32 percent for non-residential systems, and 36-49 percent for utility systems. CR at V-15 at n.30; PR at V-9 at n.30; CR/PR at Figure V-6. Moreover, these cost shares are far reduced from earlier in the POI, when the price of CSPV modules was higher.

[107] CR at V-10; PR at V-6. The majority of U.S. producers (8 of 10), importers (30 of 48), and purchasers (55 of 101) reported that the U.S. market for CSPV products was subject to business cycles, such as seasonally higher demand in warmer months and at calendar year end to finish projects to qualify for various incentive programs for tax accounting purposes. Most U.S. producers (6 of 10) and nearly half of responding importers (23 of 48) and purchasers (23 of 48) reported distinct conditions of competition for the U.S. CSPV market, with most identifying government incentive programs and changes in global supply and demand conditions. The majority of U.S. producers (6 of 9), importers (22 of 38), and purchasers (56 of 89) reported that there had been changes to the business cycle and conditions in the U.S. market since 2012, and they identified increased competition, market saturation, increased efficiency of CSPV cells, introduction and extension of various solar incentive programs (such as the Investment Tax Credit), lower interest rates, and declining global prices of CSPV cells and systems. CR at V-16 to V-17; PR at V-11.

[108] Renewable sources of solar energy include photovoltaic products (CSPV products and thin film) as well as non-photovoltaic products (solar water heat and concentrated solar power ("CSP")). Thin film uses a several micron thick layer of a photosensitive semiconductor material such as a-Si, CdTe, CIS, or CIGS to convert sunlight to electricity. CR at I-15 at n.53; PR at I-11 at n.53. Solar water heat uses sunlight to heat water, and CSP uses reflected sunlight to generate steam or a vapor that turns a turbine to generate electricity. CR at I-17 at n.57; PR at I-12 n.57. Other renewable energy sources include (Continued…)

equals the cost from the grid of electricity generated by conventional sources).[109] The LCOE varies by region, time of the day, and availability of other electricity sources,[110] and even the LCOE for a given energy source can vary widely.[111] During periods of non-peak electricity demand in the United States, only lowest-cost "baseload" generators (traditionally coal and nuclear plants) would be able to sell electricity to the grid, whereas during periods of peak electricity demand, even generators with somewhat higher costs may be able to sell electricity into the transmission or distribution grid.[112] For peak periods, natural-gas generated electricity generally sets the LCOE that CSPV and other renewable energy systems seek to meet, especially for utility sales.[113]

b. Apparent U.S. consumption trends

The vast majority of firms reported that U.S. demand for CSPV products has increased since 2012.[114] According to most of these firms, the increased demand resulted from a reduction in CSPV system prices and installation costs as well as the existence of Federal, state, and local incentive programs.[115] They also tied the increased demand to the public's increased knowledge of and general interest in renewable energy, increased technology improvements, including module efficiency, and increased military use of solar energy.[116] The increase in demand described by responding firms is reflected in the data, which show that apparent U.S.

(…Continued)
wind, geothermal, and biomass. CR/PR at Figure V-2. Conventional sources of electricity include natural gas, coal, and oil as well as nuclear and hydroelectric. CR/PR at Figure V-2.

[109] The LCOE represents the per-kW hour cost of building and operating a generating plant over an assumed financial life. Key inputs to calculate the LCOE include capital costs (all hardware, such as CSPV products), fuel costs, fixed and variable operations and maintenance costs, financing costs, and an assumed utilization rate for each plant type. The availability of Federal, state, and local incentives can also impact the calculation of the LCOE for various energy sources. Plant owners or investors that finance plants may also value portfolio diversification due to the uncertainty of future fuel prices and future policies. CR at V-58 to V-59 & n.74; PR at V-37 to V-38 & n.74.

[110] CR at V-59; PR at V-37 to V-38.

[111] CR at V-59 to V-61; PR at V-38 to V-40; *see also* CR at V-13 to V-14; PR at V-8 to V-9 (indicating that installed photovoltaic system prices vary greatly from state to state and project to project, with a considerable spread among the prices in each market segment); National Renewable Energy Lab ("NREL"), U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017 at Appendix B, EDIS Doc. 623277, file ID 1226486 at 654, 724-26; EDIS Doc. 622844.

[112] CR at V-10 to V-11, V-59; PR at V-6, V-38; CR/PR at Figure V-2, Figure V-14; *CSPV I*, USITC Pub. 4360 at 21-22; *CSPV II*, USITC Pub. 4519 at 32.

[113] CR at V-59; PR at V-37 to V-38; CR/PR at Figure V-14 (indicating that in 2016, combined-cycle natural gas had the lowest LCOE in 2016, followed by onshore wind and coal). The LCOE of coal-generated electricity has been increasing. CR at V-59 at n.78; PR at V-38 at n.78.

[114] CR/PR at Table V-3.

[115] CR at V-17; PR at V-11.

[116] CR at V-17; PR at V-11.

consumption grew substantially during the POI, increasing by *** percent between 2012 and 2016 and by at least *** percent in each of the intervening years.[117]

c. Market Segments

The vast majority of CSPV modules sold in the U.S. market are connected to the electricity grid,[118] although some CSPV products are sold for off-grid applications.[119] There are three grid-connected market segments – residential, non-residential/commercial, and utility – although the segments overlap somewhat.[120] Installation sizes vary by segment, but the size of installations generally has grown over time in each segment due to a combination of greater cell efficiency (more kW/cell) and/or larger installations (more modules/installation).[121]

Annual U.S. installations of on-grid photovoltaic systems increased from 3,373 MW in 2012 to 14,762 MW in 2016, an increase of 338 percent.[122] All three on-grid segments experienced considerable growth in both the number of installations and the total wattage of installation projects during the POI.[123] By December 2016, more than 19,770 MW of utility

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[117] According to questionnaire data, apparent U.S. consumption increased from *** kW in 2012 to *** kW in 2013, *** kW in 2014, *** kW in 2015, and *** kW in 2016. By value, apparent U.S. consumption increased from $*** in 2012 to $*** in 2013, $*** in 2014, $*** in 2015, and $*** in 2016. CR/PR at Table IV-3. Industry reports indicate that U.S. installations of on-grid photovoltaic systems (including thin film) increased from 3,373 MW in 2012 to 14,762 MW in 2016, or by 338 percent. CR at V-1; PR at V-1.

[118] CR at V-1; PR at V-1; Injury Hearing Tr. at 185-86 (Card, Messer).

[119] CSPV modules that are typically used in on-grid applications may be used in off-grid applications, but some off-grid applications may require different modules with specific power, portability, or power outputs; off-grid systems often include additional balance of system components such as a battery and charge controller, although they do not necessarily require an inverter. Off-grid applications include a range of uses, from homes not connected to the grid to power generation in remote locations, mobile power solutions, telecommunications power and lighting systems, and portable consumer goods (such as systems to recharge consumer electronics like tablets and phones). CR at I-22 to I-23, I-36 to I-37; PR at I-17, I-28. The off-grid market is diverse, with some CSPV off-grid products, such as solar chargers and solar generators, sold directly to consumers or through retail channels and other products, such as solar street lighting and off-grid power systems, sold either directly or through entities such as installers and contractors, to users such as industrial, commercial, and government entities. CR at I-42; PR at I-31.

[120] For example, many nonresidential installers also install residential CSPV systems, and what some consider as a large commercial installation might qualify as a utility installation to others. *See, e.g.*, CR at I-34, I-39; PR at I-26, I-29.

[121] CR at I-33 to I-35, V-2 at n.7, V-3 at n.10; PR at I-24 to I-27, V-1 at n.7, V-2 at n.10.

[122] CR at V-1; PR at V-1.

[123] Residential installations increased by 423 percent between 2012 and 2016, and utility installations increased by 488 percent. CR at V-1 to V-2; PR at V-1 to V-2; CR/PR at Figure V-1.

photovoltaic generating capacity was in operation across the United States, representing 60 percent of total U.S. solar photovoltaic installations (including thin film).[124]

Since 2009 – the first year of the period examined in the *CSPV I* antidumping and countervailing duty investigations – there has been a shift in the distribution of sales among the three market segments. In 2009, the commercial segment accounted for the largest share of the market, followed by the residential and utilities segments,[125] whereas throughout the 2012 to 2016 POI in the instant safeguard investigation, utilities were the largest segment of the U.S. market,[126] followed by the residential and commercial segments.[127] During the POI, the domestic industry and importers each sold CSPV products in the U.S. market to distributors,[128] residential and commercial installers, and utility customers.[129] The vast majority of the domestic industry's shipments served residential and commercial installers in 2016, whereas a majority of imports were shipped to the utility segment.[130]

2. Supply Conditions

During the POI, the U.S. market was supplied primarily by imports and to a continuously lesser degree by the domestic industry.[131]

Domestic industry: Four firms (SolarWorld, Suniva, Mission Solar, and Tesla) submitted data on their U.S. CSPV cell production operations.[132] In addition to Suniva and Mission Solar,

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[124] CR at V-3; PR at V-2 to V-3.

[125] *CSPV I*, USITC Pub. 4360 at 29 n.258, Figure II-1 (identifying shipments to the commercial segment of 241,520 MW in 2009 compared to 195,391 MW for the residential segment, and 30,407 MW for the utility segment).

[126] In 2016, 10.6 GW of photovoltaic products was installed in the utility segment (including thin film), compared to 2.6 GW in the residential segment, and 1.6 GW in the commercial segment. CR at I-39; PR at I-29; CR/PR at Figure V-1.

[127] CR/PR at Figure V-1.

[128] Distributors typically sell CSPV products into the residential and commercial market, including to installers, although Suniva reported that some of its sales to distributors served the utility segment. CR at I-37 at nn.99, 100; PR at I-28 at nn.99, 100.

[129] CR at I-37 to I-38; PR at I-28; CR/PR at Table I-1. Domestically produced CSPV cells are typically internally consumed to produce solar modules by U.S. producers, although a minor amount were sold to firms that fabricate modules or panels. CR/PR at Table I-1.

[130] CR/PR at Table I-1.

[131] CR/PR at Table IV-3, Table C-1b.

[132] Suniva expanded its CSPV cell production operations in 2009, 2010, and July 2016, but suspended its CSPV cell operations in April 2017 as part of its chapter 11 bankruptcy filing. SolarWorld produced CSPV cells throughout the POI; it ***, expanded its cell capacity in 2014, ***. As part of a series of cost-cutting measures, SolarWorld ***. Mission Solar opened its n-type monocrystalline photovoltaic cell production line in 2014, ***, and closed the CSPV cell production line in September 2016 *** due to the costliness of keeping up with technological advancement necessary to compete. Tesla produced *** of CSPV cells in 2016 that was solely for ***. CR at III-9 to III-17; PR at III-5 to III-9; Injury Hearing Tr. at 36, 84-85, 99.

several other firms closed their CSPV cell operations during or immediately following the POI.[133] The *** CSPV cell producers, Suniva and SolarWorld, together accounted for the overwhelming majority (*** percent) of U.S. CSPV cell production by kW in 2016.[134]

Fifteen firms reported data on their U.S. CSPV module manufacturing operations. The largest U.S. producers of CSPV modules are ***, accounting for *** percent, *** percent, and *** percent of U.S. module assembly during the POI, respectively.[135] A number of firms closed their U.S. CSPV module operations during the POI.[136]

The domestic industry's share of the U.S. market for CSPV products fell from a peak of *** percent of the market in 2012 to *** percent by 2016.[137] The domestic industry's capacity to produce CSPV cells and CSPV modules was substantially lower than apparent U.S. consumption throughout the POI.[138]

Imports: Imports as a whole accounted for the vast majority of the market, and their share of apparent U.S. consumption increased from *** percent in 2012 to *** percent in 2016.[139] With the exception of 2013, following the first antidumping and countervailing duty investigation on CSPV cells and modules, imports from China have consistently been the largest or one of the largest sources of imports. Other large sources included Taiwan (particularly from 2012 to 2014), Korea and Malaysia (2016), and Mexico (each year).[140]

3. Substitutability

Throughout the POI, U.S. producers and importers made commercial shipments of a wide variety of CSPV products, predominantly in the form of modules.[141] Imported and U.S.-manufactured CSPV products were sold in a range of wattages and conversion efficiencies, and modules were sold in both 60-cell and 72-cell forms.[142] Imported and U.S.-manufactured CSPV products also were sold to overlapping market segments through overlapping channels of distribution, particularly to residential and commercial installers.[143] In the U.S. market for CSPV products, purchasers consider a variety of factors in their purchasing decisions, but price

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[133] CR/PR at Table III-2, Table III-3.

[134] CR at III-22; PR at III-11.

[135] CR at III-23; PR at III-11.

[136] CR/PR at Table III-2, Table III-3.

[137] CR/PR at Table IV-4.

[138] *Compare* CR/PR at Table III-4 (CSPV cell capacity) and Table III-7 (CSPV module capacity) *with* CR/PR at Table IV-4 (apparent U.S. consumption).

[139] CR/PR at Table IV-4.

[140] CR/PR at Table IV-4.

[141] CR/PR at Table II-5 (imported technologies), Table III-6 (U.S.-manufactured technologies), Table II-4 (imported forms), Table III-11 (U.S.-manufactured forms).

[142] CR/PR at Table V-11; CR at I-19 to I-21; PR at I-14.

[143] CR/PR at Table I-1; CR at I-15; PR at I-11.

continues to be an important factor.[144] Additionally, most U.S. producers, importers, and purchasers reported that U.S.-produced CSPV products were interchangeable with imported CSPV products.[145] Accordingly, we find that imported CSPV products are highly substitutable for U.S.-manufactured CSPV products and price is an important consideration in purchasing decisions.[146]

4. Other Conditions of Competition

Raw materials account for the largest component of the total cost of goods sold for both CSPV cells and CSPV modules.[147] Raw material costs for CSPV modules, much of which is the cost of the CSPV cell, accounted for 84.9 percent of U.S. CSPV module producers' total cost of goods sold in 2016, up from 58.2 percent in 2012.[148] Raw material costs for CSPV cells accounted for *** percent of U.S. CSPV cell producers' total cost of goods sold in 2016, up from *** percent in 2012.[149] Polysilicon is a key raw material used in the production of the wafers that are used to manufacture CSPV cells and other high-tech products.[150] Historically,

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144 CR/PR at Table V-4 (indicating that the most-often cited top three factors that firms consider in their purchasing decisions for CSPV products were price (81 firms), quality/performance (77 firms), and availability (42 firms)). Purchasers identified the following factors that they considered in determining the quality of CSPV products: output, efficiency, longevity and long-term performance degradation, output tolerances, warranty (suppliers' ability to back the warranty), historical failure rates, appearance (matching cell colors and frame structure), sales support, bankability, financial strength of manufacturer, third-party testing, and UL certification). CR at V-21; PR at V-14; CR/PR at Table V-4. Seven purchasers reported that they did not purchase domestic product because U.S. manufacturers failed bankability requirements, did not meet quality requirements, had limited availability, and did not sell stand-alone CSPV products. CR at V-23; PR at V-16.

145 CR/PR at Table V-8.

146 CR at V-19; PR at V-13; CR/PR at Table V-4; Injury Hearing Tr. at 97-98 (citing SEIA's comment in a *New York Times* article that "We are competing on price and price alone. If you change the underpinnings of that, it undermines what we're doing."), 112; Suniva's Posthearing Injury Brief at Attachment N (Diane Cardwell, Solar Trade Case, with Trump as Arbiter Could Upend Market, *New York Times* (June 30, 2017)).

147 CR at V-27; PR at V-18.

148 CR/PR at V-27 to V-28; PR at V-18 to V-19.

149 CR/PR at V-27 to V-28; PR at V-18 to V-19.

150 CR at V-27; PR at V-18.

polysilicon costs have been volatile.[151] During the POI, the price of polysilicon ingots and wafers fluctuated but declined overall by 52.6 percent for ingots and by 54.5 percent for wafers.[152]

During the POI, domestic producers and importers reported selling CSPV products using primarily transaction-by-transaction negotiations and also contracts.[153] In 2016, domestic producers sold the majority of their CSPV products through short-term contracts and the remainder on a spot basis, whereas importers sold most of their CSPV products through a mix of short-term, annual, and long-term contracts.[154]

D. The Domestic Industry is Seriously Injured

1. Significant Idling of Productive Facilities

In assessing whether the domestic industry is seriously injured, we first examined whether there has been a significant idling of U.S. productive facilities in terms of plant closures and/or underutilization of productive capacity to manufacture CSPV products. Thirty-three CSPV cell or CSPV module facilities operated in the United States as of January 1, 2012, but only 13 of those facilities remained open by December 31, 2016.[155] Of the 16 additional facilities that opened during the POI, five closed.[156] Two firms announced plans for new facilities, but

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[151] In 2003, global supplies of polysilicon were inadequate to meet global demand by the semiconductor industry and particularly the CSPV industry, so spot prices of polysilicon rose from $35/kg in 2003 to a high of $500/kg in 2008 (and contract prices rose from $25/kg to $85/kg in this period). By 2008, global supply exceeded global demand, and polysilicon spot and contract prices then fell substantially to an estimated $35/kg by 2012. *CSPV I*, USITC Pub. 4360 at 28.

[152] CR/PR at Figure V-7. The majority of domestic producers (9 of 11) and importers (32 of 44) reported that prices of raw materials for CSPV products have declined since 2012. CR at V-28; PR at V-19.

[153] CR/PR at Table V-9.

[154] CR/PR at Table V-10. All five responding U.S. producers and most importers reported that short-term contracts did not allow for price renegotiations, had fixed prices and quantities, and did not have meet-or-release provisions. Two of four U.S. producers reported that their annual contracts did not allow for price renegotiations, had fixed prices and quantities, and did not have meet-or-release provisions, whereas the majority of U.S. importers reported that their annual contracts allowed for price renegotiations, had fixed prices and quantities, and did not have meet-or-release provisions. CR at V-31; PR at V-20 to V-21.

[155] CR/PR at Table III-3; SolarWorld's Posthearing Injury Brief at 4, 6, Exhibit 1, section IX at 68-76, Exhibit 35-1 to 35-24, Exhibit 36; Injury Hearing Tr. at 113 (Shea), 409-410 (Werner), 333; SolarWorld's Prehearing Injury Brief at 2, 11-14, 28 29, 43; Suniva's Posthearing Injury Brief at 2, Exhibit 9 at Question 9, Attachment K; Suniva's Prehearing Injury Brief at 26-28.

[156] CR/PR at Table III-3. Due to the many facility closures, the information on the domestic industry does not include data for all U.S. producers of CSPV cells and CSPV modules that operated during the POI, and for some firms only a portion of their data was available. For example, the Commission's report included available information for three firms that responded to questionnaires in (Continued…)

those facilities were not commercially operational by July 2017.[157] Most of the producers that went out of business were independent module producers without integrated cell production operations.[158]

U.S. cell capacity increased irregularly by *** percent over the POI, increasing from *** kW in 2012 to *** kW in 2013, declining to *** kW in 2014,[159] increasing to *** kW in 2015, and reaching a period high of *** in 2016.[160] Production increased *** percent overall, but from a low level of *** kW in 2012 to *** kW in 2013, *** kW in 2014, *** kW in 2015, and *** kW in 2016.[161] For the domestic industry as a whole, capacity utilization for CSPV cells increased irregularly but remained below full capacity, with capacity utilization increasing from *** percent in 2012 to *** percent in 2013 and a period high of *** percent in 2014 before declining to *** percent in 2015 and *** percent in 2016.[162]

U.S. module capacity increased irregularly by 34.0 percent over the POI, declining from 929,827 kW in 2012 to 913,452 kW in 2013 and 716,900 kW in 2014, increasing to 871,603 kW in 2015, and reaching a period high of 1,245,807 kW in 2016.[163] Production decreased from 538,633 kW in 2012 to 447,129 kW in 2013, 440,259 kW in 2014, 552,968 kW in 2015, and 669,089 kW in 2016, for an overall increase of 24.2 percent.[164] Capacity utilization for CSPV modules remained well below full capacity, with capacity utilization decreasing from 57.9 percent in 2012 to 48.9 percent in 2013, increasing to 61.4 percent in 2014 and a period high of 63.4 percent in 2015 and declining to 53.7 percent in 2016.[165] During this period, the domestic industry increased the share of CSPV modules it assembled in the United States from U.S.-origin CSPV cells. This trend resulted from the closure of a number of independent module producers.[166]

(…Continued)
the *CSPV II* proceedings but have since ceased operations. *See, e.g.*, CR at III-23 at n.44; PR at III-11 at n.44.

[157] CR/PR at Table III-3.

[158] CR/PR at Table III-3.

[159] CR at III-17; PR at III-10.

[160] CR/PR at Table III-4. The increases in CSPV cell capacity between 2014 and 2016 reflected Mission Solar's ***, SolarWorld's ***, Suniva's ***, and Tesla's ***. CR at III-17 to III-18; PR at III-10.

[161] CR/PR at Table III-4.

[162] CR/PR at Table III-4. In 2016, Mission Solar was in the process of shutting down its CSPV cell line while Tesla was in the process of starting up its own cell production in that year but was primarily engaged in research and development. CR at III-10, III-15 to III-16; PR at III-5, III-8 to III-9.

[163] CR/PR at Table III-7.

[164] CR/PR at Table III-7.

[165] CR/PR at Table III-7.

[166] Each year from 2012 to 2015, the domestic industry increased the share of its CSPV modules that were assembled from U.S.-manufactured CSPV cells with the share increasing from *** percent in 2012 to *** percent in 2013, *** percent in 2014, and a period high of *** percent in 2015; the share declined to *** percent in 2016, a lower share than in 2014 and 2015. CR/PR at Table III-8. The share of modules assembled by firms without integrated cell operations declined from *** percent in 2012 to *** percent in 2016. CR/PR at Table III-7.

The domestic industry increased CSPV cell and CSPV module capacity, and it increased production of both CSPV cells and CSPV modules during the POI. Neither of these increases, however, approached the magnitude of the explosive growth in apparent U.S. consumption during this period. Instead, dozens of U.S. facilities closed their operations during this period as imports captured most of the growth in demand. Those producers remaining in the market continued to operate at below full capacity, particularly for CSPV module assembly operations. Based on this evidence, on balance, we find a significant idling of domestic productive facilities during the POI.

2. Significant Unemployment or Underemployment

We next examined whether there has been significant unemployment or underemployment in the domestic industry. The substantial number of facility closures described above resulted in extensive layoffs and the award of U.S. Trade Adjustment Assistance Act benefits to many workers during the POI; in addition, workers at some facilities experienced temporary shutdowns or production slowdowns, which led to layoffs and underemployment.[167] Solar manufacturing involves highly trained, skilled workers.[168]

According to questionnaire data, the overall number of production and related workers ("PRWs") engaged in U.S. CSPV cell operations declined from *** PRWs in 2012 to *** PRWs in 2013 and *** PRWs in 2014, and increased to *** PRWs in 2015 and *** PRWs in 2016, an overall increase of *** percent.[169] Although the overall increase in employment over the POI appears consistent with the *** percent increase in U.S. production of CSPV cells, the increase at the end of the POI is primarily explained by ***.[170]

For U.S. CSPV module operations, overall employment declined from 1,293 PRWs in 2012 to 1,080 PRWs in 2013 and 956 PRWs in 2014, and increased to 1,038 PRWs in 2015 and 1,253 PRWs in 2016, an overall decrease of 3.1 percent despite dramatic growth in apparent U.S. consumption of CSPV products.[171] These employment data do not reflect post-POI

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[167] CR/PR at Table III-2; Suniva's Prehearing Injury Brief at 45, Exhibit 55. As indicated earlier, the many facility closures have impacted the available data in this investigation, so questionnaire data may understate employment for 2012-2016.

[168] *CSPV II*, USITC Pub. 4519 at 16, I-28 to I-29; Suniva's Prehearing Injury Brief at 44-45; *see also, e.g.*, EDIS Doc. 625303.

[169] CR/PR at Table III-16. The total number of hours worked by and wages paid to CSPV cell employees followed similar trends to PRWs, declining between 2012 and 2014 and increasing thereafter. For U.S. CSPV cell manufacturers, hourly wages, unit labor costs, and productivity (watts/hour) were higher in 2016 than in 2012 by *** percent, *** percent, and *** percent, respectively, whereas the number of hours worked per employee was *** percent lower. CR/PR at Table III-16.

[170] CR at III-38; PR at III-19.

[171] CR/PR at Table III-17. The total number of hours worked and wages paid to CSPV module employees followed similar trends to PRWs, declining between 2012 and 2014 and increasing thereafter. For U.S. CSPV module manufacturers, hourly wages fluctuated upward throughout the POI, (Continued…)

developments, such as Suniva's April 2017 suspension of operations for its cell and module factories as part of its chapter 11 bankruptcy filing or SolarWorld's June 2017 issuance of WARN Act notifications to ***, layoff of 360 employees in mid-July 2017, and ***.[172]

Based on the evidence, we find significant unemployment and underemployment in the domestic industry during the POI.

3. Inability of a Significant Number of Firms to Carry Out Domestic Production Operations at a Reasonable Level of Profit

We next examined the domestic industry's profitability. The value of the domestic industry's net sales declined over the POI, declining from $*** in 2012 to $*** in 2013, increasing to $*** in 2014 and $*** in 2015 and declining to $*** in 2016, for an overall decline of 2.9 percent.[173] Its cost of goods sold to net sales ratio was high, near or exceeding 100 percent, decreasing from *** percent in 2012 to *** percent in 2013, *** percent in 2014, and *** percent in 2015, and increasing to *** percent in 2016.[174] Consistent with overall declines in its net sales value and high cost of goods sold to net sales ratio, the domestic industry experienced operating losses throughout this time, with its operating loss improving from $*** in 2012 to operating losses of $*** in 2013, $*** in 2014, and $*** in 2015 before deteriorating to an operating loss of $*** in 2016.[175] Despite extremely favorable demand conditions, the domestic industry also experienced net losses throughout this period, with trends in net losses following those for operating losses, improving from a net loss of $*** in 2012 to net losses of $*** in 2013, $*** in 2014, and $*** in 2015 and deteriorating to a net

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(…Continued)
while unit labor costs fluctuated downward. Productivity increased continually from *** watts/hour in 2012 to *** watts/hour in 2016. CR/PR at Table III-17.

[172] CR/PR at Table III-2; Injury Hearing Tr. at 36, 85, 91-92, 95-96, 99, 236-38; EDIS Doc. 620012.

[173] CR/PR at Table C-1b. The domestic industry's net sales value of CSPV cells decreased from a period high of $*** in 2012 to $*** in 2013, $*** in 2014, and $*** in 2015 then improved somewhat to $*** in 2016. CR/PR at Table III-18. For CSPV modules, its net sales value declined from a period high of $607.6 million in 2012 to $410.6 million in 2013, increased to $420.7 million in 2014, $476.9 million in 2015, and $484.4 million in 2016. CR/PR at Table III-21.

[174] CR/PR at Table C-1b. For CSPV cells, the domestic industry's cost of goods sold to net sales ratio decreased from *** percent in 2012 to *** percent in 2013, *** percent in 2014, and *** percent in 2015, and increased to *** percent in 2016. CR/PR at Table III-18. For CSPV modules, the domestic industry's cost of goods sold to net sales ratio decreased from 141.3 percent in 2012 to 132.9 percent in 2013, 100.5 percent in 2014, and 90.8 percent in 2015, and increased to 100.9 percent in 2016. CR/PR at Table III-21.

[175] CR/PR at Table C-1b. For CSPV cells, the domestic industry's operating loss improved from $*** in 2012 to operating losses of $*** in 2013 and $*** in 2014, and deteriorated to operating losses of $*** in 2015 and $*** in 2016. CR/PR at Table III-18. For CSPV modules, the domestic industry's operating loss improved from $377.1 million in 2012 to $204.0 million in 2013, $58.6 million in 2014, and $10.5 million in 2015, and deteriorated to $215.0 million in 2016. CR/PR at Table III-21.

loss of $*** in 2016.[176] The domestic industry's net income margin improved from a loss of *** percent in 2012 to losses of *** percent in 2013, *** percent in 2014, and *** percent in 2015, but deteriorated to a loss of *** percent in 2016.[177] *** of the firms that submitted financial data on their CSPV cell operations reported operating losses and net losses in each year between 2012 and 2016 (except for ***), and the majority of firms submitting financial data on their CSPV module operations reported operating losses and net losses throughout the 2012 to 2016 period, with losses worsening in 2016.[178] In addition to the hundreds of millions of dollars in losses throughout the POI, the domestic industry's dismal and declining overall financial performance is further illustrated by the closures and bankruptcies identified above.[179] Based on this information, we find that a significant number of firms were unable to carry out domestic production operations at a reasonable level of profit during the POI.

4. Inability of Domestic Producers to Generate Adequate Capital to Finance the Modernization of Their Domestic Plants and Equipment or Inability to Maintain Existing Levels of Expenditures for Research and Development

The domestic industry's capital expenditures increased overall between 2012 and 2016, reaching their highest level in 2015, but the largest share of these expenditures was related to expenditures by one firm (***) on new CSPV cell operations that have not yet become commercially operational.[180] The domestic industry's research and development expenses

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[176] CR/PR at Table C-1b. For CSPV cells, the domestic industry's net loss improved from $*** in 2012 to net losses of $*** in 2013 and $*** in 2014, and deteriorated to net losses of $*** in 2015 and $*** in 2016. CR/PR at Table III-18. For CSPV modules, the domestic industry's net loss improved from $551.2 million in 2012 to $217.1 million in 2013, $54.5 million in 2014, and $21.1 million in 2015, and deteriorated to $224.9 million in 2016. CR/PR at Table III-21.

[177] CR/PR at Table C-1b. For CSPV cells, the domestic industry's net loss ratio improved from *** percent in 2012 to *** percent in 2013, and *** percent in 2014, but declined to *** percent in 2015 and improved somewhat to a net loss of *** percent in 2016. CR/PR at Table III-18. For CSPV modules, the domestic industry's net loss ratio improved from a loss of 90.7 percent in 2012 to losses of 52.9 percent in 2013, 13.0 percent in 2014, and 4.4 percent in 2015, and deteriorated to a net loss of 46.4 percent in 2016. CR/PR at Table III-21.

[178] CR/PR at Table III-18 (indicating that *** of *** responding firms reported operating losses on their CSPV cell operations in *** and *** of *** responding firms reported an operating loss in ***, and that *** of *** responding firms reported net losses on their CSPV cell operations in *** and *** of *** responding firms reported an operating loss in ***), Table III-21 (indicating that 8 of 11 responding firms reported operating losses on their CSPV module operations in 2012, compared to 9 of 12 in 2013, 10 of 11 in 2014, 4 of 7 in 2015, and 7 of 8 firms in 2016, and that 8 of 11 responding firms reported net losses on their CSPV module operations in 2012, compared to 10 of 12 in 2013, 9 of 11 in 2014, 4 of 7 in 2015, and 6 of 8 firms in 2016).

[179] *See, e.g.*, CR/PR at Table III-2, Table III-3.

[180] The domestic industry's total capital expenditures increased from $*** in 2012 to $*** in 2013, declined to $*** in 2014, increased to $*** in 2015, and declined to $*** in 2016. Its capital (Continued…)

generally declined between 2012 and 2015, but increased in 2016, largely due to ***.[181] The value of the domestic industry's production assets increased overall, again largely due to ***.[182] Other domestic producers recognized asset impairments,[183] reserved or wrote off production equipment,[184] ***,[185] ***,[186] and otherwise slowed or shut down production.[187]

Domestic producers also identified a series of actual negative effects on their investment, growth, and development due to imports. These included tabling, postponing, and deferring projects; rejection of investment proposals; reduction in the size of capital investments; negative returns on investments; inability to generate adequate capital to finance modernization of domestic plants and equipment; increased costs for debt financing; inability to maintain existing levels of research and development expenditures; rejection of bank loans; lowering of credit ratings; inability to issue stocks or bonds; inability to service debt; lowered bankability;[188] and other such difficulties.[189] Domestic producers also anticipated additional negative effects from imports.[190] Based on this evidence, we find that a significant number of domestic producers were unable to generate adequate capital to finance the modernization of their domestic plants and equipment, and a significant number of domestic producers were

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(…Continued)
expenditures on CSPV cells increased from $*** in 2012 to $*** in 2013, declined to $*** in 2014, increased to $*** in 2015, and declined to $*** in 2016. The domestic industry's capital expenditures related to CSPV modules increased from $*** in 2012 to $*** in 2013, and $*** in 2014, declined to $*** in 2015, and increased to $*** in 2016. CR/PR at Table III-24; CR at III-56; PR at III-28.

[181] The domestic industry's research and development expenses declined from $*** in 2012 to $*** in 2013, and $*** in 2014 and increased to $*** in 2015 and $*** in 2016. For CSPV cells, its research and development expenses declined overall, decreasing from $*** in 2012 to $*** in 2013 and $*** in 2014, increasing to $*** in 2015 and declining to $*** in 2016. Its research and development expenses for CSPV modules increased overall, declining from $*** in 2012 to $*** in 2013 and $*** in 2014 and 2015, and increasing to $*** in 2016. CR/PR at Table III-24; CR at III-58; PR at III-29.

[182] The domestic industry's production assets increased from $*** in 2012 to $*** in 2013, $*** in 2014, $*** in 2015, and $*** in 2016. Its CSPV cell assets increased from $*** in 2012 to $*** in 2013, $*** in 2014, and $*** in 2015, and declined to $*** in 2016. CSPV module assets decreased from $*** in 2012 to $*** in 2013, and increased to $*** in 2014, $*** in 2015, and $*** in 2016. CR/PR at Table III-24; CR at III-59; PR at III-29.

[183] *See, e.g.*, CR at III-55 (***), III-59 (***); PR at III-28 (***), III-29 (***).

[184] *See, e.g.*, CR at III-57 at n.78 (***); PR at III-29 at n.78 (***).

[185] *See, e.g.*, CR/PR at Table III-2 (***).

[186] *See, e.g.*, CR/PR at Table III-2 (***).

[187] See, e.g., CR/PR at Table III-2 (***).

[188] At a minimum, bankability encompasses both the financial viability of a supplier and the product's performance reliability, especially in the CSPV industry where manufacturers provide warranties of 25 years or longer on their products; bankability also allows installing firms to apply for non-recourse loans for their solar development projects. *See, e.g.*, *CSPV I*, USITC Pub. 4360 at 11 n.84, 27-28.

[189] CR/PR at Table III-25, Table E-1.

[190] CR/PR at Table III-25, Table E-1.

unable to maintain existing levels of expenditures for research and development, despite explosive demand growth during the POI.

5. Decline in Sales or Market Share, Higher and Growing Inventories, Downward Trends in Production, Profits, Wages, Productivity, or Employment in the Domestic Industry

The domestic industry's U.S. shipments decreased from *** kW in 2012 to *** kW in 2013, increased to *** kW in 2014 and *** kW in 2015, and decreased to *** kW in 2016, for an overall increase of *** percent.[191] Because this overall increase was dwarfed by the *** percent growth in apparent U.S. consumption during this period, the domestic industry's market share fell from a period high of *** percent in 2012 to *** percent in 2013, increased somewhat to *** percent in 2014, and decreased to *** percent in 2015 and a period low of *** percent in 2016.[192]

The domestic industry's end-of-period inventories increased overall by *** percent between 2012 and 2016,[193] whereas U.S. importers' end-of-period inventories more than ***, with most of the increase occurring in 2015 and 2016.[194] Moreover, as of the deadline for submitting questionnaire data (June 29, 2017), U.S. importers reported that they already had arranged for the importation of an additional 10.2 million kW in CSPV products for calendar year 2017.[195] According to petitioners, additional imports of CSPV products surged into the U.S. market in advance of any global safeguard measure, leading to further increases in inventories and manufacturer shortages.[196] Respondents dispute that such a surge occurred in 2017, and

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[191] Its U.S. shipment values decreased from $*** in 2012 to $*** in 2013, increased to $*** in 2014 and $*** in 2015, and $*** in 2016, for an overall increase of *** percent. CR/PR at Table C-1b.

[192] By value, the domestic industry's market share fell from a period high of *** percent in 2012 to *** percent in 2013, increased marginally to *** percent in 2014, and decreased to *** percent in 2015 and a period low of *** percent in 2016. CR/PR at Table C-1b.

[193] The domestic industry's end-of-period inventories declined from *** kW in 2012 to *** kW in 2013, and *** kW in 2014 and increased to *** kW in 2015 and *** kW in 2016. CR/PR at Table C-1b.

[194] U.S. importers' end-of-period inventories increased from *** kW in 2012 to *** kW in 2013, *** kW in 2014, *** kW in 2015, and *** kW in 2016, an overall increase of *** percent. CR/PR at Table C-1b.

[195] At that time, U.S. importers reported that they had arranged to import 1.7 million kW in the first quarter of 2017, 2.7 million kW in the second quarter of 2017, 3.5 million kW in the third quarter of 2017, and 2.3 million kW in the fourth quarter of 2017. CR/PR at Table II-6.

[196] *See, e.g.*, Suniva's Posthearing Injury Brief at Exhibit 9 at 41; *Sunpreme bags deal to supply 150 MW of heterojunction solar modules to TGCM* in pv magazine (Sept. 12, 2017), EDIS Doc. 623538 ("Analysts and solar developers have told pv magazine that most tier 1 PV makers have sold out of product through the end of the year, as installers and construction contractors hoard PV modules in anticipation of trade action by the Trump Administration."); *see also* Remedy Hearing Tr. at 65, 69-70, 109, 380. Petitioners emphasize that improvements in cell and module efficiencies each year can quickly make inventories obsolete, increasing the incentive to offload inventories at low prices. SolarWorld's Posthearing Injury Brief at 12; SolarWorld's Prehearing Injury Brief at 88.

state that importer inventories have not increased relative to changes in apparent U.S. consumption even if they have increased absolutely.[197]

As indicated above, the domestic industry's capacity and production levels did not increase along with demand growth, and its capacity utilization for CSPV cells and CSPV modules remained low and dropped at the end of the POI. The significant idling of productive facilities continued into 2017, and two additional U.S. production facilities had closed by July 2017.[198] The domestic industry's unemployment and underemployment worsened after the petition in the instant investigation was filed, particularly after Suniva's bankruptcy filing and SolarWorld's issuance of WARN Act notices. At the end of the POI, the domestic industry's net sales value declined and its COGS to net sales ratio increased to above 100 percent, leading to deterioration in its operating and net losses, as indicated above. These financial difficulties persisted into 2017, as additional firms shut down their operations and/or declared bankruptcy.

6. Extent to Which the U.S. Market is a Focal Point for Diversion of Exports

As reported in response to the foreign producer questionnaires, the foreign industries have substantial and increasing capacity to manufacture CSPV cells and CSPV modules.[199] Their collective capacity consistently exceeded their combined production levels.[200] The foreign industries' excess capacity, which grew between 2014 and 2016, consistently exceeded the size of the entire U.S. market.[201] Their combined end-of-period inventories also increased each year from 2012 to 2016.[202] Thus, the foreign industries collectively have the ability to export significant volumes of CSPV products to the United States.

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[197] SEIA Posthearing Injury Brief, Appendix A at 89.

[198] CR/PR at Table III-3.

[199] The foreign industries' collective CSPV cell capacity increased from 27.3 million kW in 2012 to 31.2 million kW in 2013, 36.4 million kW in 2014, 43.3 million kW in 2015, and 56.9 million kW in 2016. CR/PR at Table IV-89. Their collective CSPV module capacity increased from 25.2 million kW in 2012 to 29.2 million kW in 2013, 36.4 million kW in 2014, 47.9 million kW in 2015, and 66.6 million kW in 2016. CR/PR at Table IV-90.

[200] The foreign industries collectively produced 18.4 million kW of CSPV cells in 2012, 24.0 million kW in 2013, 31.2 million kW in 2014, 38.0 million kW in 2015, and 48.0 million kW in 2016, whereas they collectively produced 15.8 million kW of CSPV modules in 2012, 20.8 million kW in 2013, 28.6 million kW in 2014, 38.4 million kW in 2015, and 51.4 million kW in 2016. They reported further increases in their CSPV cell and CSPV module capacity for 2017 and 2018 that would exceed their projected production levels of CSPV cells and CSPV modules. CR/PR at Table IV-89, Table IV-90.

[201] For example, the foreign industry's excess CSPV module capacity was 9.4 million kW in 2012, 8.3 million kW in 2013, and increased from 7.8 million kW in 2014 to 9.4 million kW in 2015 and 15.2 million kW in 2016. Derived from CR/PR at Table IV-90. These levels consistently exceeded apparent U.S. consumption of *** kW in 2012, *** kW in 2013, *** kW in 2014, *** kW in 2015, and *** kW in 2016. CR/PR at Table C-1b.

[202] The foreign industries' collective end-of-period inventories of CSPV cells rose annually from 664,204 kW in 2012 to 858,421 kW in 2013, 1.4 million kW in 2014, 1.5 million kW in 2015, and 2.4 million kW in 2016, and they projected substantial CSPV cell inventories in 2017 and 2018. The
(Continued…)

The foreign industries also possess the incentive to export significant volumes to the United States. Although the foreign industries collectively consume the majority of the CSPV cells that they manufacture in their home market CSPV module assembly operations,[203] their CSPV module operations are export oriented.[204] Their combined exports of CSPV modules increased from 2012 to 2016.[205] Several foreign industries face antidumping and/or countervailing duty orders on their exports to one or more non-U.S. markets, including the European Union (CSPV cells and modules from China, Malaysia, and Taiwan), Canada (CSPV modules from China), and Turkey (CSPV modules from China).[206] The foreign industries have demonstrated an ability to redirect exports from one market to another and to increase exports substantially to individual markets from one year to the next.[207] The large U.S. market has been and will remain a likely target for their exports.[208] Although the parties disagreed about demand for CSPV products in other markets,[209] questionnaire data indicate that the

(…Continued)
foreign industries' collective end-of-period inventories of CSPV modules rose annually from 1.5 million kW in 2012 to 1.6 million kW in 2013, 2.8 million kW in 2014, 3.1 million kW in 2015, and 4.0 million kW in 2016, and they projected substantial increases in CSPV module inventories in 2017 and 2018. CR/PR at Table IV-89. At the same time, the vast majority of foreign producers reported that they could not produce other products with the same equipment and workers used to produce CSPV products. CR at V-8; PR at V-5.

[203] The foreign industries collectively reported consuming between 69.1 and 79.0 percent of the CSPV cells that they manufacture in their home markets, primarily for internal consumption. CR/PR at Table IV-89.

[204] Exports accounted for between 55.9 percent and 77.7 percent of the foreign industries' collective shipments during the POI. CR/PR at Table IV-90.

[205] The foreign industries' collective exports of CSPV modules increased from 12.0 million kW in 2012 to 13.5 million kW in 2013, 18.2 million kW in 2014, 23.4 million kW in 2015, and 28.0 million kW in 2016. CR/PR at Table IV-90.

[206] In addition, the government of India is currently conducting an antidumping duty investigation on "Solar Cells whether or not assembled partially or fully in Modules or Panels or on glass or some other suitable substrates" originating in or exported from China, Malaysia, and Taiwan, and the government of China imposed measures on a raw material used in the production of CSPV products (solar-grade polysilicon) from Korea, the European Union, and the United States. CR/PR at Table I-4; CR at I-61 to I-67; PR at I-46 to I-50.

[207] *See, e.g.*, CR/PR at Table IV-90 (changes from one year to the next for exports of CSPV modules). Industries in individual foreign countries have also demonstrated a similar ability and willingness to shift export markets from year to the next.

[208] The U.S. market was the fifth largest global market in 2012, accounting for 11.0 percent of photovoltaic system installations (including thin film). By 2015, the United States was the second largest market, accounting for 14.7 GW of photovoltaic system installations, or approximately 20 percent of the global market. CR at IV-9; PR at IV-5.

[209] There was a large increase in demand in China between 2012 and 2016. Outside of China and the United States, demand also increased during this period, though at a slower pace (as declining demand in Europe was offset by growth elsewhere). Global demand excluding China and the United States either slightly increased or slightly decreased from 2015 to 2016, depending on the source. CR at (Continued…)

foreign industries collectively increased their exports of CSPV modules to the United States throughout 2012 to 2016,[210] and the U.S. market accounted for an increasing share of their total shipments of CSPV modules during this period.[211] As discussed above, the volume of U.S. imports rose overall between January 2012 and December 2016, and U.S. importers reported arranging for additional imports throughout 2017.

As further evidence of the attractiveness of the U.S. market, after the imposition of the antidumping and countervailing duty orders on imports from China in December 2012 and on imports from China and Taiwan in February 2015,[212] imports from other countries substantially increased their presence in the U.S. market.[213] By the end of 2015, imports had almost *** their level from 2014, and they continued to grow into 2016.[214] Indeed, without closing any of their existing capacity in China, the six largest firms producing CSPV cells and CSPV modules in China increased their global capacity to produce CSPV cells by *** percent between 2012 and 2016, with four of the six firms adding CSPV cell manufacturing capacity in one or more of the following five countries during that time: Korea, Malaysia, the Netherlands, Thailand, and Vietnam.[215] These same six firms also increased their global capacity to produce CSPV modules by *** percent between 2012 and 2016, without closing any of their existing capacity in China, with four of the six firms adding CSPV module capacity in one or more of the following six countries: Canada, Indonesia, Korea, Malaysia, Thailand, and Vietnam.[216] Notably, imports from the four countries where Chinese affiliates added both CSPV cell and CSPV module capacity (Korea, Malaysia, Thailand, and Vietnam) increased their share of apparent U.S. consumption from *** percent in 2012 to *** percent in 2016, and much of this increase occurred between 2015 and 2016, as their collective share of the U.S. market more than ***

(…Continued)
IV-9 to IV-10; PR at IV-5 to IV-7; SolarWorld's Prehearing Injury Brief, Exhibit 12; Petitioners' Injury Hearing Economic Slides at Slide 21 (Aug. 15, 2017), EDIS Doc. 620615.

[210] The foreign industries' collective exports of CSPV modules to the United States increased from 2.3 million kW in 2012 to 3.2 million kW in 2013, 4.7 million kW in 2014, 7.8 million kW in 2015, and 11.8 million kW in 2016. CR/PR at Table IV-90.

[211] CR/PR at Table IV-90 (indicating that U.S. exports accounted for 15.0 percent of the foreign industries' total shipments of CSPV modules in 2012, 15.5 percent in 2013, 17.1 percent in 2014, 20.6 percent in 2015, and 23.6 percent in 2016).

[212] The antidumping and countervailing duty orders on imports from China and Taiwan had a restraining effect on imports from those countries, which maintained a presence in the U.S. market, but at lower levels. *See, e.g.*, CR/PR at Table IV-3 (indicating that combined imports from China and Taiwan declined from *** kW in 2015 to *** kW in 2016). Indeed, as the Commission noted, before the imports subject to the *CSPV I* orders had receded from the U.S. market, imports from China and Taiwan that were within the scope of the *CSPV II* investigations increased their presence in the U.S. market. *CSPV II*, USITC Pub. 4519 at 34.

[213] CR/PR at Table IV-3, Table C-1b.

[214] CR/PR at Table IV-3, Table C-1b.

[215] CR at IV-39 at n.38; PR at IV-26 at n.38; CR/PR at Table IV-17 (referring to Canadian Solar (China), Hanwha Qidong (China), Shanghai JA Solar, Jinko Solar (China), Changzhou Trina (China), and Yingli Green).

[216] CR/PR at Table IV-18; CR at IV-39 at n.38; PR at IV-26 at n.38.

from *** percent in 2015 to *** percent in 2016 just after the second round of antidumping and countervailing duty orders went into effect in February 2015.[217] Consistent with these shifts, a substantial number of U.S. importers and purchasers reported that the origin of their purchases had shifted, as they purchased CSPV products imported from other countries.[218]

Accordingly, based on the substantial production capacity and available unused capacity in the foreign industries, their export orientation, their willingness to shift substantial volumes among export markets from one period to the next, and the demonstrated attractiveness of the U.S. market to the foreign industries, we find that the U.S. market is a focal point for the diversion of exports.

7. Price Effects

We also examined prices of CSPV products during the POI. As discussed above, imported CSPV products are highly substitutable with U.S.-manufactured products, and price is an important consideration in purchasing decisions in this industry.

In this investigation, two U.S. producers and 31 importers provided usable quarterly net U.S. f.o.b. selling price data for five CSPV products for the period January 2012 through December 2016, although not all firms reported pricing data for all products for all quarters.[219] The Commission asked questionnaire respondents to report separate pricing data for monocrystalline and multicrystalline products and to report pricing data on 60-cell modules as well as 72-cell modules.[220] The pricing data obtained in this investigation accounted for approximately 83.3 percent of the domestic industry's U.S. shipments of CSPV products and 74.1 percent of U.S. importers' U.S. shipments of CSPV products in 2016.[221]

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[217] CR/PR at Table IV-3, Table C-1b; *see also* Petitioners' Injury Hearing Economic Slides at Slide 31 to Slide 34 (Aug. 15, 2017), EDIS Doc. 620615.

[218] CR at F-12, F-22; PR at F-4 to F-6; CR/PR at Table F-5 (U.S. importers); Table F-6 (identifying U.S. importers that discontinued or reduced imports from China because of the orders, identifying U.S. importers that discontinued or reduced imports from Taiwan because of the orders, and identifying U.S. importers that began or increased imports from sources other than China and Taiwan), Table F-7 (identifying U.S. importers that reported that the existence of the antidumping and countervailing duty orders on imports from China and Taiwan had a significant impact), Table F-8 (U.S. purchasers), Table F-9 (identifying purchasers that discontinued or reduced purchases from China because of the orders, identifying U.S. purchasers that discontinued or reduced purchases from Taiwan because of the orders, and purchasers that began or increased purchases from China and Taiwan), Table F-10 (indicating the significance of the orders according to foreign producers).

[219] The pricing products included the following: (1) monocrystalline cells with an efficiency between 17.0 percent and 22.0 percent; (2) 60-cell multicrystalline silicon module, with a peak power wattage of 240 to 250, inclusive, P-max or Wp; (3) 60-cell monocrystalline silicon module, with a peak power wattage of 250 to 300, inclusive, P-max or Wp; (4) 72-cell multicrystalline silicon module, with a peak power wattage of 290 to 340, inclusive, P-max or Wp; and (5) 72-cell monocrystalline silicon module, with a peak power wattage of 300 to 350, inclusive, P-max or Wp. CR at V-32; PR at V-21.

[220] *See, e.g.*, CR/PR at Table V-12 to Table V-16; Figure V-10 to Figure V-12.

[221] CR at V-32 to V-33; PR at V-21 to V-22.

Based on these data, imported CSPV products were priced lower than U.S.-manufactured products in 33 of 52 instances involving approximately two-thirds of the total volume in the pricing data (*** kW), and were priced higher in 19 instances (*** kW).[222] Seven domestic producers reported that they had lost sales to imported CSPV products since 2012.[223] The majority of purchasers reported that they had increased their purchases of imported CSPV products, and they identified lower price most often as the reason for increasing their purchases of imported CSPV products.[224] Purchasers reported that imported CSPV modules as a share of their total purchases of CSPV products increased by 15.6 percentage points from 75.6 percent of total CSPV purchases in 2012 to 91.2 percent of total CSPV purchases in 2016.[225]

We also considered movements in the prices of products 1 to 5 during the POI. Quarterly prices for all five pricing products declined between January 2012 and December 2016, with prices of U.S.-manufactured products declining between 48.5 and 73.2 percent and imported CSPV products declining between 45.7 and 51.0 percent during this period.[226] According to industry reports, prices of CSPV cells and CSPV modules fell by 60.4 percent and 58.5 percent, respectively from 2012 to 2016.[227] Eight of 12 responding domestic producers reported that they had to reduce prices, and three reported having to roll back announced price increases in order to avoid losing sales to competitors selling imported CSPV products during the POI.[228] Of the 103 responding purchasers, 38 reported that U.S. producers had reduced prices of their CSPV products in order to compete with lower-priced imports, and 44 of them reported that they did not know whether U.S. producers had reduced their prices to compete with lower-priced imports.[229] Several purchasers reported steeper price reductions in 2016.[230]

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[222] CR/PR at Table V-12 to Table V-16; Figure V-10 to V-12; CR at V-45; PR at V-26.

[223] CR at V-47; PR at V-28 (noting that four domestic producers estimated total lost sales of approximately 950,000 kW since 2012).

[224] CR at V-23; PR at V-15 to V-16. Of the 104 responding purchasers, 91 reported that since 2012 they had purchased imported CSPV products instead of U.S.-manufactured CSPV products. Seventy-three of these purchasers reported that import prices were lower than U.S.-manufactured CSPV products, and 33 reported that price was a primary reason for their decision to purchase imported CSPV products over products manufactured in the United States. Purchasers estimated that the quantity of imported CSPV products that they purchased instead of domestic CSPV products ranged from 54 kW to 1.7 million kW, and totaled 3.4 million kW. CR at V-50; PR at V-30; CR/PR at Table V-19, Table V-20.

[225] CR/PR at Table V-19.

[226] CR/PR at Table V-17.

[227] CR at V-46; PR at V-27 to V-28; CR/PR at Figure V-13.

[228] CR at V-46; PR at V-27 to V-28 (noting that three domestic producers estimated total lost revenues of approximately $140 million since 2012).

[229] CR at V-51; PR at V-31 (noting that purchasers estimated that domestic producers reduced prices anywhere from 3 to 70 percent, averaging 31 percent).

[230] CR at V-51; PR at V-31. The decline in prices between the fourth quarter of 2015 and the fourth quarter of 2016 were usually twice as large as the price declines between the first quarter of 2015 and the first quarter of 2016 according to the pricing data submitted in this investigation, as discussed below. Derived from CR/PR at Table V-11 to Table V-16.

Although the domestic industry's net sales values fell overall between 2012 and 2016,[231] its cost of goods sold declined by a greater amount.[232] As a result, although the domestic industry's cost of goods sold to net sales ratio was high, near or exceeding *** percent throughout this period, it decreased from *** percent in 2012 to *** percent in 2013, *** percent in 2014, and *** percent in 2015, and increased to *** percent in 2016, as indicated above.[233]

We find that the domestic industry experienced adverse price conditions, given that imports were lower priced than U.S.-manufactured CSPV products, prices of the domestic industry's CSPV products fell between 2012 and 2016 despite very strong demand growth, and the domestic industry's costs remained near or above its net sales values throughout the POI.

8. Conclusion

Thus, we find a significant idling of domestic productive facilities for CSPV products between 2012 and 2016 and significant unemployment and underemployment within the domestic industry. A significant number of firms were unable to carry out domestic production operations at a reasonable level of profit, and a significant number of domestic producers were unable to generate adequate capital to finance the modernization of their domestic plants and equipment or to maintain existing levels of expenditures for research and development. The domestic industry's sales and market share declined significantly, and inventories were high and growing during this period of adverse price conditions. The domestic industry's performance indicators particularly declined between 2015 and 2016 and continued to deteriorate into 2017 despite explosive demand growth. Based on this evidence and the status of the U.S. market as a focal point for exports, we find a significant overall impairment in the domestic industry's position. Consequently, we find that the domestic industry is seriously injured.

E. Increased Imports are a Substantial Cause of Serious Injury to the Domestic Industry Manufacturing CSPV Products

In determining whether increased imports are a substantial cause of serious injury, we considered the impact of imports as well as the impact of other possible causes. As discussed

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[231] The domestic industry's net sales value declined from *** in 2012 to $*** in 2013, increased to $*** in 2014 and $*** in 2015 and declined to $*** in 2016. CR/PR at Table C-1b.

[232] The domestic industry's cost of goods sold fell from a period high of $*** in 2012 to a period low of $*** in 2013, increased to $*** in 2014 and $*** in 2015, and fell to $*** in 2016. Its unit cost of goods sold followed similar trends until 2015, declining from $***/kW in 2012 to $***/kW in 2013, increasing to $***/kW in 2014 but declining to $***/kW in 2015 and $***/kW in 2016. CR/PR at Table C-1b.

[233] CR/PR at Table C-1b.

above, the statute defines "substantial cause" as a cause "which is important and not less than any other cause."[234]

We find that increased imports are a substantial cause of serious injury to the domestic industry manufacturing CSPV products. In 2009, the beginning of the period of investigation in the *CSPV I* investigations, the domestic industry held the largest share of apparent U.S. consumption (*** percent), followed by imports from China corresponding to the scope of those investigations (*** percent), and imports from all other sources (*** percent).[235] Imports from China overtook the domestic industry's U.S. shipments by 2010,[236] and by the end of 2011, imports from China had nearly doubled from their 2009 level.[237]

After the Commission determined that the dumped and subsidized imports from China were materially injuring the domestic industry in the *CSPV I* investigations, U.S. imports of CSPV cells produced in China, CSPV modules assembled in China from CSPV cells made in China, and CSPV modules assembled in a third country from CSPV cells made in China became subject to orders effective December 7, 2012.[238] Before those imports began to recede from the U.S. market, imports from China and Taiwan corresponding to the scope of the *CSPV II* antidumping and countervailing duty investigations increased their presence in the U.S. market.[239] Those imports from China and Taiwan almost completely replaced the substantial market share previously held by the *CSPV I* imports from China and took additional market share from the domestic industry.[240] Before the *CSPV II* orders became effective in February 2015, imports from additional countries entered the U.S. market.[241] By the end of 2015, imports had almost doubled their level from 2014, and imports continued to grow into 2016.[242]

As discussed earlier, the six largest firms producing CSPV cells and CSPV modules in China increased their global CSPV cell and CSPV module capacity without closing their capacity in China.[243] Imports from the four countries where Chinese affiliates added both CSPV cell and CSPV module capacity (Korea, Malaysia, Thailand, and Vietnam) increased their share of

[234] 19 U.S.C. § 2252(b)(1)(B).

[235] *CSPV II*, USITC Pub. 4519 at 33; *CSPV I*, USITC Pub. 4360 at 25-26, 28-29; Confidential *CSPV I* Views, EDIS Doc. 618919, file 1215365 at 36-37, 43.

[236] *CSPV I*, USITC Pub. 4360 at 28-29.

[237] *CSPV I*, USITC Pub. 4360 at 29; Confidential *CSPV I* Views, EDIS Doc. 618919, file 1215365 at 43.

[238] 77 Fed Reg. 73107 (Dec. 7, 2012); 77 Fed. Reg. 73018 (Dec. 7, 2012).

[239] *CSPV II*, USITC Pub. 4519 at 34.

[240] *CSPV II*, USITC Pub. 4519 at 38-39 & nn.22-23; Confidential *CSPV II* Views, EDIS Doc. 618909, file 1215370 at 54-55 & nn.22-23 (indicating that those imports from China and Taiwan increased their share of the U.S. market from *** percent in 2011 to *** percent in 2012 and *** percent in 2013 whereas imports from other sources, which the Commission noted were primarily of products from China that became subject to the *CSPV I* orders, fell from *** percent in 2011 to *** percent in 2012 and *** percent in 2013).

[241] CR/PR at Table IV-3, Table C-1b.

[242] CR/PR at Table IV-3, Table C-1b.

[243] CR/PR at Table IV-17, Table IV-18.

apparent U.S. consumption from *** percent in 2012 to *** percent in 2016. Much of this increase occurred between 2015 and 2016, as their collective share of the U.S. market more than doubled from *** percent in 2015 to *** percent in 2016 just after the *CSPV II* orders went into effect in February 2015.[244]

Although the composition of imports changed between 2012 and 2016, imports from China maintained a substantial presence in the U.S. market throughout the POI, despite the existence of two sets of antidumping and countervailing duty orders.[245] Consistent with the large and attractive nature of the U.S. market and the large and growing size of the export-oriented collective foreign industries, imports of CSPV products increased both absolutely and relative to domestic production in each year since 2012, reaching record highs in 2016.[246] As indicated above, these imports were highly substitutable for U.S.-manufactured CSPV products and generally were lower priced.[247]

During this period of substantial and growing volumes of low-priced imports, prices for all five pricing products declined between January 2012 and December 2016, with prices of imported CSPV products declining 45.7 to 51.0 percent and prices of U.S.-manufactured products declining 48.5 to 73.2 percent.[248] According to industry reports, prices of CSPV cells and CSPV modules fell by 60.4 percent and 58.5 percent, respectively from 2012 to 2016.[249] The domestic industry reported having to reduce prices and/or roll back announced price increases to compete with imported CSPV products.[250] Of the 103 responding purchasers, 38 reported that U.S. producers had reduced prices of their CSPV products to compete with

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[244] CR/PR at Table IV-3, Table C-1b.

[245] CR/PR at Table IV-4. Some respondents focused on trends in imports from individual countries, arguing, for example, that that imports from China were not a substantial cause of serious injury because imports from China declined at the end of the POI. *See, e.g.*, Government of China's Posthearing Injury Statement at 6; CCCME's Prehearing Injury Brief at 2, 7-17, 32-33; Government of Taiwan's Prehearing Injury Brief at 8-10; Vietnamese Respondents' Prehearing Injury Brief at 3-11. By focusing separately on their own exports to the United States, these respondents overlook the global nature of safeguard investigations. Moreover, unlike a number of other respondent countries, China, Taiwan, and Vietnam do not have an FTA with the United States with a safeguard exclusion provision, and therefore there is no basis for the Commission to look at imports from any of these countries separately.

[246] Imports increased absolutely from 2.2 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016. CR/PR at Table II-2, Table IV-3, Table C-1b. As a ratio to domestic production, imports increased from 733.9 percent in 2012 to 948.4 percent in 2013, 1,141.0 percent in 2014, 1,593.5 percent in 2015, and 2,276.2 percent in 2016. CR/PR at Table II-2, Table IV-3, Table C-1b.

[247] CR/PR at Table V-12 to Table V-16; CR/PR at Figure V-10 to Figure V-12; CR at V-45; PR at V-26.

[248] CR/PR at Table V-17.

[249] CR at V-46; PR at V-27; CR/PR at Figure V-13.

[250] CR at V-46; PR at V-28 (noting that three domestic producers estimated total lost revenues of approximately $140 million since 2012).

lower-priced imports, and 44 of them did not know whether U.S. producers had reduced their prices to compete with lower-priced imports.[251]

Prices declined substantially in 2012, but stabilized somewhat after imports from China became subject to antidumping and countervailing duty orders in December 2012, additional investigations on imports from China and Taiwan were commenced at the end of 2013, and imports grew at a slower pace than apparent U.S. consumption between 2013 and 2014. As imports from additional sources entered the U.S. market and rapidly increased to higher volumes, however, the domestic industry's prices steadily fell throughout 2016.[252] Several purchasers also reported steeper price reductions in 2016,[253] as the domestic industry's share of the market fell to its lowest level.[254]

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[251] CR at V-51 (noting that purchasers estimated that domestic producers reduced prices anywhere from 3 to 70 percent, averaging 31 percent).

[252] CR at V-46; PR at V-27. The decline in prices between the fourth quarter of 2015 and the fourth quarter of 2016 were usually twice as large as the price declines between the first quarter of 2015 and the first quarter of 2016 according to the pricing data submitted in this investigation. Derived from CR/PR at Table V-11 to Table V-16 (indicating price declines from the first quarter of 2015 to the first quarter of 2016 of 10.1 percent for imported pricing product 2, 9.2 percent for U.S.-manufactured pricing product 3, 14.7 percent for imported pricing product 3, 12.6 percent for imported product 4, 11.0 percent for U.S.-manufactured pricing product 5, and 11.6 percent for imported pricing product 5 compared to price declines from the fourth quarter of 2016 to the fourth quarter of 2016 of 19.8 percent for imported pricing product 2, 18.3 percent for U.S.-manufactured pricing product 3, 30.6 percent for imported pricing product 3, 26.4 percent for imported product 4, 31.7 percent for U.S.-manufactured pricing product 5, and 22.1 percent for imported pricing product 5). According to industry reports, prices of cells and modules declined by 34.4 percent and 38.1 percent respectively, from the first quarter of 2016 to the fourth quarter of 2016. CR at V-46 at n.50; PR at V-27 at n.50; CR/PR at Figure V-13.

[253] CR/PR at Tables V-12 to V-16, V-18; Figure V-10 to Figure V-12. According to several industry sources, average installed prices for photovoltaic system installations declined steadily in all three on-grid market segments during the POI. According to one industry report, the median installed price of a photovoltaic system (including thin film) fell between 24.1 percent (residential system) and 43.6 percent (non-residential system greater than 500 kW) from 2012 to 2015. CR/PR at Figure V-4. According to another industry report, U.S. photovoltaic system pricing fell by almost 20 percent from the fourth quarter of 2015 to the fourth quarter of 2016. This report attributed the steep decline in photovoltaic system prices during 2016 to large decreases in module prices combined with substantial declines in hardware costs. CR at V-13; PR at V-8. For most of the POI, declining system prices largely reflected falling non-module costs as module prices remained relatively stable from 2013 to 2015. In residential photovoltaic systems, module costs fell 9 percent while non-module costs fell 27 percent from 2012 to 2015. CR/PR at Figure V-5. In 2016, however, declining system prices largely reflected falling module prices. Between the fourth quarter of 2015 and the fourth quarter of 2016, module prices fell by 35.4 percent. Declines in non-module costs (*e.g.*, inverters, mounting hardware, labor, design/engineering, permitting fees, overhead, and profit margin) ranged from 6 percent for fixed-tilt utility systems, 13 percent for residential and non-residential systems, and 15 percent for single axis tracking utility systems. CR at V-14 to V-15; PR at V-9 to V-10; CR/PR at Figures V-4 to V-6.

[254] CR/PR at Table IV-4, Table C-1b.

The domestic industry's net sales fell overall between 2012 and 2016, and its cost of goods sold declined by a greater amount.[255] The domestic industry's cost of goods sold to net sales ratio was high, near or exceeding *** percent throughout this period, decreasing from *** percent in 2012 to *** percent in 2013, *** percent in 2014, and *** percent in 2015, and increasing to *** percent in 2016.[256] Accordingly, the domestic industry's financial condition, which was at its worst at the beginning of the POI before the antidumping and countervailing duty orders were imposed on imports from China in December 2012, improved marginally after imposition of the orders and the filing of new antidumping and countervailing duty cases, but remained poor and deteriorated further in 2016, as imports peaked in terms of volume and market share and prices dropped anew.[257]

Consistent with the hundreds of millions of dollars in net and operating losses throughout the POI, a significant number of domestic producers were unable to generate adequate capital to finance the modernization of their domestic plants and equipment, and a significant number of them were unable to maintain existing research and development expenditure levels.[258] This inability to generate adequate capital for investments and research and development impaired the domestic industry's ability to develop next-generation products in this highly capital-intensive and technologically sophisticated market.[259]

Additionally, despite the need in this industry to increase capacity in order to achieve economies of scale, the domestic industry's capacity and production levels did not increase commensurately with demand growth,[260] and its capacity utilization levels remained low and dropped at the end of the POI,[261] as imports reached their summit.[262] A substantial number of

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[255] The domestic industry's cost of goods sold fell from a period high of $*** in 2012 to a period low of $*** in 2013, increased to $*** in 2014 and $*** in 2015, and fell to $*** in 2016. Its unit cost of goods sold followed similar trends until 2015, declining from $***/kW in 2012 to $***/kW in 2013, increasing to $***/kW in 2014 but declining to $***/kW in 2015 and $***/kW in 2016. CR/PR at Table C-1b. The domestic industry's net sales values declined at a somewhat slower rate, falling from $*** in 2012 to $*** in 2013, increasing to $*** in 2014 and $*** in 2015 and declining to $*** in 2016. CR/PR at Table C-1b.

[256] CR/PR at Table C-1b.

[257] The domestic industry's operating loss improved from $*** in 2012 to operating losses of $*** in 2013, $*** in 2014, and $*** in 2015 but deteriorated to an operating loss of $*** in 2016. The domestic industry's net losses improved from a net loss of $*** in 2012 to net losses of $*** in 2013, $*** in 2014, and $*** in 2015 and deteriorated to a net loss of $*** in 2016. The domestic industry's net income margin improved from a loss of *** percent in 2012 to losses of *** percent in 2013, *** percent in 2014, and *** percent in 2015, but deteriorated to a loss of *** percent in 2016. CR/PR at Table C-1b.

[258] *See, e.g.*, CR/PR at Table III-2, Table III-25, Table E-1; CR at III-55, III-57 at n.78, III-59; PR at III-27 to III-28, III-29 at n.78.

[259] SolarWorld's Posthearing Injury Brief at 12; SolarWorld's Prehearing Injury Brief at 90-92; Suniva's Prehearing Injury Brief at 68-69.

[260] CR/PR at Table III-4 (CSPV cells), Table III-7 (CSPV modules).

[261] Capacity utilization for CSPV modules declined from 57.9 percent in 2012 to 48.9 percent in 2013 and increased to 61.4 percent in 2014 and 63.4 percent in 2015, but declined to 53.7 percent in
(Continued…)

domestic CSPV cell and CSPV module facilities closed during the POI,[263] resulting in numerous layoffs and the need for trade adjustment assistance for the highly trained, skilled workers affected by these closures.[264]

As imports increased rapidly and the domestic industry faced underutilization of its production assets, underinvestment, and closures, the domestic industry similarly was unable to take advantage of a market in which apparent U.S. consumption increased nearly *** in five years.[265] Imports accounted for a growing and substantial share of the U.S. market, increasing their share of apparent U.S. consumption from *** percent in 2012 to *** percent in 2016.[266] In all but one year (2013/2014) of the POI, imports increased at a greater rate than apparent U.S. consumption year over year, ensuring their dominant position in the U.S. market as demand surged forward.[267] Although many U.S. producers entered the U.S. market seeking to take advantage of this demand growth, the consistent inability of the domestic industry to

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(…Continued)
2016 (the second lowest level over the POI). Capacity utilization for CSPV cells increased from a low of *** percent in 2012 to *** percent in 2013 and *** percent in 2014, while prices stabilized somewhat and imports temporarily grew at a lower rate than apparent U.S. consumption, but capacity utilization declined to *** percent in 2015 and *** percent in 2016 as additional foreign suppliers entered the U.S. market in large volumes. CR/PR at Table III-4, Table III-7.

[262] While respondents argue that the domestic industry was unable to supply adequate levels of CSPV cells to sustain U.S. CSPV module assembly operations or demand in the U.S. market, which is accurate, *compare* CR/PR at Table III-4 (CSPV cell capacity) *with* Table III-7 (CSPV module capacity) and Table IV-3 (apparent U.S. consumption), the vast majority of imports of CSPV products during the POI consisted of finished CSPV modules and not CSPV cells. CR/PR at Table II-4 (indicating that cells accounted for a declining share of total CSPV imports, declining from *** percent in 2012 to *** percent in 2016 and CSPV modules increased their share of total CSPV imports from *** percent in 2012 to *** percent in 2016). Certain domestic producers attempted to increase CSPV cell capacity during the POI, but at no point was the domestic industry able to operate at full capacity utilization for CSPV cells. CR/PR at Table III-4.

[263] Respondents repeatedly point to opponents of the case, but many of these firms are not part of the domestic industry manufacturing CSPV products. Moreover, some firms that manufactured CSPV products during the POI did not express a position on this investigation because they no longer exist. *See, e.g.*, CR/PR at Table III-2, Table III-3. Additionally, producers accounting for the vast majority of domestic production in 2016 supported this case prior to institution. CR/PR at Table I-2; Suniva's May 12, 2017 response at Exhibit 6; Injury Hearing Tr. at 81.

[264] CR/PR at Table III-2; Suniva's Prehearing Injury Brief at 44-45; *CSPV II*, USITC Pub. 4519 at 16, I-28 to I-29.

[265] Apparent U.S. consumption increased from *** kW in 2012 to *** kW in 2013, *** kW in 2014, *** kW in 2015, and *** kW in 2016. CR/PR at Table IV-4, Table C-1b.

[266] CR/PR at Table IV-4.

[267] Import volumes increased *** percent between 2012 and 2013, *** percent from 2013/2014, *** percent from 2014/2015, *** percent from 2015/2016, and *** percent from 2012/2016, whereas apparent U.S. consumption grew *** percent between 2012 and 2013, *** percent from 2013/2014, *** percent from 2014/2015, *** percent from 2015/2016, and *** percent from 2012/2016. CR/PR at Table C-1b.

compete with low-priced imports forced many of these firms, as well as others, to shut down their facilities.

Although the domestic industry increased its U.S. shipments over the POI,[268] this overall increase was dwarfed by the *** percent growth in apparent U.S. consumption during this period,[269] meaning that the domestic industry lost market share to the consistently growing low-priced imports. The domestic industry's share of apparent U.S. consumption fell from *** percent in 2012 to *** percent in 2013, and increased to *** percent in 2014, as prices stabilized somewhat while imports temporarily grew at a slower pace than apparent U.S. consumption. The domestic industry's market share declined anew to *** percent in 2015 and *** percent in 2016, as imports peaked.[270] Domestic producers reported losing sales to low-priced imports of CSPV products,[271] and the majority of purchasers reported that they had increased their purchases of imported CSPV products, most often identifying lower price as the reason for increasing their purchases of imported CSPV products.[272]

Consistent with declines in many of the domestic industry's trade and financial indicators between 2015 and 2016, as imports reached their POI pinnacle, available information suggests that the domestic industry's condition continued to deteriorate into 2017, beyond the POI for which data were collected in this investigation. Two additional U.S. production facilities closed by July 2017.[273] The domestic industry's unemployment and underemployment also worsened in 2017, with Suniva's bankruptcy filing and SolarWorld's issuance of WARN Act notices and additional layoffs.[274] Importers reported that they had already arranged for substantial volumes of imports at the time they submitted their questionnaire data. Petitioners assert that additional imports of CSPV products surged into the U.S. market in advance of any global safeguard measure, leading to further increases in inventories and manufacturer shortages,[275] although this is disputed by respondents.[276]

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[268] The domestic industry's U.S. shipments decreased from *** kW in 2012 to *** kW in 2013, increased to *** kW in 2014 and *** kW in 2015, and decreased to *** kW in 2016, for an overall increase of *** percent. CR/PR at Table C-1b.

[269] CR/PR at Table IV-4, Table C-1b.

[270] CR/PR at Table IV-4, Table C-1b.

[271] CR at V-47; PR at V-28 (noting that four domestic producers estimated total lost sales of approximately 950,000 kW since 2012).

[272] CR at V-23; PR at V-16. Of the 104 responding purchasers, 91 reported that since 2012 they had purchased imported CSPV products instead of U.S.-manufactured CSPV products. Seventy-three of these purchasers reported that import prices were lower than U.S.-manufactured CSPV products, and 33 reported that price was a primary reason for their decision to purchase imported CSPV products over products manufactured in the United States. Purchasers estimated that the quantity of imported CSPV products that they purchased instead of domestic CSPV products ranged from 54 kW to 1.7 million kW, and totaled 3.4 million kW. CR at V-50; PR at V-30; CR/PR at Table V-19, Table V-20.

[273] CR/PR at Table III-3.

[274] CR/PR at Table III-2; Injury Hearing Tr. at 36, 85, 91-92, 95-96, 99, 236-38; EDIS Doc. 620012.

[275] *See, e.g.*, Suniva's Posthearing Injury Brief at Exhibit 9 at 41; *Sunpreme bags deal to supply 150 MW of heterojunction solar modules to TGCM* in pv magazine (Sept. 12, 2017), EDIS Doc. 623538 (Continued…)

Consequently, we find that increased imports are a substantial cause of serious injury to the domestic industry manufacturing CSPV products based on a clear causal link between them.

F. Imports are an Important Cause Not Less Than Any Other Cause

Respondents assert that causes other than imports are more important and explain any injury to the domestic industry.[277] They identify two such causes: (1) alleged missteps by the domestic industry and (2) factors other than imports that led to declines in domestic prices.[278] We have examined these factors but find that respondents' arguments are not supported by the facts.

1. Alleged Missteps by the Domestic Industry

Respondents point to alleged missteps by the domestic industry in terms of the quality and types of products they manufacture, the market segments they serve, and alleged delivery and service issues.

Turning first to their product-related arguments, respondents argue that technological change is a key characteristic of the solar industry, meaning that producers need to manufacture products that convert sunlight into electricity more efficiently over time and continuously become more efficient at the industrial production level.[279] By 2016, most CSPV cells were 156.0 mm^2 (6.14 $inches^2$) or 156.75 mm^2 (6.17 $inches^2$), and by 2017, power wattages for CSPV cells ranged from 4 watts to more than 5 watts/cell.[280] Typical on-grid modules have 60,[281] 72,[282] or 96 CSPV cells, although manufacturers sometimes cut the CSPV cells in half to yield 120 or 144 half-cut CSPV cells.[283] On-grid modules typically have a power

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(…Continued)
("Analysts and solar developers have told pv magazine that most tier 1 PV makers have sold out of product through the end of the year, as installers and construction contractors hoard PV modules in anticipation of trade action by the Trump Administration."; *see also* Remedy Hearing Tr. at 65, 69-70, 109, 380.

[276] SEIA Posthearing Injury Brief, Appendix A at 89.

[277] Respondents do not allege that demand conditions are responsible for any injury to the domestic industry. As indicated earlier, demand for CSPV products flourished during the POI, as evidenced by the tremendous growth in apparent U.S. consumption over the POI and from one year to the next throughout 2012 to 2016. CR/PR at Table IV-4, Table C-1b. Thus, demand conditions were favorable and not injurious.

[278] *See, e.g*., SEIA's Prehearing Injury Brief at 70-120.

[279] *See, e.g.*, SEIA's Prehearing Injury Brief at 18; SEIA's Posthearing Brief, Appendix A, Question 36.

[280] CR at I-15; PR at I-11.

[281] On average, 60-cell CSPV modules weigh between 33 and 51 pounds and measure 65 inches long by 39 inches wide and 1.5 to 2 inches thick. CR at I-18; PR at I-13.

[282] On average, 72-cell CSPV modules weigh between 45 and 61 pounds and measure 78 inches long by 39 inches wide and 1.5 to 2 inches thick. CR at I-18; PR at I-13.

[283] CR at I-17 to I-18; PR at I-13.

output of between 240 watts and 340 watts.[284] The two main types of CSPV products are monocrystalline and multicrystalline silicon products; monocrystalline CSPV products, grown from a single crystal, tend to convert sunlight into electricity more efficiently than multicrystalline CSPV products with random crystal structures.[285] Monocrystalline and multicrystalline modules are manufactured in a range of ever-increasing conversion efficiencies[286] and nominal power outputs.[287]

Both imported and domestic CSPV products were available in cell, laminate, and module forms, with most in the form of modules.[288] During the POI, imported and U.S.-manufactured CSPV products were sold across a range of wattages and conversion efficiencies, and modules were sold in 60- and 72-cell forms.[289] Domestic producers pioneered certain CSPV technologies,[290] and they have continued to innovate, develop, and manufacture leading-edge products.[291]

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[284] CR at V-1; PR at V-1.

[285] Conversion efficiency is the percent of sunlight that is converted into electricity. CR at I-19; PR at I-14.

[286] For example, SolarPro's 2017 module specifications identified multicrystalline modules with 72 or more cells with efficiencies of 15.2 to 17.8 percent compared to efficiencies of 15.5 to 21.5 percent for monocrystalline modules. CR/PR at Figure I-5; CR at I-19; PR at I-14; *see also* CR/PR at Figure I-4 (indicating that the median efficiency of modules installed in U.S. residential systems increased from 15.3 percent in 2012 to 16.7 percent in 2015, and that the median efficiency of multicrystalline modules (the only type for which separate data were available) installed in residential systems increased from 14.5 percent in 2012 to 16.0 percent in 2015).

[287] Power output for 60-cell multicrystalline modules commonly ranges from 240 to 290 watts, whereas output for 60-cell monocrystalline modules commonly ranges from 260 to 320 watts; SolarPro's 2017 module specifications identified an average of power output of 319 watts for 72-cell multicrystalline modules and 340 watts for 72-cell monocrystalline modules. CR at I-21; PR at I-14.

[288] CR/PR at Table II-4 (imported forms), Table III-11 (U.S.-manufactured forms).

[289] CR/PR at Table V-11; CR at I-19 to I-21; PR at I-13 to I-16. The same was true during the periods examined during the antidumping and countervailing duty investigations which overlapped with the POI here. Products of particular wattages or cell counts were not limited to a single segment of the U.S. market. *CSPV I*, USITC Pub. 4360 at 27-28, 31-32; *CSPV II*, USITC Pub. 4519 at 35-37, 41-42, 47.

[290] *See, e.g.*, Injury Hearing Tr. at 89-90, 94-98, 103, 108-109, 114-116, 143, 220-223.

[291] *See, e.g*., CR/PR at Table III-2, Table III-6; CR at III-9 to III-17, III-22; PR at III-5 to III-10; SolarWorld's Posthearing Injury Brief at 10-11; Injury Hearing Tr. at 88, 90 (Stein); SolarWorld's Prehearing Injury Brief at 52-55; Suniva's Posthearing Injury Brief at 7-8, Exhibit 9 at 4. For example, SolarWorld was one of the earliest producers of monocrystalline products and the first producer of monocrystalline PERC products, and petitioners observe that the market now is strongly moving to monocrystalline PERC products, where SolarWorld is a recognized leader. SolarWorld's Posthearing Injury Brief at 9, 10, Exhibit 1, section I at 1, section II at 9, Exhibit 9; Injury Hearing Tr. at 220-21 (Stein), 222 (Card). SolarWorld also developed the p-type PERC bifacial cell in 2015, the next level of innovation that increases energy yield at the system level and has a greater impact on the cost of the delivered energy. SolarWorld increased the power of its 60-cell modules by approximately 10 watts per year from 240 watts in 2011 to 300 watts currently. SolarWorld also developed or patented several cell (Continued…)

In an attempt to differentiate itself from large volumes of low-priced imports, SolarWorld reports that it shifted from producing multicrystalline products to higher-end, more efficient monocrystalline products. SolarWorld quickly encountered competition from lower-priced imported monocrystalline products as well.[292] Petitioners report that U.S. importers not only quickly moved up the value chain from multicrystalline to monocrystalline products but also now offer bifacial and hybrid products as well.[293]

Some respondents argued that certain CSPV products were only available from foreign suppliers, such as monocrystalline n-type interdigitated back contact ("IBC") products (Sunpower), n-type technology with back-contact solar cells with double-side cell structure (LGE), or commercial-scale multicrystalline modules with rear-side passivated cells (Hanwha Q), and did not compete with products manufactured by the domestic industry.[294] While certain foreign producers may produce CSPV products that are unique or unavailable from other sources,[295] available evidence indicates that these products accounted for only a small share of the U.S. market for CSPV products and that there was more overlap between U.S. and imported specialized CSPV products than acknowledged by respondents. As of 2016, n-type

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innovations to increase module power using the same materials, resulting in substantial cost reductions, including ***. SolarWorld was among the first manufacturers to implement statistical process control to ensure higher product quality and improve production yields, thereby reducing costs. SolarWorld's Posthearing Injury Brief at Exhibit 1, section I at 1-2. SolarWorld reports that it also was the first to market with a number of other innovations intended to enhance product reliability. SolarWorld's Posthearing Injury Brief at Exhibit 1, section I at 3-4, Exhibit 10; Injury Hearing Tr. at 106. Suniva also identified a number of innovations that the firm made throughout its history and the technology changes it implemented during the POI to remain competitive. Suniva's Posthearing Injury Brief at Exhibit 9 at Question 6.

[292] SolarWorld's Prehearing Injury Brief at 53. SolarWorld reported that low-priced imports compelled it to ***. *See, e.g.*, CR/PR at Table III-2.

[293] SolarWorld's Prehearing Injury Brief at 54-55. Bifacial cells convert sunlight that hits both the front and back of the CSPV cell into electricity. Whereas most CSPV cells have a metalized back layer, bifacial cells allow light through to the back side of the CSPV cell. They often incorporate either PERC or heterojunction technologies. When incorporated into modules, they use a transparent back sheet or rear glass layer to allow sunlight to pass through to the rear of the CSPV cell. Hybrid (heterojunction) cells include thin layers of photosensitive semiconductor materials (typically amorphous silicon) on top of a monocrystalline wafer. CR/PR at Figure I-16; CR at I-46 to I-49; PR at I-34 to I-37.

[294] *See, e.g.*, Sunpower's Prehearing Injury Brief at 3-5, 19-20; Hanwha America's Prehearing Injury Brief at 10-15, 18-19; KOPIA's Injury Prehearing Brief at 19-23.

[295] Several purchasers and one importer reported that certain types of products were only or primarily available from non-U.S. sources. For example, several purchasers stated that the higher efficiency modules are manufactured primarily in Asia and are not available from any U.S. producers. Six purchasers reported that multicrystalline PERC CSPV products are primarily only available in Taiwan, Korea, Japan, China, and Malaysia. Two purchasers stated that n-type monocrystalline CSPV products are only available from LG Electronics in Korea. CR at V-21; PR at V-15. Three importers and one purchaser reported that interdigitated back contact solar CSPV products are not manufactured in the United States and are not interchangeable with front-contact CSPV products. CR at V-24; PR at V-16.

monocrystalline cells accounted for less than 5 percent of global CSPV cell production,[296] and there were a relatively small number of manufacturers of these products, including LG, Panasonic, SunPower, and Yingli.[297] Moreover, contrary to respondents' assertion, there was domestic production of n-type monocrystalline CSPV products in the United States during the POI.[298] Indeed, despite the closures of numerous domestic producers and the inability of a number of domestic producers to generate adequate capital to finance facility expansions or upgrades or research and development efforts discussed earlier, the domestic industry supplied a wide variety of monocrystalline and multicrystalline products that overlapped with imported CSPV products, including CSPV products with 2, 3, 4, and 5 busbars,[299] PERC products (including ***),[300] frameless (glass-glass) modules,[301] heterojunction cells,[302] bifacial products,[303] and

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[296] Whereas most monocrystalline CSPV wafers are p-type wafers where the silicon is doped with boron, n-type wafers are manufactured by doping the silicon with phosphorous to create a negative electrical orientation. In the cell production process, a positive layer is added to create the p/n junction. These n-type cells can be more expensive to manufacture, but they benefit from higher conversion efficiencies and no light-induced degradation, and they can be manufactured from wafers that are less pure. CR at I-29, I-43 to I-44; PR at I-21, I-32 to I-33.

[297] CR at I-44; PR at I-32; CR/PR at Figure I-16.

[298] Mission Solar opened its n-type monocrystalline photovoltaic cell production line in 2014, ***, and closed the CSPV cell production line in September 2016 ***. CR at III-9 to III-10; PR at III-5 to III-6.

[299] Many manufacturers are increasing the number of the busbars (the wider metal strips that carry electricity from the thin metal strips on the solar cells to the junction box) in CSPV cells to yield higher efficiencies and greater power output. Three-busbar cells accounted for slightly more than half the global market in 2016, down from more than 80 percent in 2014. Four or more busbar cells accounted for more than 40 percent of the market in 2016 and are forecast to account for close to 60 percent of the global market in 2017. Five busbar cells accounted for less than 10 percent of the global market in 2016, but are also forecast to gain market share in 2017. CR at I-49 to I-50; PR at I-36.

[300] PERC cells incorporate an additional rear dielectric layer that reflects light that did not generate electricity as it initially passed through the CSPV cell back into the CSPV cell, providing an additional opportunity for the CSPV cell to absorb this light. PERC cells have a higher efficiency and improved performance compared to other CSPV cells in certain conditions, such as low-light and high-heat conditions. PERC and related technologies accounted for more than 10 percent of the global market in 2016, and their production (particularly of monocrystalline PERC) is expected to significantly increase in the next few years, with one estimate projecting more than 15 GW of global PERC production in 2017. SolarWorld was the first company to commercialize PERC production, with Sunrise Global, Hanwha QCells, and REC also starting commercial production relatively early. Among module suppliers listed by Taiyang News, SolarWorld has the highest monocrystalline PERC production efficiency (at 21.6 percent), followed by Trina (21.12 percent) and Tainergy and Talesun (21.1 percent), though a number of suppliers have only slightly lower efficiencies. Trina has the highest multicrystalline production efficiency among module suppliers listed by Taiyang News (19.86 percent), followed by HT-SAAE (19.8 percent), and Astronergy and Suntech (19.7 percent). CR at I-44 to I-46; PR at I-33 to I-34.

[301] Some photovoltaic modules do not use a frame, which reduces costs. These typically use a glass as the rear layer to ensure mechanical stability. Frameless modules account for less than 5 percent of the global market. CR at I-51; PR at I-38.

hybrid CSPV products.[304] Even Hanwha Q concedes that its multicrystalline modules with rear-side passivated cells are "similar to PERC technology."[305] Additionally, the pricing data reflect that the domestic industry and importers of CSPV products generally reported sales of CSPV products within similar efficiency and wattage ranges.[306] Moreover, despite the existence of some variations in product offerings between imports and U.S.-manufactured CSPV products,

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[302] Heterojunction cells, which include heterojunction with intrinsic thin layer ("HIT"), add thin layers of photosensitive semiconductor materials (typically amorphous silicon) on top of a monocrystalline wafer. These additional layers increase the absorption of sunlight, and the overall efficiencies of the CSPV cells. They also perform better in hot climates than typical monocrystalline cells. They are more expensive to produce and are difficult to scale up to commercial production, however, so only a few companies currently manufacture this technology. Panasonic was the first large-scale producer of heterojunction cells globally and held many of the key patents related to heterojunction technology until they expired in 2010. Other companies with production of heterojunction cells include BenQ Solar, Ecosollifer, Hevel, Kaneka, Sunpreme, and Tesla. Solartech Universal assembles modules from heterojunction cells. Meyer Burger also offers a turnkey production line for heterojunction cells. Heterojunction cells account for less than 5 percent of the global market. CR at I-47 to I-48; PR at I-35.

[303] As indicated earlier, bifacial cells convert sunlight that hits both the front and back of the CSPV cell into electricity, and they often incorporate either the PERC or heterojunction technologies discussed above. Bifacial cells increase energy production, but are also more expensive to manufacture. The extent to which energy production increases depends in part on the characteristics of the surface below the installed modules. As of early 2017, bifacial modules were commercially available in the U.S. market from about eight companies, including LG, Lumos Solar, Mission Solar, Prism Solar, Silfab, SolarWorld, Sunpreme, and Yingli Solar. Despite the relatively limited number of current suppliers, ***. Globally, bifacial modules accounted for 1 to 2 percent of the global module market in 2015 but the market share was projected to grow in the next five years. CR/PR at Figure I-16; CR at I-47 to I-49; PR at I-35 to I-36.

[304] *See, e.g.*, CR at III-9 to III-17, III-22; PR at III-5 to III-11; CR/PR at Table II-5 (imported technologies), Table III-2, Table III-6 (U.S.-manufactured technologies). Among the larger U.S. importers, ***, which accounted for *** percent of total CSPV product imports, respectively, reported imports of monocrystalline and multicrystalline CSPV products. ***, which accounted for *** percent of total U.S. CSPV product imports also reported monocrystalline and multicrystalline CSPV products as well as hybrid CSPV products. ***, which accounted for *** percent of total CSPV product imports, reported imports of monocrystalline and multicrystalline as well as PERC CSPV products. CR at II-16; PR at II-14.

[305] Hanwha America's Prehearing Injury Brief at 10-11.

[306] CR/PR at Table V-11; CR at V-33; PR at V-22. On May 1, 2014, the U.S. Department of Justice indicted members of China's People's Liberation Army for unauthorized access to SolarWorld's computer network. The indictment included allegations of corporate espionage and theft of intellectual property. Injury Hearing Tr. at 234-35 (Brightbill); *see also, e.g.*, Suniva's Posthearing Remedy Brief at 25-27, Exhibit 12; SolarWorld's Posthearing Remedy Brief at 3, 4, Exhibit 51, Section XVII; https://www.justice.gov/iso/opa/resources/5122014519132358461949.pdf.

all CSPV products convert sunlight into electricity, and CSPV products made from different technologies compete with each other on the basis of electrical output and cost.[307]

As further evidence that the domestic industry supplied quality products during the POI, SolarWorld reported that it was the first to offer a 25-year warranty, a 30-year warranty, and a 20-year workmanship warranty, which it was able to do given that its warranty rate was far lower than many other producers.[308] Most U.S. producers, importers, and purchasers reported that U.S.-produced CSPV products were interchangeable with imported CSPV products.[309] Additionally, independent research firm EuPD Research ranked SolarWorld as the most purchased brand by U.S. installers and the *** recommended brand by U.S. installers.[310] Furthermore, most purchasers reported that no domestic or foreign supplier had failed in its attempt to qualify product or had lost its approved status since 2012.[311]

Respondents also argue that domestic producers were not "bankable" for large-scale commercial and utility purchases and lacked "Tier 1" status on the Bloomberg BNEF Tier 1 list.[312] Although they acknowledge that the industry has no standard definition of bankability,[313] respondents contend that it includes factors such as "creditworthiness" and performance of the product over time and may vary from project to project or customer to customer.[314] In their

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[307] Respondents' arguments are inconsistent with their statements, discussed below, that competition occurs between CSPV products and other conventional or renewable sources of electricity (such as natural gas and thin film).

[308] SolarWorld's Posthearing Injury Brief at 6-7, Exhibit 1, section I at 2-3, section II Suniva's Posthearing Injury Brief at Exhibit 9 at 5; Injury Hearing Tr. at 106-107. Suniva reported that its warranty claim rate was below 0.05 percent. Injury Hearing Tr. at 103.

[309] CR/PR at Table V-8.

[310] SolarWorld's Posthearing Injury Brief at Exhibit 1, section II at 5-8; Injury Hearing Tr. at 107.

[311] Nineteen of 95 responding purchasers reported that a domestic or foreign supplier had failed in its attempt to qualify product or had lost its approved status since 2012 for reasons such as customer service, financial strength, broken commitments, cell cracks, use of thinner frame, quality control, bankability, failed audit, efficiency, delivery rates, and prefer local manufacturer. Three purchasers stated that both SolarWorld and Yingli had lost their approved status due to financial distress. CR at V-22; PR at V-15.

[312] SunPower's Posthearing Injury Brief at Appendix at vii-viii; SEIA's Posthearing Injury Brief, Appendix A, Question 30; SEIA's Prehearing Injury Brief at 72; Hanwha America's Prehearing Injury Brief at 39-41; CCCME's Posthearing Injury Brief at 10.

[313] At a minimum, bankability encompasses both the financial viability of a supplier and the product's performance reliability, especially in the CSPV industry where manufacturers provide warranties of 25 years or longer on their products; bankability also allows installing firms to apply for non-recourse loans for their solar development projects. In the *CSPV I* investigations, one U.S. producer reported that producers in China were seen as more "bankable" because of ease of access to credit from "state-owned" banks, low risk of bankruptcy, and ability to fulfill warranties. *See, e.g.*, *CSPV I*, USITC Pub. 4360 at 11 n.84, 27-28.

[314] More specifically, respondents argue that Suniva failed to qualify as a Tier 1 supplier, which precluded the firm from supplying major utility projects, and a $676 million judgment against SolarWorld's German parent for breach of its contract with Hemlock Semiconductor under four take-or-
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questionnaire responses, however, purchasers did not identify "bankability" as one of their "top three" purchasing factors,[315] and only three of 56 responding importers indicated that developers, installers, and project owners chose module suppliers with high bankability that are listed as Tier 1 suppliers.[316] Even Bloomberg cautions banks and module producers against relying heavily on its list.[317] Moreover, SolarWorld (***) qualified as a Bloomberg Tier 1 supplier in 2014, 2015, all of 2016, and through February 2017;[318] its subsequent loss of bankability provides added confirmation of the serious injury substantially caused by increased imports.[319]

Respondents also allege that domestic producers focused their business models on the higher-profit residential and commercial segments of the U.S. market and until recently did not seek to compete for lower-margin, higher-volume utility sales (the bulk of which were greater than 20 MW projects in 2016), even though utilities were the fastest-growing segment that accounted for the largest share of the market.[320] Respondents also report being unaware of any domestic producer that is able "to provide the required combination of product type and

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pay long-term supply agreements for polysilicon harms SolarWorld's financial reputation and bankability among potential purchasers. SunPower's Posthearing Injury Brief at Appendix at vii-viii; SEIA's Posthearing Injury Brief, Appendix A, Question 30, Question 43; SEIA's Prehearing Injury Brief at 72, 91-92, Exhibit 86; Hanwha America's Prehearing Injury Brief at 3, 39-41, 44-47; CCCME's Posthearing Injury Brief at 10 (citing Injury Hearing Tr. at 263 (Lamon)); 8minutenergy Renewable's Prehearing Injury Submission at 20-21.

[315] Purchasers reported price (81 firms), quality/performance (77 firms), and availability (42 firms) as important purchasing factors, with bankability a distant fourth (15 firms). CR/PR at Table V-4.

[316] CR at V-25; PR at V-17.

[317] SolarWorld's Posthearing Injury Brief at 8; Suniva's Posthearing Injury Brief at 6, Exhibit 9 at Question 15.

[318] Indeed, during *CSPV I*, respondents even acknowledged that the major U.S. producers were bankable. *CSPV I*, USITC Pub. 4360 at 28.

[319] SolarWorld's Posthearing Injury Brief at 2, 7-8, Exhibit 1 section II at 9-10; Injury Hearing Tr. at 144 (Stein) (also explaining that the Hemlock Semiconductor judgment involves a subsidiary of SolarWorld's parent and has "nothing to do with SolarWorld Americas."). According to Suniva, to qualify for Tier 1 status, a producer would need to demonstrate that it had supplied modules to at least six different projects that were financed by non-recourse debt from six different banks in the preceding two years. Suniva reported that "the unrelenting pressure of low-priced imports" forced it out of the utility segment and necessitated that the firm shift its focus to projects that did not rely on such non-recourse loan funding, which implicated the firm's ability to achieve Tier 1 status. Suniva's Posthearing Injury Brief at Exhibit 9 at Question 15.

[320] SEIA's Prehearing Injury Brief at 19-23; Hanwha America's Prehearing Injury Brief at 7-8, 33-41 and Exhibit 26; SEIA's Posthearing Injury Brief at 6-7 (citing Injury Hearing Tr. at 163-64 (Card), 325 (Grace), Appendix A at 126-127, Question 13; 8minutenergy Renewables' Posthearing Submission at 2-7.

demonstrated product performance" demanded by utilities.[321] The vast majority of CSPV modules sold in the U.S. market are connected to the electricity grid.[322] As discussed earlier in these Views, there are three broadly defined grid-connected market segments – residential,[323] commercial,[324] and utility[325] – although the segments overlap somewhat.[326] Since 2009 – the first year of the period examined in the *CSPV I* antidumping and countervailing duty investigations – there has been a shift in the distribution of sales among the three market segments. In 2009, the commercial segment accounted for the largest share of the market, followed by the residential and utilities segments,[327] whereas throughout the 2012 to 2016 POI

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[321] SunPower's Posthearing Injury Brief at Appendix at xviii-xix; KOPIA's Posthearing Injury Brief at Exhibit 2; 8minutenergy Renewables' Posthearing Injury Submission at 12-13, Exhibit 17; Injury Hearing Tr. at 325.

[322] CR at V-1; PR at V-1; Injury Hearing Tr. at 185-86 (Card, Messer).

[323] In the residential segment, CSPV systems are installed at individual homes, typically on the roof or sometimes mounted on the ground. These systems may use a central inverter that connects to multiple modules or a microinverter attached to each module to convert direct current to the alternating current used in the grid. Homeowners use energy from the grid when solar electricity generated by their residential system is insufficient to meet demand and often feed energy back into the grid when the system generates more than the home uses. CR at I-33; PR at I-25. Many installers of residential systems offer financing options to the customers, and some also offer customers the option to lease or purchase the power from the system (known as third-party ownership) instead of buying the system. CR at I-39 to I-40; PR at I-29 to I-30.

[324] Nonresidential systems are installed at commercial, industrial, government, and similar buildings and sites. They function similarly to residential installations, providing electricity to meet on-site needs, pulling additional electricity from the grid when needed, and feeding excess electricity back into the grid when not needed. CR at I-34 to I-35; PR at I-26. Many commercial installers offer financing and third-party ownership options to customers. CR at I-40; PR at I-30.

[325] Utility systems provide electricity directly to the grid instead of using the electricity on-site. These systems are generally ground-mounted and tend to use central inverters rather than microinverters. These systems may utilize fixed-tilt, single-axis tracking (panels rotate to follow the east-west movement of the sun) or dual-axis tracking that also rotates to follow the north-south movement of the sun during the year). Between 2012 and 2015, 72 percent of installed systems larger than 5 MW used tracking, with most using single-axis tracking. Prior to 2012, most U.S. utility installations involved 600 volts, but higher-voltage (1,000-volt) systems became increasingly common between 2012 and 2016, and by the end of this period, 1,500-volt systems were introduced in the U.S. market. These higher-voltage systems use fewer balance of system components, require less installation time, reduce electricity losses, and lead to higher inverter efficiencies, resulting in lower energy costs. CR at I-35 to I-36; PR at I-27.

[326] For example, many nonresidential installers also install residential CSPV systems, and what some consider to be a large commercial installation might qualify as a utility installation to others. *See, e.g.*, CR at I-34, I-39; PR at I-24, I-29.

[327] *CSPV I*, USITC Pub. 4360 at 29 n.258, Figure II-1 (identifying shipments to the commercial segment of 241,520 GW in 2009 compared to 195,391 GW for the residential segment, and 30,407 GW for the utility segment).

in the instant safeguard investigation, utilities were the largest segment of the U.S. market,[328] followed by the residential and commercial segments.[329] All three on-grid segments experienced considerable growth in both the number of installations and the total wattage of installation projects during the POI.[330]

During the POI, the domestic industry and importers each sold CSPV products in the U.S. market to distributors,[331] residential and commercial installers, and the utility segment.[332] Imported and U.S.-manufactured CSPV products also were sold in similar channels of distribution to overlapping segments of the market.[333] Installation size varies by segment, but the size of installations generally has grown over time in each segment.[334] The installers in the residential[335] and commercial segments[336] are more fragmented than the project developers

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[328] In 2016, 10.6 GW of photovoltaic products was installed in the utility segment (including thin film), compared to 2.6 GW in the residential segment, and 1.6 GW in the commercial segment. CR at I-39; PR at I-29; CR/PR at Figure V-1.

[329] CR/PR at Figure V-1.

[330] Residential installations increased by 423 percent between 2012 and 2016, and utility installations increased by 488 percent. CR at V-1 to V-2; PR at V-1 to V-2; CR/PR at Figure V-1.

[331] Distributors typically sell CSPV products into the residential and commercial market, including to installers, although Suniva reported that some of its sales to distributors served the utility segment. CR at I-37 at nn.99, 100; PR at I-29 at nn.99, 100.

[332] CR at I-37 to I-38; CR/PR at Table I-1; PR at I-28. Domestically produced CSPV cells are typically consumed to produce solar modules by U.S. producers, although a minor amount were sold to firms that fabricate modules or panels. CR/PR at Table I-1.

[333] CR/PR at Table I-1; CR at I-15; PR at I-11.

[334] According to the U.S. Energy Information Administration ("U.S. EIA"), the average size of a residential photovoltaic system (including thin film) is 5 kW, whereas commercial installations average 200 kW, and utility projects are defined as those having a capacity of 1 MW and above. CR at V-2 n.7; PR at V-1 n.7. According to NREL, the median size of residential installations increased from 5.5 kW in 2012 to 6.1 kW in 2015; the median size of non-residential installations 500 kW or less was 31 kW in 2015 but may be substantially larger, with NREL (which uses a different definition of utility systems than the U.S. EIA) reporting a median size of 1.1 GW for systems 500 kW or greater. Between 2012 and 2016, the median size of utility projects was 4.9 MW and the mean size was 17.15 MW. CR at I-33 to I-35; PR at I-24 to I-27. According to the U.S. EIA, the average utility project increased from 10 MW in 2014 to more than 17 MW in 2016, and according to respondent SEIA, 82 percent of utility installations in 2016 were greater than 20 MW, and 13 percent were less than 10 MW. CR at V-3 at n.10; PR at V-2 at n.10.

[335] According to one survey, the median volume installed by a residential installer in 2016 was 500 kW. In 2015, there were several thousand residential solar installers, most of which were relatively small firms, but several larger firms operated in multiple states, with the top three installers accounting for 48 percent of U.S. residential installations in the second quarter of 2016. CR at I-39; PR at I-29. By comparison, in 2012, there were more than 2,000 active residential installers in the U.S. market, with the top six firms collectively accounting for less than one-third of the U.S. market. *CSPV II*, USITC Pub. 4519 at II-5.

[336] In 2015, there were over 1,000 commercial installers, many of which also installed residential systems. The majority of them were small, with one survey reporting median installations of 285 kW for commercial installers in 2016. The top three commercial installers accounted for about 26 percent of (Continued…)

and the engineering, procurement, and construction ("EPC") firms in the utility segment.[337] The utility segment is acutely price sensitive, often involving a bidding process by which project developers or EPC firms submit bids, and once the contract has been awarded, the project developer or EPC enters into a supply agreement with a manufacturer to source the CSPV modules.[338] Utility bids often involve price renegotiations throughout the project.[339]

Although the vast majority of the domestic industry's shipments went to residential and commercial installers throughout the POI,[340] SolarWorld and Suniva each provided information indicating that they competed for and shipped to the utility segment of the market. SolarWorld reported that it currently is capable of supplying modules for projects up to ***, and that it has sold up to *** of modules for a single project during the POI.[341] Suniva reported servicing the "small utility market" during the POI.[342] SolarWorld provided a list of *** projects for the utility segment totaling *** that it bid on during the period, of which it won *** projects totaling ***. SolarWorld also supplied an additional *** of modules to customers for utility projects through supply agreements with various companies.[343] Suniva provided a list of *** winning bids in the utility segment, which totaled *** during the POI.[344] Thus, the domestic industry sold or tried to sell CSPV products to utilities throughout the POI in addition to the residential and commercial segments, but was frequently unable to win large bids in this segment. Moreover, the domestic industry lost market share to imports regardless of the segment.[345]

(…Continued)
the U.S. commercial market in 2015, whereas the top five firms accounted for less than 25 percent of installations by wattage in 2012. CR at I-40 to I-41; PR at I-29 to I-31; *CSPV II*, USITC Pub. 4519 at II-5.

[337] Developers of utility projects include firms whose primary business is project development; firms that produce equipment (*e.g.*, modules) and develop projects; unregulated entities related to major utility companies; other independent power producers that primarily produce electricity for sale in the wholesale market; utilities; and other firms. Project developers may perform EPC services, or large contractors often handle these services. The top nine utility project developers in 2016 accounted for a combined 70 percent of the utility market in 2016, and the top nine EPC firms accounted for 69 percent of the market. CR at I-41; PR at I-30. By comparison, the top five utility project developers accounted for 59 percent of U.S. projects completed in 2012. *CSPV II*, USITC Pub. 4519 at II-5 to II-6.

[338] CR at V-3 to V-4; PR at V-2 to V-3.

[339] For example, NRG, one of the largest independent power producers in the United States whose projects can reach 200 MW in size, reported that it specifies the design of a module required for a utility project three years in advance of construction, solicits requests for proposals approximately 12 months from construction, and makes its final module selection no later than 6 months prior to the start of construction. CR at V-4 at n.15; PR at V-4 at n.15.

[340] CR/PR at Table I-1.

[341] SolarWorld's Posthearing Injury Brief, Exhibit 1 at 23-26.

[342] Injury Hearing Tr. at 100-101, 165 (Card); Suniva's Posthearing Injury Brief, at Exhibit 9 at 1-2, Attachment A.

[343] SolarWorld has supply agreements with EPCs such as DEPCOM and Borrego, and therefore has limited information on specific bid proposals for which its modules were used. SolarWorld's Posthearing Injury Brief at Exhibit 1 at 22-23.

[344] Suniva's Posthearing Injury Brief, Exhibit 9 at 1-2, Attachment A.

[345] CR/PR at Table I-1, Table C-4.

Respondents also allege that the domestic industry was either unable to produce or lacked sufficient capacity to produce 72-cell modules, which, along with thin film, they contend became the standard for utility installations by 2013-2014.[346] Residential and smaller commercial installations typically use 60-cell modules due to their higher conversion efficiency and smaller size, whereas the majority of utility projects now use 72-cell modules that are typically less expensive to install due to lower labor and balance of system costs per kW installed.[347] Utilities previously also purchased 60-cell modules, including 60-cell monocrystalline modules.[348] Contrary to respondents' arguments, the record showed that the domestic industry sold both 60-cell and 72-cell modules throughout the POI and lost market share to imports for both types of modules, accounting for *** percent of U.S. shipments of 60-cell modules and *** percent of U.S. shipments of 72-cell modules in 2016.[349] SolarWorld reported that *** it added a 72-cell module assembly line to its U.S. facilities in 2016 due to increasing demand in the utility market.[350] Suniva devoted 45 percent of its cell manufacturing capacity to 72-cell modules to serve the commercial and "small utility" market during the POI.[351] Moreover, the domestic industry consistently supplied monocrystalline modules, which as noted above convert sunlight more efficiently than multicrystalline products.[352] Purchasers do not generally specify whether they want monocrystalline or multicrystalline CSPV products, and since both technologies were sold in all segments of the U.S. market, prices of multicrystalline CSPV products affected prices of monocrystalline products and *vice versa*.[353]

Thus, the evidence indicates that the domestic industry clearly sought to compete in the large, concentrated, and price-sensitive utility market, but the large volume of imports at low and declining prices adversely impacted the domestic industry's financial performance, making it difficult for the domestic industry to increase capacity to a scale that made it more

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[346] SEIA's Posthearing Injury Brief, Appendix A, Question 13, Question 14 (acknowledging that Suniva manufactured 72-cell modules early but lacked large-scale capacity and arguing that SolarWorld was very late to manufacture them and instead imported them from its affiliates). SEIA argues that SolarWorld delivered 72-cell modules made in Thailand for a utility project in Oregon that specifically requested U.S.-manufactured modules. SEIA's Posthearing Injury Brief at 7, Exhibit 88.

[347] CR at V-1; PR at V-1.

[348] Respondents acknowledge that, at the beginning of the POI, 60-cell modules predominated in all three segments, but they argue that the utility segment shifted to 72-cell modules to reduce balance of system costs. *See, e.g.*, 8minutenergy Renewable's Prehearing Injury Brief at 5, 10-14; *CSPV I*, USITC Pub. 4360 at 38.

[349] CR/PR at Table C-5 (market share); CR/PR at Table V-11 (pricing data).

[350] SolarWorld's Posthearing Injury Brief at 10; Injury Hearing Tr. at 108.

[351] Injury Hearing Transcript at 100-101, 164 (Card).

[352] CR/PR at Table V-11. Indeed, the market is moving towards monocrystalline and PERC products. *See, e.g.*, Injury Hearing Tr. at 109.

[353] *See, e.g.*, *CSPV II*, USITC Pub. 4519 at 36, 41; SolarWorld's Posthearing Injury Brief at 4-5; Suniva's Prehearing Injury Brief at 47-51; Suniva's Posthearing Injury Brief at 4, Exhibit 9 at Question 4; Injury Hearing Tr. at 108-109.

competitive in this segment, even if it managed to develop and even pioneer innovative products that utilities and others sought.

Respondents also argued that the domestic industry had delivery and service issues or failed to compete for certain sales.[354] Petitioners responded to these allegations, often with detailed explanations.[355] The evidence simply does not support the sort of widespread problems alleged by respondents.[356]

Thus, the record does not support respondents' contentions that the domestic industry was unable to provide quality products, failed to serve certain segments of the market, or suffered widespread delivery and service issues.

2. Factors Other Than Imports That Allegedly Led to Price Declines

Respondents argued that factors other than imports, such as declining government incentive programs, declining polysilicon raw material costs, and the need to meet grid parity with other sources of electricity, explain any declines in prices of CSPV products and the condition of the domestic industry.

We do not find that changes in incentive programs explain the domestic industry's condition, although we recognize that changes in the availability and scope of Federal, state, and local government incentives and regulations continue to affect the price of and demand for

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[354] SEIA's Posthearing Injury Brief, Appendix A at 114-120, Question 30, Question 31, Question 33. SEIA's Prehearing Injury Brief at 72, 82-90 (alleging quality issues with Suniva's products and delivery delays). Respondents argue that SolarWorld ***, and they cite instances where SolarWorld supplied imported instead of U.S. products, supplied ***, ***, or recalled over 1.5 million solar panel systems. SEIA's Prehearing Injury Brief at 91-95; SEIA's Posthearing Injury Brief at 9-10.

[355] For example, SolarWorld reports that much of the delivery delays discussed by NEXTracker at the hearing resulted from NEXTracker's ***, any alleged product specification issues with NEXTracker resulted from NEXTracker's ***, and contrary to NEXTracker's testimony, NEXTracker never notified SolarWorld that it had removed SolarWorld as an approved vendor, NEXTracker's website still lists SolarWorld as an approved vendor, and SolarWorld continues to supply NEXTracker projects. SolarWorld's Posthearing Injury Brief at Exhibit 1, section II at 8, 10-13, Exhibits 12-16. SolarWorld also provided documentation responding to allegations regarding transactions with DEPCOM, California Solar System, Borrego, and SunRun. SolarWorld's Posthearing Injury Brief, Exhibit 1, section II at 14-20, Exhibits 17-25; *see also* Suniva's Posthearing Injury Brief at 5-6; Injury Hearing Tr. at 107.

[356] For example, Sunrun reported that both SolarWorld and Suniva refused to participate in the Sunrun Vendor Quality Management Program, thereby preventing Sunrun from approving them for systems financed by investors. SolarWorld reported that it chose not to participate in the program because Sunrun required SolarWorld to release its bill of material, which is SolarWorld's intellectual property. Suniva stated that it participated in preliminary stages of negotiation with Sunrun but determined that the two firms were too far apart on price and therefore it did not make sense for Suniva to spend the money to go through the qualification process. CR at V-22 to V-23; PR at V-15; Injury Hearing Tr. at 239-40 (Messer), 241 (Card), 269-72 (Fenster).

CSPV products.[357] These incentives offset the cost of generating solar or other renewable energy, mandate its use, or otherwise influence its price, thereby stimulating demand for renewable energy-generated electricity and assisting developers of solar power and other renewable energy sources to achieve sufficient economies of scale to become more competitive with conventional sources of electricity.[358] These mechanisms benefit systems owners, and typically are not directed at any particular domestic or foreign manufacturer of CSPV products.[359] These incentives and their benefits were designed to decline over time, with the expectation that the cost to generate solar-powered electricity would also fall.[360]

Although some programs have expired, others continue. Most questionnaire respondents reported that the level or availability of Federal incentives has changed since 2012. Between 2015 and 2016, U.S. installations of on-grid photovoltaic systems (which include thin film) increased 97 percent. This growth, primarily in the utility segment, was driven by the anticipated December 2016 expiration of the 30 percent Federal Investment Tax Credit;[361]

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[357] CR at V-10, V-50; PR at V-6. Government incentives designed to lower the cost of solar project development include various tax credits, revenues from the sale of solar renewable energy certificates, cash grants in lieu of credit, accelerated depreciation, and loan guarantees, of which tax credits were the most common form of Federal incentives. In some states, the Public Utility Regulatory Policies Act of 1978, which requires utilities to purchase electricity from qualifying facilities (renewable projects that meet size requirements) at the utility's avoided cost, has led to the development of more solar projects for the utility segment. Renewable portfolio standards, a widespread state regulatory measure, mandate that entities supplying electricity, such as utilities, generate or buy a portion of their retail electricity sales from renewable energy sources, including solar electricity, thereby increasing demand for CSPV products. States and utilities also encourage the installation of solar projects through renewable energy rebates, feed-in-tariffs, or net metering incentives. Renewable energy rebates refund a portion of the system installation costs to customers that install photovoltaic systems, whereas feed-in-tariffs pay solar electric generators a known rate for electricity fed into the grid over a period of 15 to 20 years. Under net metering, residential and commercial customers that generate their own solar electricity receive credit for excess electricity that they feed back to the grid, but utilities have lobbied against net metering policies on the basis that they reduce the number of ratepayers that are needed to cover the large costs of traditional power generation and grid maintenance. CR at V-51 to V-56; PR at V-31 to V-36.

[358] CR at V-51 to V-56; PR at V-31 to V-36; CR/PR at Table V-21; *CSPV II*, USITC Pub. 4519 at II-24 to II-28.

[359] CR at V-51; PR at V-31. The Advanced Energy Manufacturing Tax credit and the U.S. Department of Energy's section 1705 Loan Guarantee program were designed to provide direct financial assistance to U.S. manufacturers of U.S. CSPV products and other renewable energy sources, but have expired. The U.S. Department of Energy's SunShot Initiative continues to assist manufacturers of solar energy, including CSPV manufacturers, primarily in research and development initiatives. CR/PR at Table V-21.

[360] CR at V-52; PR at V-31 to V-33.

[361] CR at V-2; PR at V-2; CR/PR at Figure V-1. The Federal Investment Tax Credit provided a 30 percent tax credit on capital expenditures for new solar photovoltaic systems for the residential, commercial, and utility segments. CR/PR at Table V-21. The program was initially scheduled to expire (Continued…)

instead of allowing the program to expire, Congress extended it for several more years.[362] When asked how changes in the level of Federal incentives had changed demand for CSPV products since 2012, most firms reported that changes to Federal incentives had not changed demand for CSPV products; those that reported an increase in demand for CSPV products identified the level of Federal incentives as the reason for the increase, noting the extension of the Federal Investment Tax Credit.[363] Questionnaire respondents also reported that the U.S. Treasury Department's cash grant program under section 1603 of the Recovery and Reinvestment Tax Act expired in 2016.[364] Questionnaire respondents were divided on whether the level or availability of state and local incentives had changed since 2012,[365] but a plurality of them reported an increase in the demand for CSPV products due to the availability of state and local incentives.[366] Most questionnaire respondents reported that the availability of these incentives has led to a decrease in the price of solar-generated electricity, and several attributed the decline in the price of solar-generated electricity to the increase in supply of solar-generated electricity in the market place.[367] We find that the existence of these incentive programs has made CSPV products more cost-competitive with other sources of electricity. Moreover, any decline in incentives has not led to declines in apparent U.S. consumption. Instead, demand continued to experience robust growth throughout the POI, including in states most affected by changes in incentive programs, such as California.[368] Indeed, in 2016, solar power was the largest source of new electric generating capacity, accounting for 39 percent of all new electric generating capacity installed in the United States.[369]

(…Continued)
on December 31, 2007, but was repeatedly extended. *See, e.g.*, USITC Pub. 4360 at Table II-4 (noting possible expirations of December 31, 2007 and December 31, 2008); USITC Pub. 4519 at Table II-10 (noting that projects must be commissioned by end of 2015 for 30 percent tax credit); CR/PR at Table V-21 (noting that projects must be commissioned by the end of 2019 for 30 percent tax credit, 26 percent tax credit in 2020, 22 percent in 2021, and after 2021 residential drops to zero while commercial and utility drop to a permanent 10 percent and that projects commenced before December 2021 may still qualify for the Investment Tax Credit if they are placed in service before December 31, 2023).

[362] CR/PR at Table V-21.

[363] The largest share of responding producers, importers, and purchasers reported "no change" in how the availability of Federal government incentives affected demand for CSPV products, with the next largest share reporting that the availability of Federal government incentives "increased" demand for CSPV products since 2012. CR/PR at Table V-23; CR at V-57; PR at V-36.

[364] In lieu of the Federal Investment Tax Credit, the Treasury Department's section 1603 program provided cash grants of up to 30 percent of eligible capital expenditures for commercial solar projects. To qualify, the project needed to be under construction by the end of 2011 and completed by the end of 2016. CR at V-56; PR at V-35; CR/PR at Table V-21, Table V-22.

[365] CR/PR at Table V-22; CR at V-56 to V-57; PR at V-35 to V-36.

[366] CR/PR at Table V-23; CR at V-57; PR at V-36 (noting that U.S. producers, importers, and purchasers most often described state renewable portfolio standard mandates as a mechanism that increased demand for CSPV product installations).

[367] CR at V-57 to V-58; PR at V-35 to V-37.

[368] *See, e.g.*, CR at V-54 to V-60; PR at V-34 to V-38.

[369] CR/PR at Figure V-2; CR at V-11; PR at V-6.

We also considered the role of raw material costs in the price declines experienced during the POI. As we found above, raw materials account for the largest component of the total cost of goods sold for both CSPV cells and CSPV modules.[370] Raw material costs for CSPV modules, much of which is the cost of the CSPV cell, accounted for 84.9 percent of U.S. CSPV module producers' total cost of goods sold in 2016, up from 58.2 percent in 2012.[371] Raw material costs for CSPV cells accounted for *** percent of U.S. CSPV cell producers' total cost of goods sold in 2016, up from *** percent in 2012.[372] Polysilicon is a key raw material used in the production of the wafers that are used to manufacture CSPV cells and other high-tech products.[373] Historically, polysilicon costs have been volatile.[374] During the POI, the price of polysilicon ingots and wafers fluctuated but declined overall by 52.6 percent for ingots and by 54.5 percent for wafers.[375] Despite declining polysilicon costs, which would help make CSPV products more cost-competitive with other sources of electricity, declines in the domestic industry's net sales values kept pace with declines in its costs, leading to substantial losses throughout the POI.

Respondents also point to the need for CSPV products to attain grid parity to compete with electricity generated from other sources such as natural gas to explain declines in the price of CSPV products and the domestic industry's condition. A plurality of importers and purchasers reported that changes in the price of conventional energy have decreased the price of solar-generated electricity.[376] In addition, firms reporting that changes in the price of U.S. conventional energy have increased demand cited a positive relationship between electricity rates and the demand for PV systems and modules.[377] While conventional energy prices may account for some of the decrease in the prices of CSPV products in some years, they do not explain the consistent observed price declines over the 2012-2016 period.[378] The price of natural gas for electricity generation increased in the latter half of 2012 and 2013, peaked in February 2014, and declined to its lowest level in March 2016 after which it rose and is

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[370] CR at V-27; PR at V-18.

[371] CR/PR at V-27 to V-28; PR at V-18.

[372] CR/PR at V-27 to V-28; PR at V-18.

[373] CR at V-27; PR at V-18.

[374] In 2003, global supplies of polysilicon were inadequate to meet global demand by the semiconductor industry and particularly the CSPV industry, so spot prices of polysilicon rose from $35/kg in 2003 to a high of $500/kg in 2008 (and contract prices rose from $25/kg to $85/kg in this period). By 2008, global supply exceeded global demand, and polysilicon spot and contract prices then fell substantially to an estimated $35/kg by 2012. *CSPV I*, USITC Pub. 4360 at 28.

[375] CR/PR at Figure V-7. The majority of domestic producers (9 of 11) and importers (32 of 44) reported that prices of raw materials for CSPV products have declined since 2012. CR at V-28; PR at V-19.

[376] In contrast, most U.S. producers reported that changes in the price of U.S. conventional energy have not affected the price of solar-generated electricity since 2012. CR/PR at Table V-27.

[377] CR at V-62; PR at V-41 to V-42.

[378] As noted above, grid parity is based on the levelized cost of energy which during peak periods of demand is set by natural-gas generated electricity.

projected to increase. The domestic prices of CSPV products, on the other hand, decreased throughout the POI. As discussed above, questionnaire respondents point to large volumes of low-priced imports as the reason for price declines. Indeed, rather than changes in availability of incentive programs, changes in raw material costs, or the need to meet grid parity, foreign producers' own financial disclosures attribute the decline in prices of CSPV products to global excess capacity.[379]

We consequently conclude that the alternative causes cannot individually or collectively explain the serious injury to the domestic industry, particularly the declining market share, low capacity utilization levels, facility closures, and abysmal financial performance. Accordingly, we find that increased imports are a substantial cause of serious injury to the domestic industry manufacturing crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) that is not less than any other cause.

V. Findings Regarding Possible Exclusion of Certain Imports

If the Commission makes an affirmative determination of serious injury or threat thereof (or is equally divided on the issue), the statute requires the Commission to make a number of additional findings. The requirement for many of these findings originates in the implementing statutes for various FTAs that the United States has negotiated in the last two decades or under statutory provisions related to certain preferential trade programs.[380]

A. Findings Regarding NAFTA Imports

Under section 311(a) of the NAFTA Implementation Act, which implements article 802 of the NAFTA, if the Commission makes an affirmative determination or is equally divided on the question of injury, the Commission also must find whether

(i) imports of the article from a NAFTA country, considered individually, account for a substantial share of total imports; and

(ii) imports of the article from a NAFTA country, considered individually or, in exceptional circumstances, imports from NAFTA countries considered

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[379] Suniva's Posthearing Injury Brief at 5, Exhibit 2, Exhibit 9 at 10-11, Question 12; SolarWorld's Posthearing Injury Brief at Exhibit 32.

[380] Specifically, the Commission is required to make certain additional findings under the implementing statutes for NAFTA (Canada and Mexico), CAFTA-DR (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and the Dominican Republic), the U.S.-Australia Free Trade Agreement, KORUS, the U.S.-Colombia Trade Promotion Agreement, the Agreement between the United States of America and the Hashemite Kingdom of Jordan on the Establishment of a Free Trade Area, the U.S.-Panama Trade Promotion Agreement, the U.S.-Peru Free Trade Agreement, the U.S.-Singapore Free Trade Agreement, and the U.S./Israel Free Trade Agreement or under statutory provisions related to preferential trade programs (CBERA and GSP). *See* 19 U.S.C. § 2112 note (Jordan, Israel); 19 U.S.C. § 2253(e)(6) (GSP); 19 U.S.C. § 2703(e) (CBERA); 19 U.S.C. § 3371 (NAFTA); 19 U.S.C. § 3805 note (Australia, Colombia, KORUS, Panama, Peru, Singapore); 19 U.S.C. § 4101 (CAFTA-DR).

> collectively, contribute importantly to the serious injury, or threat thereof, caused by imports.[381]

With respect to the first prong, the statute states that imports from a NAFTA country "normally shall not be considered to account for a substantial share of total imports if that country is not among the top 5 suppliers of the article subject to the investigation, measured in terms of import share during the most recent three-year period."[382]

With respect to the second prong (whether imports from NAFTA countries individually or in exceptional circumstances, collectively, contribute importantly to the serious injury or threat of serious injury), the statute defines "contribute importantly" as an important cause, but not necessarily the most important cause.[383] In determining whether imports have contributed importantly to the serious injury or threat thereof caused by imports, the Commission is directed to

> consider such factors as the change in the import share of the NAFTA country or countries, and the level and change in the level of imports from such country or countries. Imports from a NAFTA country or countries normally shall not be considered to contribute importantly to serious injury, or the threat thereof, if the growth rate of imports from such country or countries during the period in which an injurious increase in imports occurred is appreciably lower than the growth rate of total imports from all sources over the same period.[384]

In exceptional circumstances, imports from NAFTA countries may be considered collectively in determining whether NAFTA imports have contributed importantly to the serious injury or threat. According to Statement of Administrative Action accompanying the NAFTA Implementation Act ("NAFTA SAA"), the Commission is likely to consider imports from NAFTA countries collectively when imports from individual NAFTA countries are each small in terms of import penetration, but collectively are found to contribute importantly to the serious injury or threat of serious injury.[385]

As discussed in section III above, this investigation includes several possible data sources for measuring imports and any increase in imports. For the reasons explained in section III, which we incorporate into this discussion, we relied primarily on the country-of-origin methodology that Canadian respondents proposed (the NAFTA rules of origin for imports from Canada and Mexico and for imports from all other countries, the country where the cell was

[381] 19 U.S.C. § 3371(a); NAFTA Implementation Act § 311.
[382] 19 U.S.C. § 3371(b)(1).
[383] 19 U.S.C. § 3371(c).
[384] Section 311(b)(2) of the NAFTA Implementation Act, 19 U.S.C. § 3371(b)(2).
[385] NAFTA SAA, H. Doc. 103-159, 103rd Cong., 1st Sess. at 565 (1993).

manufactured, as adjusted to reflect U.S. cells assembled into modules in a NAFTA country) as the source for import data in this investigation.[386]

1. Finding With Respect to Imports from Canada[387]

We find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Canada do not account for a substantial share of total imports and do not contribute importantly to the serious injury caused by the imports. Accordingly, we make a negative finding with respect to imports from Canada.

According to adjusted importer questionnaire data, the industry in Canada was not among the top five suppliers of imports of CSPV products during the three most recent years.[388]

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[386] *See, e.g.*, Table II-2 , Table IV-3, Table C-1b (implementing the methodology and reducing U.S. imports from non-NAFTA sources to reflect reported information indicating that the CSPV cells were assembled into modules in Canada or Mexico).

[387] Chairman Schmidtlein does not join section V.A.1 of these Views. She finds that under section 311(a) of the NAFTA Implementation Act (19 U.S.C. § 3371(a)), U.S. imports of CSPV products from Canada account for a substantial share of total imports and contribute importantly to the serious injury caused by imports. Accordingly, she makes an affirmative finding with respect to U.S. imports from Canada.

Under section 311(a) of the NAFTA Implementation Act, a country normally will not be considered to account for a substantial share of total imports if it was not among the top five suppliers of the subject good. The Statement of Administrative Action accompanying the NAFTA Implementation Act, however, states that the use of the word "normally" in the statutory language recognizes the need for some flexibility in exercising this rule and that there may be instances in which a country not meeting this guideline should be included in the safeguards action. Although U.S. imports from Canada were not among the top five sources of imports, they were among the top ten sources during the POI. Moreover, the absolute volume of U.S. imports from Canada increased in all but one period of the POI and increased at very large rates of growth (U.S. imports from Canada increased from ***). CR/PR at Table II-2. These rates of growth exceed the corresponding rates for global U.S. imports between 2012 and 2015. Therefore, Chairman Schmidtlein finds that because these very large rates of increase warrant the use of the flexibility envisioned in the SAA, U.S. imports from Canada do account for a substantial share of total U.S. imports.

As to whether the imports from the NAFTA country "contribute importantly" to the serious injury, Chairman Schmidtlein finds that because of the large increase in the absolute volume of U.S. imports from Canada, their increasing U.S. market share from virtually zero at the beginning of the POI to *** percent in 2015, and the larger rate of growth of these U.S. imports relative to global U.S. imports, U.S. imports from Canada, considered individually, do contribute importantly to the serious injury caused by U.S. imports. CR/PR at Table C-1b.

Finally, Chairman Schmidtlein joins Commissioners Broadbent, Johanson, and Williamson in acknowledging that excluding U.S. imports from Canada from any safeguard measure may result in unrestrained imports from Canada imminently increasing to harmful levels because of the factors outlined in footnote 400, *infra*.

[388] Neither of the scenarios contemplated by the NAFTA SAA as possible reasons why the Commission might find that imports from a NAFTA country account for a substantial share of total (Continued…)

It was the tenth largest source in 2012 and 2013, the ninth largest source in 2014, the seventh largest source in 2015, and the tenth largest source in 2016.[389] Consequently, we find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Canada, considered individually, do not account for a substantial share of total imports.

We also examined whether imports of CSPV products from Canada considered individually contribute importantly to the serious injury caused by imports.[390] Imports from Canada increased from *** kW in 2012 to *** kW in 2013, *** kW in 2014, and *** kW in 2015, and declined to *** kW in 2016.[391] As a share of total imports, imports from Canada accounted for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[392] Imports from Canada generally were even smaller as a share of apparent U.S. consumption, accounting for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[393] Their rate of increase was *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and

(…Continued)
imports even though the NAFTA country is not one of the top five suppliers is present in this investigation. *See* NAFTA SAA, H. Doc. 103-159, 103rd Cong., 1st Sess. at 565 (1993) (indicating that it might be appropriate to do so where there is little difference between the share of a fifth-place supplier and those that follow fifth place, or there are many suppliers, each accounting for a substantial share). The NAFTA SAA further provides that, "Section 312 includes a 'surge' provision … that allows the President to include the previously excluded imports in the action if he later determines that a surge in imports of the product from the excluded country or countries is undermining the effectiveness of the action." *Id*.; 19 U.S.C. § 3372(c).

389 CR/PR at Table II-2. Based on official import statistics, by value, imports from Canada ranked eleventh in 2014 and 2015 and twelfth in 2016. CR/PR at Table C-7. Based on unadjusted importer questionnaire data, there were *** imports from Canada. CR/PR at Table II-1. According to foreign producer questionnaire responses, there was no reported production of CSPV cells in Canada during the POI. CR at IV-19; PR at IV-13.

390 The statute refers to "the serious injury, or threat thereof, caused by imports." 19 U.S.C. § 3371(a)(2)). Having found under section 202 of the Trade Act (19 U.S.C. § 2252(b)) that crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) are being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products), we limit our findings for NAFTA countries to whether imports of the article from each NAFTA country contribute importantly to the serious injury caused by imports consistent with the Commission's approach in prior investigations. *See, e.g.*, *Circular Welded Carbon Quality Line Pipe*, Inv. No. 201-TA-70, USITC Pub. 3261 at I-32 to I-33 (Dec. 1999).

391 In terms of value, imports from Canada increased from $*** in 2012 to $*** in 2013, $*** in 2014, and $*** in 2015, and declined to $*** in 2016. CR/PR at Table II-2.

392 As a share of domestic production, imports from Canada accounted for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016. CR/PR at Table II-2.

393 CR/PR at Table IV-4.

*** percent from 2015-2016, for an overall increase of *** percent.[394] Although these rates exceed the corresponding rates for global imports between 2012 and 2015 and the overall increase between 2012 and 2016,[395] Canada's rate of increase is a function of the very low level of imports from Canada in 2012.[396] Moreover, imports from Canada declined between 2015 and 2016 while global imports continued to increase.[397]

Under the second prong for imports from NAFTA countries, the statutory standard is whether the imports from the NAFTA country "contribute importantly to the serious injury … caused by imports," which is a lower standard than whether global imports are a substantial cause of serious injury.[398] Despite the larger growth rate for imports from Canada relative to global imports, given the relatively small share of total imports accounted for by imports from Canada, the relatively small change in the Canadian industry's import share over the POI, and the more modest level and change in the level of imports from Canada, particularly relative to total imports from all sources over the POI, we find that imports from Canada considered individually do not contribute importantly to the serious injury caused by imports.[399]

Given that imports from Canada started the POI at a smaller baseline than other foreign suppliers and increased overall during the POI at a rate that exceeded the growth rate for global imports, we recognize that if the President were to determine to exclude imports from Canada from any safeguard measure, unrestrained imports from Canada might increase to harmful levels.[400] In those circumstances, however, if any such increase were to occur, the

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[394] CR/PR at Table C-1b.

[395] The rate of increase for global imports was *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent. CR/PR at Table C-1b.

[396] Global imports, in contrast, increased from 2.2 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016. CR/PR at Table II-2.

[397] CR/PR at Table IV-4.

[398] The statute defines substantial cause as "a cause which is important *and* not less than any other cause." 19 U.S.C. § 2252(b)(1)(B) (emphasis added).

[399] We do not find exceptional circumstances that would warrant considering whether imports from Canada and Mexico collectively contribute importantly to the serious injury caused by imports. For example, although imports from Canada were relatively small in terms of import penetration, imports from Mexico were not small in terms of import penetration. CR/PR at Table IV-4 (indicating that imports from Mexico accounted for *** percent of apparent U.S. consumption in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016). CR/PR at Table IV-4.

[400] Factors increasing the likelihood of a surge of imports into the U.S. market from Canada include the following: the CSPV module industry in Canada increased capacity and production between 2012 and 2016; the Canadian industry shipped an irregularly increasing share of its total shipments to the United States (increasing nearly four-fold from *** percent of its total shipments in 2012 to *** percent by 2016); the Canadian industry had available capacity throughout the POI, with its capacity utilization ranging from a low of *** percent in 2012 to a high of *** percent in 2015, and a near lowest level of *** percent at the end of the POI in 2016); producers in Canada (including the *** foreign producer (Canadian Solar)) maintain corporate and other arm's length supply chain relationships with firms in several other countries; Canadian producers and their related firms exported growing volumes (Continued…)

domestic industry would have other options to consider, including the import-surge mechanism of 19 U.S.C. § 3372(c) and the antidumping and/or countervailing duty laws (19 U.S.C. § 1671, 19 U.S.C. § 1673).

2. Findings With Respect to Imports from Mexico

We find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Mexico account for a substantial share of total imports and contribute importantly to the serious injury caused by the imports. Accordingly, we make an affirmative finding with respect to imports of CSPV products from Mexico.

As discussed in section III above, for purposes of this analysis, we applied the NAFTA rules of origin for imports from Canada and Mexico. According to adjusted importer questionnaire data, the industry in Mexico was among the top five import suppliers of CSPV products during the three most recent years and accounted for significant and rapidly increasing volumes of imports, both by quantity and volume.[401] It was the third largest source in 2012, the second largest source in 2013, the third largest source in 2014 and 2015, and the fourth largest source in 2016.[402] Consequently, we find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Mexico, considered individually, account for a substantial share of total imports.

We also examined whether imports of CSPV products from Mexico considered individually contribute importantly to the serious injury caused by imports.[403] Imports from Mexico progressively increased each year from *** kW in 2012 to *** kW in 2013, *** kW in 2014, *** kW in 2015, and *** kW in 2016.[404] Their rate of increase was *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent,[405] whereas the rate of increase for global imports was *** percent from 2012-2013, *** percent from 2013-2014, *** percent from

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(…Continued)
of CSPV products to the United States over the POI; if the CSPV products manufactured by Canadian producers' affiliates are subject to a global safeguard measure, the industry in Canada will have an incentive to supply the U.S. market from its Canadian operations instead. CR/PR at Table IV-10, Table IV-11, Table IV-17, Table IV-18.

[401] CR/PR at Table II-2.

[402] CR/PR at Table II-2. Based on official import statistics, by value, imports from Mexico ranked fourth in 2014, third in 2015, and fourth in 2016. CR/PR at Table C-7. Based on unadjusted importer questionnaire data, there were *** imports from Mexico. CR/PR at Table II-1. The three responding foreign producers/exporters of CSPV modules in Mexico did not report any production of CSPV cells, but publicly available information indicates that i3 Group, a holding company, is the only manufacturer of CSPV cells in Mexico, which are produced through its subsidiaries. CR at IV-27; PR at IV-17.

[403] As explained above, we do not find exceptional circumstances that warrant considering whether imports from Canada and Mexico collectively contribute importantly to the serious injury caused by imports.

[404] In terms of value, imports from Mexico increased from $*** in 2012 to $*** in 2013, $*** in 2014, and $*** in 2015, and $*** in 2016. CR/PR at Table II-2.

[405] CR/PR at Table C-1b.

2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent.[406] Thus, imports from Mexico and global imports both increased throughout the POI, with imports from Mexico sometimes increasing at a greater rate than global imports, and sometimes increasing at a lower rate than global imports.[407] As a share of total imports, imports from Mexico accounted for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[408] As a share of apparent U.S. consumption, imports from Mexico accounted for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[409] Imports from Mexico exceeded the domestic industry's production of CSPV products throughout the POI; as a ratio to domestic production, they accounted for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[410] Given the substantial level of imports from Mexico, substantial increases in the level of imports from Mexico over the POI, the sizable share of total imports accounted for by imports from Mexico, and the level of imports from Mexico relative to domestic production of CSPV products, we find that imports from Mexico considered individually contribute importantly to the serious injury caused by imports.

B. Findings With Respect to Imports from Korea, Singapore, Australia, CAFTA-DR countries, Colombia, Jordan, Panama, and Peru

Several of the United States' FTAs contain similar language providing the President with discretion to exclude imports from FTA partners from any global safeguard measure. Despite the permissive nature of the exclusions in the FTAs, the corresponding U.S. implementing statutes mandate that the Commission make a finding whether imports of the article from the FTA partner are a substantial cause of serious injury or threat thereof and report its finding to the President at the same time that it submits its report.[411] For imports from each of these countries, we thus consider whether CSPV products are being imported in increased quantities (either actual or relative to production); whether the domestic industry producing an article that is like or directly competitive with the imported article is seriously injured or threatened

[406] CR/PR at Table C-1b. Global imports increased from 2.2 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016. CR/PR at Table II-2.

[407] CR/PR at Table IV-4.

[408] CR/PR at Table II-2.

[409] CR/PR at Table IV-4.

[410] CR/PR at Table II-2.

[411] *See, e.g.*, CAFTA-DR Article 8.6(2) (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and the Dominican Republic); the U.S.-Australia Free Trade Agreement Article 9.5; KORUS Article 10.5(1); the U.S.-Colombia Trade Promotion Agreement Article 8.6(2); U.S./Jordan Agreement on the Establishment of a Free Trade Area Article 10.8; U.S./Panama Trade Promotion Agreement Article 8.2(2); the U.S.-Peru Free Trade Agreement Article 8.6(2); and the U.S./Singapore Free Trade Agreement Article 7.5. *See* 19 U.S.C. § 2112 note (Jordan); 19 U.S.C. § 3371 (NAFTA); 19 U.S.C. § 3805 note (Australia, Colombia, KORUS, Panama, Peru, Singapore); 19 U.S.C. § 4101 (CAFTA-DR).

with serious injury; and whether the article is being imported in such increased quantities as to be a substantial cause of serious injury or threat of serious injury to the domestic industry.[412]

1. Findings With Respect to Imports from Korea

For the reasons discussed below, we find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Korea are a substantial cause of threat of serious injury.[413] Accordingly, we make an affirmative finding with respect to imports of CSPV products from Korea.

With respect to whether imports of CSPV products from Korea increased, the evidence shows that imports from Korea progressively increased each year from *** kW in 2012 to *** kW in 2013, *** kW in 2014, and *** kW in 2015, and reached a period high of *** kW in 2016 that was more than *** the level in 2015.[414] Their annual growth rate was *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent,[415] whereas global imports grew by *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent.[416] Thus, imports from Korea grew even faster than global imports in every period, except for 2012-2013.[417] As a ratio to domestic production, imports from Korea irregularly increased over the POI, declining from *** percent in 2012 to *** percent in 2013, and increasing to *** percent in 2014, *** percent in 2015, and a period high of *** percent in 2016, well above *** percent.[418] Based on this information, we find increased imports from Korea.

As discussed in more detail in section IV.D above, the domestic industry's performance indicators declined over the POI, particularly between 2015 and 2016 and continued to deteriorate into 2017 despite explosive demand growth. Given the overall impairment in the domestic industry's position, we next considered whether imports from Korea are a substantial cause of serious injury or threat.[419] Imports from Korea progressively increased each year from

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[412] *See* 19 U.S.C. § 2252(b)(1)(A).

[413] We recall that the statute defines "substantial cause" as a cause "which is important and not less than any other cause." 19 U.S.C. § 2252(b)(1)(B).

[414] In terms of value, imports from Korea decreased from $*** in 2012 to $*** in 2013 and increased to $*** in 2014, $*** in 2015, and a period high of $*** in 2016. CR/PR at Table II-2.

[415] CR/PR at Table C-1b.

[416] CR/PR at Table C-1b. Global imports increased from 2.2 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016. CR/PR at Table II-2.

[417] CR/PR at Table IV-4.

[418] CR/PR at Table II-2.

[419] The required analysis of imports from Korea differs in important respects from the analysis with respect to imports from NAFTA countries. For instance, the injury standards differ, with a two-pronged test for imports from NAFTA countries (imports "account for a substantial share of total imports" and "*contribute importantly to* the serious injury, or threat thereof, caused by imports") and a single test for imports from Korea (whether imports are "a *substantial cause of* serious injury or threat").
(Continued…)

*** kW in 2012 to a period high of *** kW in 2016 (that was more than *** the level in 2015).[420] Imports from Korea grew even faster than global imports, increasing over the entire POI by *** percent and by *** percent from 2015-2016 alone,[421] whereas global imports increased over the entire POI by *** percent and by *** percent from 2015-2016.[422] Imports from Korea also increased substantially as a ratio to domestic production, increasing overall from *** percent in 2012 to a period high of *** percent in 2016, well above *** percent.[423] As a share of total imports, imports from Korea accounted for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[424] As a share of apparent U.S. consumption, market share for imports from Korea was *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[425]

(…Continued)

Moreover, the context for our analysis differs. Our analysis of imports from NAFTA countries is intertwined with our analysis of global imports. If we determine under section 201 of the Trade Act (19 U.S.C. § 2252(b)) that an article is being imported in such increased quantities as to be a substantial cause of *serious* injury to the domestic industry producing an article like or directly competitive with the imported article, then the statute limits our analysis of imports from NAFTA countries to the basis for that determination (*i.e.*, *serious* injury), as we have found in prior safeguard proceedings. *See, e.g.*, *Circular Welded Carbon Quality Line Pipe*, Inv. No. 201-TA-70, USITC Pub. 3261 at I-32 to I-33 (Dec. 1999). The operative language is the requirement that imports from the NAFTA country "contribute importantly to *the* serious injury, or threat thereof, *caused by imports*." 19 U.S.C. § 3371(a)(2) (emphasis added). Thus, the Commission analyzes imports from the NAFTA country against the backdrop of its determination of serious injury caused by imports. No such language exists for purposes of analyzing imports from Korea, so if, as here, the Commission based its determination with respect to global imports on *serious* injury, the statute *does not limit* the analysis of imports from Korea to the *serious* injury context (as distinguished from the *threat of serious injury* context). 19 U.S.C. § 3805 note at section 341.

The Commission's point of reference also changes. To analyze imports from the NAFTA country, the Commission focuses on whether they "contribute importantly to *the* serious injury, or threat thereof, *caused by imports*." 19 U.S.C. § 3371(a)(2) (emphasis added). That is, the statute contemplates that the Commission will analyze the imports from the NAFTA country against the imports that the Commission determined caused the serious injury (or threat thereof) – global imports. For imports from Korea, however, the statute does not direct the Commission to examine imports from Korea with global imports that caused the serious injury (or threat thereof) as a reference point. The statute simply directs the Commission to find whether imports of the Korean article "are a substantial cause of serious injury or threat thereof." 19 U.S.C. § 3805 note at section 341(a).

[420] CR/PR at Table II-2.

[421] CR/PR at Table C-1b.

[422] CR/PR at Table C-1b. Global imports increased from 2.2 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016. CR/PR at Table II-2.

[423] CR/PR at Table II-2.

[424] CR/PR at Table II-2.

[425] CR/PR at Table IV-4.

Thus, by 2016, imports from Korea were among the largest suppliers of CSPV products to the U.S. market, ranking third behind only Malaysia[426] and China.[427] Imports from China had declined from 2015 to 2016, as had their market share, whereas imports from Korea were considerably higher both absolutely and relative to apparent U.S. consumption and domestic production between those years.[428] In recent years, there has been significant investment in Korea in productive facilities for CSPV cells and CSPV modules by ***.[429]

Based on this evidence, we find that imports from Korea are a substantial cause of clearly imminent threat of serious injury that is important and not less than any other cause, including imports from Malaysia.[430]

2. Findings With Respect to Imports from Singapore

For the reasons discussed below, we find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Singapore are not a substantial cause of serious injury or threat thereof. Accordingly, we make a negative finding with respect to imports from Singapore.

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[426] Imports from Malaysia were larger than imports from Korea by 2016, as they had been throughout the POI. CR/PR at Table II-2. We note that while the CSPV module capacity and production reported for the industry in Malaysia exceeded that reported for the industry in Korea in 2016, the data reported for Korea are significantly understated and represent *** percent of CSPV cell production capacity and only *** percent of CSPV module production capacity in Korea. The data reported for firms in Malaysia, by contrast, accounted for all known CSPV cell capacity in Malaysia and 93 percent of CSPV module production. *Compare, e.g.*, CR/PR at Table IV-43 (CSPV cell capacity in Korea of *** kW in 2016 and production of *** kW), Table IV-44 (CSPV module capacity in Korea of *** kW in 2016 and production of *** kW) with Table IV-49 (CSPV cell capacity in Malaysia of *** kW in 2016 and production of *** kW), Table IV-50 (CSPV module capacity in Malaysia of *** kW in 2016 and production of *** kW); CR at IV-84, IV-93; PR at IV-48, IV-52. This indicates that productive capacity in Korea is considerably higher than productive capacity in Malaysia and that capacity for the industry in Korea is projected to be even higher than capacity for the industry in Malaysia in the imminent future. CR/PR at Table IV-43, Table IV-44, Table IV-49, Table IV-50. Imports from Korea grew at a faster rate between 2015 and 2016 than imports from Malaysia, demonstrating the attractiveness of the U.S. market to imports from Korea. CR/PR at Table C-1b (indicating that imports from Korea increased by *** percent between 2015 and 2016 whereas imports from Malaysia increased by *** percent). Moreover, in 2016, the pricing data indicate that imports from Korea generally were lower priced than the domestic industry's U.S. shipments and imports from Korea also generally were lower priced than imports from Malaysia, the largest source of imports. CR/PR at Appendix G.

[427] CR/PR at Table II-2.

[428] CR/PR at Table II-2, Table IV-4.

[429] CR/PR at Table IV-17, Table IV-18.

[430] In arriving at this finding, we also took into consideration our findings in section IV above about the other alleged causes of any injury, including the lack of evidence supporting respondents' arguments.

With respect to whether imports of CSPV products from Singapore increased, the evidence shows that imports from Singapore increased overall during the POI but fell between 2015 and 2016, decreasing from *** kW in 2012 to *** kW in 2013, increasing to *** kW in 2014, *** kW in 2015, and declining to *** kW in 2016.[431] Their annual growth rate was *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent,[432] whereas global imports grew by *** percent from 2012-2013, *** percent from 2013-2014, *** percent from 2014-2015, and *** percent from 2015-2016, for an overall increase of *** percent.[433] Although the overall growth rate for imports from Singapore was *** to the growth rate for global imports, imports from Singapore started from a considerably smaller base.[434] As a ratio to domestic production, imports from Singapore irregularly increased over the POI, declining from *** percent in 2012 to *** percent in 2013, and increasing to *** percent in 2014, a period high of *** percent in 2015, and declined to *** percent in 2016.[435]

Even assuming *arguendo* that imports from Singapore "increased in such quantities," given the significant overall impairment in the domestic industry's position discussed in more detail in section IV.D above, we considered whether imports from Singapore are a substantial cause of serious injury or threat. Imports from Singapore increased overall from *** kW in 2012 to *** kW in 2016.[436] Their overall growth rate *** the growth rate for global imports, ***.[437] As a share of total imports, imports from Singapore were at the same level at the end of the POI as at the beginning of the POI, accounting for *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[438] As a share of apparent U.S. consumption, imports from Singapore also were at the same level at the end of the POI as at the beginning of the POI, with a market share of *** percent in 2012, *** percent in 2013, *** percent in 2014, *** percent in 2015, and *** percent in 2016.[439]

Although there were some fluctuations in the volume of imports from Singapore over the POI, we do not find that imports from Singapore are a substantial cause of serious injury or threat thereof. They did not increase their share of total imports or their share of the U.S. market over the POI. The decline in the volume of imports from Singapore between 2015 and 2016 absolutely and relative to domestic production and apparent U.S. consumption also undermines any claim of a threat of serious injury. Based on this evidence, we find that imports from Singapore are not a substantial cause of serious injury or threat thereof.

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[431] CR/PR at Table II-2.

[432] CR/PR at Table C-1b.

[433] CR/PR at Table C-1b. Global imports increased from 2.2 million kW in 2012 to 3.1 million kW in 2013, 4.6 million kW in 2014, 8.4 million kW in 2015, and 12.8 million kW in 2016. CR/PR at Table II-2.

[434] CR/PR at Table IV-4.

[435] CR/PR at Table II-2.

[436] CR/PR at Table II-2.

[437] CR/PR at Table C-1b.

[438] CR/PR at Table II-2.

[439] CR/PR at Table IV-4.

3. Findings With Respect to Imports from Australia, CAFTA-DR countries, Colombia, Jordan, Panama, and Peru

We find that imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) from Australia, CAFTA-DR countries, Colombia, Jordan, Panama, and Peru, individually, are not a substantial cause of serious injury or threat thereof. Accordingly, we make a negative finding with respect to imports of CSPV products from each of these FTA partners.

The Commission's questionnaires in this investigation requested separate U.S. import data on imports from Australia, CAFTA-DR countries, Colombia, Jordan, Panama, and Peru, but no importer reported any imports from any of these sources during the POI.[440] The responses to these questionnaires and other available industry information indicate that there is only one known producer of CSPV products in each of the following countries: Australia, the Dominican Republic, El Salvador, Jordan, and Panama.[441] It is not known whether there are any producers of CSPV products in Colombia, Peru, or other CAFTA-DR countries.[442] Based on this information, particularly the absence of any reported imports from any of these FTA partners, we find that imports of CSPV products from Australia, CAFTA-DR countries, Colombia, Jordan, Panama, and Peru, individually, are not a substantial cause of serious injury or threat thereof.

4. Findings With Respect to Other Imports

In certain circumstances, the statute provides the President with discretion to suspend the reduction or elimination of duties on certain imports of articles subject to an affirmative global safeguard action. The President, however, can only suspend the reduction or elimination of the duties if the Commission finds that the serious injury (or threat thereof) substantially caused by imports results from the reduction or elimination of any duty provided under that provision. Thus, these sorts of provisions involve two components: (1) serious injury or threat thereof by the imports and (2) a linkage between the serious injury or threat thereof and the reduction or elimination of any duty provided to those imports.

For imports from Israel, the implementing statute for the U.S./Israel FTA permits the President to suspend the reduction or elimination of any duty provided under any trade agreement provision entered into with Israel under section 102(b)(1) of the Trade Act with respect to any article and permits the President to proclaim a duty rate for such article if such

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[440] CR at I-56; PR at I-41. The Commission also sought data for a "catch-all" category of all other imports, which may have included imports from these countries. Reported imports for all other countries were consistently very small during the POI. *See, e.g.*, CR/PR at Table C-1b (indicating no imports from "all other sources" in 2012 and 2013, and that these imports were *** kW in 2014, *** kW in 2015, and *** kW in 2016, equivalent to less than *** percent of apparent U.S. consumption throughout this period).

[441] CR at IV-141 to IV-143; PR at IV-73 to IV-74.

[442] CR at IV-144; PR at IV-74 to IV-75.

safeguard action is proclaimed,[443] but it precludes the President from suspending the reduction or elimination of any duty provided for under any trade agreement with Israel –

> unless the Commission in addition to making an affirmative determination with respect to such article … determines in the course of its investigation … that the serious injury (or threat thereof) substantially caused by imports to the domestic industry producing a like or directly competitive article results from the reduction or elimination of any duty provided under any trade agreement provision entered into with Israel under section 102(b)(1) of the Trade Act of 1974 … .[444]

In order to provide information necessary for the President to make this determination, the statute requires the Commission, in the event of an affirmative determination of serious injury or threat thereof (or an equally divided Commission), to state in its report to the President "whether and to what extent its findings and recommendations apply to such an article when imported from Israel."[445]

Legislation authorizing certain U.S. preferential trade programs for developing countries also requires the Commission to address the extent to which its findings and recommendations apply to beneficiary countries under those programs. The CBERA provisions of the Caribbean Basin Initiative trade program[446] provide that "in any report by {the Commission} to the President under section 202(f) of the {the Trade Act} regarding any article for which duty-free treatment has been proclaimed by the President pursuant to this chapter, the Commission shall state whether and to what extent its findings and recommendations apply to such article when

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[443] The U.S./Israel FTA provides the President with discretion whether to exclude imports from Israel from any global safeguard measure. Under the U.S./Israel FTA, "When, in the view of the importing Party, the importation of a product from the other Party is not a substantial cause of the serious injury or threat thereof referred to in paragraph 1, the importing party may except the product of the other Party from any import relief that may be imposed with respect to imports of that product from third countries, taking into account the objective of achieving bilateral free trade as embodied in the Agreement, the domestic laws and international obligations of the Parties." Agreement on the Establishment of a Free Trade Area between the Government of Israel and the Government of the United States of America, Article 5(3) (emphasis added).

[444] 19 U.S.C. § 2112 note U.S./Israel FTA Implementing Act § 403(d).

[445] 19 U.S.C. § 2112 note U.S./Israel FTA Implementing Act § 403(b).

[446] The list of CBERA beneficiary countries has declined over time as some individual countries have entered into bilateral free trade agreements with the United States and are no longer eligible for CBERA benefits. Current beneficiaries include Antigua and Barbuda, Aruba, The Bahamas, Barbados, Belize, Curaçao, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, and the British Virgin Islands. 19 U.S.C. § 2702; https://ustr.gov/issue-areas/trade-development/preference-programs/caribbean-basin-initiative-cbi.

imported from beneficiary countries."[447] In order to assist the President's decision whether to suspend duty-free treatment for CBERA imports, in cases where the Commission makes an affirmative determination in a global safeguard investigation under section 202(b) of the Trade Act, the Commission determines whether "the serious injury (or threat thereof) substantially caused by imports to the domestic industry producing a like or directly competitive article results from the duty-free treatment provided by this chapter."[448]

In this investigation, the evidence indicates that there has been no reduction or elimination of duties on eligible imports. Imported articles that are provided for in subheading 8541.40.60 of the HTSUS have been free of duty under the general duty rate since at least 1987.[449] Moreover, although the Commission's questionnaires in this investigation sought separate data for Israel and CBERA beneficiaries on imports and foreign production of CSPV products, we note that no U.S. importer submitted any data on imports of CSPV products from these sources, and no corresponding foreign producers submitted any data on production operations in these locations.[450] Consequently, the serious injury substantially caused by imports to the domestic industry producing a like or directly competitive article does not result from the reduction or elimination of any duty provided for under the U.S.-Israel Free Trade

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[447] 19 U.S.C. § 2703(e)(2). A similar provision required the Commission to report whether the serious injury (or threat thereof) substantially caused by imports to the domestic industry producing a like or directly competitive article resulted from the duty-free treatment provided by the Andean Trade Preference Act. 19 U.S.C. § 3203(c)(4). In the absence of any preferences due to the expiration of the President's authority to provide such duty-free treatment to eligible goods under the Andean Trade Preference Act program, the Commission is not making any such determination in this investigation.

[448] 19 U.S.C. § 2703(e)(4). The statute also requires the Commission to find whether, as a result of the designation of certain articles as eligible for duty-free treatment under the GSP program, the domestic industry is injured or threatened with serious injury as a result of increases in such imports. Section 203(e)(6)(B) of the Trade Act; 19 U.S.C. § 2253(e)(6)(B) ("No proclamation providing for a suspension {of duty-free treatment under the GSP program} may be made by the President, nor may any such suspension be recommended by the Commission under section 2252(e) of this title, unless the Commission, in addition to making an affirmative determination under section 2252(b)(1) of this title, determines in the course of its investigation under section 2252(b) of this title that the serious injury, or threat thereof, substantially caused by imports to the domestic industry producing a like or directly competitive article results from, as the case may be – (i) the application of subheading 9802.00.60 or subheading 9802.00.80 of the Harmonized Tariff Schedule of the United States; or (ii) the designation of the article as an eligible article for the purposes of subchapter V of this chapter.")

[449] CR at I-52; PR at I-38.

[450] CR at I-56, IV-141; PR at I-41, IV-73. As discussed above, reported imports for countries other than Canada, China, Germany, Indonesia, Japan, Korea, Malaysia, Mexico, Philippines, Singapore, Taiwan, Thailand, and Vietnam were consistently very small during the POI. *See, e.g.*, CR/PR at Table C-1b (indicating *** imports from such "all other sources" in 2012 and 2013, and that these imports were *** kW in 2014, *** kW in 2015, and *** kW in 2016, equivalent to less than *** percent of apparent U.S. consumption throughout this period).

Agreement or from duty-free treatment provided for under the CBERA provisions of the Caribbean Basin Initiative Trade Program.[451]

VI. Conclusion

For the foregoing reasons, we determine that crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) are being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing an article like or directly competitive with the imported article. We find that imports of CSPV products from Mexico account for a substantial share of total imports and contribute importantly to the serious injury caused by imports. We find that imports of CSPV products from Canada do not account for a substantial share of total imports and do not contribute importantly to the serious injury caused by imports.[452] We find that imports of CSPV products from Korea are a substantial cause of threat of serious injury, but that imports of CSPV products from Australia, CAFTA-DR countries, Colombia, Jordan, Panama, Peru, and Singapore, individually, are not a substantial cause of serious injury or threat thereof.[453]

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[451] For the same reasons, the serious injury substantially caused by imports to the domestic industry producing a like or directly competitive article does not result from any reduction or elimination of any duty under the GSP program.

[452] As indicated above, Chairman Schmidtlein does not join section V.A.1 of these Views. She finds under section 311(a) of the NAFTA Implementation Act (19 U.S.C. § 3371(a)) that imports of CSPV products from Canada account for a substantial share of total imports and contribute importantly to the serious injury caused by imports.

[453] We also determine that the serious injury substantially caused by imports to the domestic industry producing a like or directly competitive article does not result from the reduction or elimination of any duty provided for under the U.S.-Israel Free Trade Agreement or from duty-free treatment provided for under the CBERA provisions of the Caribbean Basin Initiative Trade Program or any reduction or elimination of any duty under the GSP program.

VIEWS ON REMEDY OF CHAIRMAN RHONDA K. SCHMIDTLEIN

I. Findings and Recommendations

For the reasons set forth below, I recommend the following actions, which I find will address the serious injury to the domestic industry producing crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) ("CSPV products") and be most effective in facilitating the efforts of the domestic industry to make a positive adjustment to import competition:

1. That the President impose a tariff-rate quota on imports of CSPV products in cell form for a four-year period, as follows:

    a. *Year 1*: a tariff of 10.0 percent *ad valorem* on imports of up to 0.5 gigawatts and a tariff of 30.0 percent *ad valorem* on imports in excess of 0.5 gigawatts
    b. *Year 2*: a tariff of 9.5 percent *ad valorem* on imports of up to 0.6 gigawatts and a tariff of 29.0 percent *ad valorem* on imports in excess of 0.6 gigawatts
    c. *Year 3*: a tariff of 9.0 percent *ad valorem* on imports of up to 0.7 gigawatts and a tariff of 28.0 percent ad valorem on imports in excess of 0.7 gigawatts
    d. *Year 4*: a tariff of 8.5 percent *ad valorem* on imports of up to 0.8 gigawatts and a tariff of 27.0 percent *ad valorem* on imports in excess of 0.8 gigawatts

2. That the President impose a tariff on imports of CSPV products in module form for a four-year period. The tariff would be at the rate of 35.0 percent *ad valorem* in the first year of relief, 34.0 percent *ad valorem* in the second year of relief, 33.0 percent *ad valorem* in the third year of relief, and 32.0 percent *ad valorem* in the fourth year of relief;

3. Having made an affirmative finding with respect to imports of CSPV products from Canada and Mexico under section 311 of the NAFTA Implementation Act,[1] that such imports be subject to the tariff-rate quotas and additional tariffs described above;

4. That the tariff-rate quotas and tariffs described above not apply to imports of CSPV products from the following countries with which the United States has free trade agreements: Australia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Nicaragua, Panama, Peru, and Singapore; or to imports

[1] 19 U.S.C. § 3371(a).

of CSPV products from the beneficiary countries under the Caribbean Basin Economic Recovery Act;

5. That the President initiate international negotiations to address the underlying cause of the increase in imports of CSPV products and alleviate the serious injury thereof.

II. Introduction

Having found that increased imports are a substantial cause of serious injury to the domestic industry, I must now recommend to the President action that will address the serious injury and be most effective in facilitating the efforts of the domestic industry to make a positive adjustment to import competition. In deciding what relief to recommend, I have taken into account the considerations set forth in section 202(e)(5)(B) of the Trade Act of 1974,[2] including (1) the form and amount of action that will, in my view, remedy the serious injury that the Commission unanimously found to exist; (2) commitments submitted by firms in the domestic industry during the course of the investigation; (3) information available to the Commission concerning the conditions of competition in domestic and world markets; and (4) likely developments affecting such conditions during the period for which action is being requested. I join Vice Chairman Johanson and Commissioner Williamson in recommending a tariff-rate quota on CSPV cells and a tariff on CSPV modules for four years and join their plurality views in a number of sections, as noted below. I, however, do not join Vice Chairman Johanson and Commissioner Williamson in their recommended tariff rates and tariff-rate quota volume levels because I believe higher tariff rates and a lower starting tariff-rate quota level will provide the domestic industry more protection from increasing volumes of low-priced imports of CSPV products and provide a better opportunity to realize greater operating income during the remedy period which the domestic industry could use to increase capacity and achieve economies of scale.

III. Conditions of Competition

I adopt and incorporate section III of the plurality views of Vice Chairman Johanson and Commissioner Williamson which sets forth the demand and supply conditions of competition in the CSPV products industry.

IV. Commitments Submitted By Firms in the Domestic Industry

I adopt and incorporate section IV of the plurality views of Vice Chairman Johanson and Commissioner Williamson which discusses the commitments submitted by individual firms in the domestic CSPV industry.

[2] 19 U.S.C. § 2252(e)(5)(B).

V. Recommended Relief

I agree with much of my colleagues' views in the plurality recommendation regarding the nature and duration of the recommended remedy. As stated above, I also recommend a four-year tariff-rate quota on CSPV cells[3] and a four-year tariff on CSPV modules, and therefore adopt and incorporate the plurality's rationale for using this specific remedy form, which is explained in section V of the plurality views of Vice Chairman Johanson and Commissioner Williamson. I differ from my colleagues as to only the appropriate magnitude of the specific tariff rates and tariff-rate quota levels.

With regard to determining the appropriate tariff rates and quota levels for any tariff-rate quota, like my colleagues, I have considered all of the information obtained in this investigation, including questionnaire responses, hearing testimony, and the briefs of interested parties, as well as the results of an industry-specific partial equilibrium economic model that distinguished between CSPV cell production and CSPV module production. I used this model to estimate changes in the domestic market for CSPV products and the financial impact of my remedy recommendation on the domestic producers of cells and modules. Similar to my colleagues in the plurality, when formulating my remedy recommendation, I strived to balance the interests of both integrated and non-integrated domestic producers as well as any effects my recommended remedy may have on upstream and downstream domestic industries.

Based on the results of the industry-specific partial-equilibrium model, my recommended remedy will restrict import volume of CSPV modules and increase prices sufficiently for the domestic industry to increase its operating income, allowing it to invest in new capacity and achieve the economies of scale necessary to compete with imports. In my view, the model results show that a tariff rate on modules that is moderately higher than that recommended by the plurality is necessary for these purposes. The model results show that an increase in the price of imports of CSPV modules will benefit both U.S. module producers that use imported cells and U.S. module producers that use cells produced in the United States.[4]

With regard to my recommended tariff-rate quota for CSPV cells, the model results show that U.S. imports of CSPV cells will increase, which will benefit non-integrated U.S. module producers that presently require imported cells to manufacture CSPV modules in the United States. Any increase in imports of CSPV cells, however, will be constrained by the tariff-rate quota level of 0.5 gigawatts in the first year of the remedy period. However, this level is greater than the imported CSPV cell volume in any year of the period of investigation, including 2016, the year in which imported cells surged into the U.S. market. Hence, my recommended

[3] I note that the President may find it more effective to administer any tariff-rate quota with either a time allocation for the quota, a country allocation for the quota, or both.

[4] *See Memorandum EC-PP-023 (October 23, 2017)* and *Estimated Economic Effects of the Remedy Recommendation of Chairman Schmidtlein*, Email correspondence, November 6, 2017.

I also considered the existing antidumping and countervailing duty orders on CSPV products from China and Taiwan and that these measures already provide some degree of protection to the domestic industry.

tariff-rate quota level is designed to allow non-integrated module producers to obtain imported cells as well as allow for some growth for these producers, especially given that overall demand for CPSV products is expected to decline in 2018 from 2016 levels. The in-quota tariff rate I recommend is designed to work in conjunction with the tariffs on modules to raise prices in the U.S. market to the overall benefit of both integrated and non-integrated module producers. The results of the model show that the small increase in cell prices should not have any significant detrimental effect on non-integrated module producers given the expected increase in module prices.

I recommend that the safeguard measure be imposed for four years in order to afford the domestic industry sufficient time to make a positive adjustment to import competition. I recognize that relief of more than three years in duration will require the Commission to conduct a mid-course review under 19 U.S.C. § 2254(a)(2). Such an investigation would provide the Commission with an opportunity to review the progress of firms in the domestic industry in the implementation of the commitments which they submitted to the Commission. It also would provide the President, after receiving the Commission's report, with the opportunity to reduce or terminate relief if the industry has not made adequate efforts to make a positive adjustment to import competition.

VI. Country Exclusions

I recommend that the above tariff-rate quota and increased rates of duty not apply to imports from the following countries with which the United States has free trade agreements: Australia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Nicaragua, Panama, Peru, and Singapore. I also recommend that the tariff-rate quota and increased rates of duty not apply to imports from the beneficiary countries under the Caribbean Basin Economic Recovery Act.

VII. Requests for Product Exclusions

During the remedy phase of this investigation, the Commission was presented with a number of requests to exclude from any remedy particular products included in the scope of the investigation as to which the Commission made an affirmative determination in the injury phase of the proceedings. The parties making these requests generally contended that the products for which they were requesting exclusions were niche or specialty products either not produced by the domestic industry or produced in insufficient quantities to satisfy U.S. demand.[5] However, petitioners argue that most of the products covered by these exclusion requests compete directly with products produced by the domestic industry, and that to

[5] *See* KOPIA's Prehearing Remedy Brief at 22-29; Prehearing Remedy Brief of the Government of Korea at 5-6; BYD's Prehearing Remedy Brief at 2-4; SunPower's Prehearing Remedy Brief at 13-16; SunPower's Posthearing Remedy Brief at 10-15; Solatube's Prehearing Remedy Brief at 1-15; Solatube's Posthearing Remedy Brief at 2-6; Goal Zero's Prehearing Remedy Brief at 2-21; Goal Zero's Posthearing Remedy Brief at 1-9; Enphase's September 27, 2017 Comments on Remedies at 1-4.

exclude them will undermine any safeguard remedy and discourage U.S. investment in these technologies.[6] Because certain product exclusions may undermine any imposed remedy, I decline to recommend the exclusion of any specific products from my remedy recommendation. In order to deal with product exclusion requests that all parties agree would not undermine any imposed remedy, I recommend that a procedure be established at the Office of the U.S. Trade Representative to allow parties to request specific product exclusions.

VIII. Short- and Long-Term Effects of the Recommended Remedy

I agree with my colleagues, as explained in the plurality's recommendation, that given the precarious current position of the domestic industry as a result of the serious injury caused by increased imports, the survival of the domestic industry requires the immediate imposition of strong import relief that enables domestic firms to commence adjustment efforts very quickly. In the short term, the remedy that I have recommended will provide the domestic industry some protection from imports, and allow a modest increase in U.S. prices. Accordingly, U.S. producers' cash flow and operating income will increase, giving them funds necessary for investments in increased capacity and production, as well as in R&D and innovation. The survival of the domestic industry depends on its ability to innovate and improve both its products and its production processes, and to expand production and capacity to achieve economies of scale, so as to enable it to compete with imports of CSPV cells and modules.

SolarWorld's company-specific commitments indicate that if import relief is granted, it intends to ramp up its CSPV cell production to full capacity at its existing facilities by May 2018, with module production to follow suit. SolarWorld also intends to make longer-term plans for investments to increase capacity, capacity utilization, and cost-savings; spur innovation and technology upgrades; enter into R&D partnerships; and solidify and expand its customer base.[7] Suniva's prospective action plan -- which depends on agreement to a reorganization plan in its Chapter 11 bankruptcy proceeding -- envisions that, if granted, import relief would enable it to emerge from the Chapter 11 proceeding and, shortly thereafter, reactivate its production capacity. At the same time, the plan envisions that Suniva would move towards full capacity, profitability, and the resumption of its R&D efforts, while in the longer term seeking to ***.[8]

The import relief I have recommended will also encourage additional private investment and new entrants in the domestic industry, including both integrated producers and non-integrated module producers. As noted by the plurality, information obtained during the investigation shows that a number of domestic producers are planning or considering opening U.S. CPSV production facilities in anticipation of import relief, including ***, ***, ***, ***, and ***.[9]

[6] *See S*olarWorld's Posthearing Remedy Brief, Exhibit 2, at 67-69; Suniva's Posthearing Remedy Brief, Exhibit 5, Attachment D.

[7] SolarWorld's Posthearing Remedy Brief, Exhibit 1, at pages 5-13.

[8] Suniva's Posthearing Remedy Brief at Exhibit 5, Attachment B.

[9] *See e.g.*, SolarWorld's Posthearing Remedy Brief at 8 and Exhibit 11; CR/PR at Table D-2.

Petitioners and respondents agree that the most relevant and reliable projections show a decline in demand for CSPV products from 2016 levels in 2017 and 2018, but a resumption in growth in 2019 and afterwards, even in the event of an imposed remedy which results in higher U.S. prices.[10] Thus, any short-term adverse effect on U.S. downstream demand from higher U.S. prices as a result of import restrictions is unlikely to have a significant effect on the recovery of the U.S. industry from the serious injury, or its positive adjustment to import competition.

In the longer term, by the conclusion of the remedy period, the increased capacity and production of domestic producers, their strengthened financial and working capital position, and their improved products and production processes, should give them the ability to achieve the economies of scale necessary for them compete in all sectors of the industry, including the large projects in the utility sector. For all these reasons, I believe that my recommended remedy will enable the domestic industry to make a positive adjustment to import competition during the remedy period, and emerge in a greatly strengthened competitive position over the long term.

IX. Short- and Long-Term Effects of Not Taking the Recommended Action

I again agree with my colleagues in the plurality recommendation and find that in the absence of relief, the injurious surge of imports would likely continue, given the large and growing excess capacity of foreign producers and the attractiveness of the U.S. market to those producers. As a result, the domestic industry, including both CSPV cell and module producers, would likely cease to exist in the short term. The domestic industry suffered operating losses throughout the period of investigation, and those losses would likely continue and worsen in the absence of relief, leaving the domestic industry unable to invest in the innovation and R&D necessary for its long-term survival. This industry requires continual technological advances and efficiency increases, necessitating constant innovation aimed at both improving the product and the production process, all of which require substantial investments in R&D. The current CSPV cell and module technology is to a substantial degree a product of R&D and innovation in the United States, including by the petitioners.[11] The disappearance of the U.S.

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[10] *See* SolarWorld's Prehearing Remedy Brief at 23; SolarWorld's Posthearing Remedy Brief at 13; Transcript of Remedy Hearing at 215 (Prusa).

[11] *See, e.g.*, CR/PR at Table III-2, Table III-6; CR at III-9 to III-17, III-22; PR at III-5 to III-9, III-11; SolarWorld's Posthearing Injury Brief at 10; Hearing Tr. at 88, 90 (Stein); SolarWorld's Prehearing Injury Brief at 52; Suniva's Posthearing Injury Brief at 7-8, Exhibit 9 at 4. For example, SolarWorld was one of the earliest producers of monocrystalline products and the first producer of monocrystalline PERC products, and petitioners observe that the market now is strongly moving to monocrystalline PERC products, where SolarWorld is a recognized leader. SolarWorld's Posthearing Injury Brief at 9, 10, Exhibit 1, section I at 1, section II at 9, Exhibit 9; Transcript of Injury Hearing at 220-21 (Stein), 222 (Card). SolarWorld also developed the p-type PERC bifacial cell in 2015, the next level of innovation that increases energy yield at the system level and has a greater impact on the cost of the delivered energy. SolarWorld's Posthearing Injury Brief at Exhibit 1, section I at 1-2. Suniva also identified a number of innovations that the firm made throughout its history and the technology changes it implemented *(continued…)*

industry producing CSPV cells and modules would lead to a decline in U.S. R&D and innovation in the solar energy field, which has economic and social benefits in the United States far beyond the benefits to the specific firms conducting the R&D.[12] Indeed, the loss of the domestic industry, and the resulting reliance of downstream industries on foreign producers of CSPV products, could have significant long-term consequences for U.S. economic and national security interests.[13]

X. Other Steps to Facilitate the Industry's Positive Adjustment to Import Competition

In addition to their proposals for import relief, petitioners proposed that the President: (1) issue an executive order directing all U.S. government agencies to require use of U.S. origin solar cells,[14] (2) conduct a study of the cyber, electrical grid, and national security risks of using solar panels of foreign origin in the United States,[15] (3) propose that the Investment Tax Credit and other Federal tax incentives be amended to stimulate U.S. solar demand and in particular for projects using domestically produced cells and panels,[16] (4) pursue settlement negotiations with respect to the U.S. AD/CVD orders on solar cells and modules from China and Taiwan and the duty deposits collected under those orders currently under suspension, (5) direct the Department of Energy ("DOE") to fund the full cost of DOE SunShot Initiative research grants.[17]

I make no recommendation with respect to petitioners' additional proposals summarized above. I do recommend, however, that the President initiate international negotiations to address the underlying cause of the increase in imports of CSPV products. Further, given the extent of the serious injury to the domestic industry and the need for a comprehensive solution, the President may wish to consider the additional proposals to the extent that they are consistent with U.S. law and would facilitate the domestic industry's positive adjustment to import competition.

(…continued)
during the period of investigation to remain competitive. Suniva's Posthearing Injury Brief at Exhibit 9 at Question 6.

[12] *See* Suniva's Prehearing Remedy Brief at 25-27 and Exhibit 6.

[13] *See* Suniva's Prehearing Remedy Brief at 23-28 and Exhs. 12-13; Transcript of Injury Hearing at 96-97 (Card); SolarWorld's Posthearing Remedy Brief, Exhibit 2, at 81-84.

[14] SolarWorld's Prehearing Remedy Brief at 21-23; SolarWorld's Posthearing Remedy Brief, Exhibit 1, at 60-64; Suniva's Prehearing Remedy Brief at 13-15.

[15] Suniva's Prehearing Remedy Brief at 15-16.

[16] SolarWorld's Prehearing Remedy Brief at 23-24.

[17] SolarWorld's Prehearing Remedy Brief at 29.

VIEWS ON REMEDY OF VICE CHAIRMAN DAVID S. JOHANSON AND COMMISSIONER IRVING A. WILLIAMSON

I. Findings and Recommendations

For the reasons set forth below, we recommend the following actions, which we find will address the serious injury to the domestic industry producing crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) ("CSPV products") and be most effective in facilitating the efforts of the domestic industry to make a positive adjustment to import competition:

1. That the President impose a tariff-rate quota on imports of CSPV products in cell form for a four-year period, as follows: an additional tariff of 30.0 percent *ad valorem* on imports in excess of 1.0 gigawatts in the first year of relief, 25.0 percent *ad valorem* on imports in excess of 1.2 gigawatts in the second year of relief, 20.0 percent *ad valorem* on imports in excess of 1.4 gigawatts in the third year of relief, and 15.0 percent *ad valorem* on imports in excess of 1.6 gigawatts in the fourth year of relief. The rate of duty on in-quota CSPV products in cell form would remain unchanged throughout the four-year period;

2. That the President impose an additional tariff on imports of CSPV products in module form for a four-year period. The additional tariff would be at the rate of 30.0 percent *ad valorem* in the first year of relief, 25.0 percent *ad valorem* in the second year of relief, 20.0 percent *ad valorem* in the third year of relief, and 15.0 percent *ad valorem* in the fourth year of relief;

3. Having made a negative finding with respect to imports of CSPV products from Canada under section 311 of the NAFTA Implementation Act,[1] that such imports not be subject to the tariff-rate quotas and additional tariffs described above;

4. Having made an affirmative finding with respect to imports of CSPV products from Mexico under section 311 of the NAFTA Implementation Act,[2] that such imports be subject to the tariff-rate quotas and additional tariffs described above;

5. That the tariff-rate quotas and tariffs described above not apply to imports of CSPV products from the following countries with which the

[1] 19 U.S.C. § 3371(a).
[2] 19 U.S.C. § 3371(a).

United States has free trade agreements: Australia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Nicaragua, Panama, Peru, and Singapore; or to imports of CSPV products from the beneficiary countries under the Caribbean Basin Economic Recovery Act;

6. That the President consider excluding from the tariff-rate quotas and tariffs described above certain CSPV products proposed by respondents and to which petitioners have not objected.

We find that the actions described above will not exceed the amount necessary to remedy the serious injury we find to exist. In addition, we recommend that the President take other appropriate actions to facilitate the efforts of the domestic industry to make a positive adjustment to import competition, including directing the U.S. Department of Labor and the U.S. Department of Commerce to provide expedited consideration of any application for trade adjustment assistance for workers and firms that have been affected by imports of CSPV products. We also recommend that the President consider appropriate funding mechanisms for the U.S. CSPV products industry that may facilitate a positive adjustment to import competition.

II. Introduction

Having found that increased imports are a substantial cause of serious injury to the domestic industry, we must now recommend to the President action that will address the serious injury and be most effective in facilitating the efforts of the domestic industry to make a positive adjustment to import competition. In deciding what relief to recommend, we have taken into account the considerations set forth in section 202(e)(5)(B) of the Trade Act of 1974 (the "Trade Act"),[3] including the form and amount of action that will, in our view, remedy the serious injury we have found to exist; commitments submitted by firms in the domestic industry during the course of the investigation; information available to the Commission concerning the conditions of competition in domestic and world markets; and likely developments affecting such conditions during the period for which action is being requested.

III. Conditions of Competition

A. Demand Conditions

Demand for CSPV products is derived from the demand for solar electricity, which is influenced by factors such as cost competitiveness with traditional energy sources, environmental concerns, a desire for national energy independence, total energy consumption,

[3] 19 U.S.C. § 2252(e)(5)(B).

and the availability of federal, state, and local incentives.[4] In addition to solar electricity, purchasers can use energy and electricity from a wide variety of sources, including traditional fossil fuels such as coal and natural gas, and various other forms of renewable energy, including wind, geothermal, and biomass. The availability of these alternative sources of energy affects demand for CSPV products.[5] The principal market segments for CSPV products are residential, non-residential/commercial, and utility, all of which are connected to the electrical grid. There is also an off-grid market segment.[6]

The vast majority of firms reported that U.S. demand for CSPV products has increased since 2012,[7] and the data show that apparent U.S. consumption grew substantially during the period of investigation, increasing by *** percent between 2012 and 2016.[8] [9] Information obtained in the investigation indicates that there was a spike in demand in 2016, primarily in the utility segment, driven by the anticipated expiration of the Federal Investment Tax Credit in December 2016,[10] although the program was subsequently extended for several more years.[11]

Both petitioners and respondents agree that the most relevant and reliable projections anticipate that in 2017 and 2018 demand for CSPV products will dip below 2016 levels, but growth will resume in 2019 and afterwards.[12] Although the available data on imports of CSPV products that have been arranged for delivery after December 31, 2016, suggest that the total quantity of arranged U.S. imports for calendar year 2017 will be over 20 percent lower than the volume of U.S. imports in 2016,[13] press reports indicated that imports increased in recent months in anticipation of any global safeguard relief. [14]

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[4] Confidential Report ("CR") at V-10; Public Report ("PR") at V-6.

[5] CR at V-58; PR at V-37.

[6] *See* CR at I-33 to I-42; PR at I-24 to I-31.

[7] CR/PR at Table V-3.

[8] CR/PR at Table IV-3.

[9] We note that for purposes of our views on remedy, in our analysis of CSPV imports from Canada and Mexico, we have primarily relied on the country-of-origin methodology that Canadian respondents proposed (the North American Free Trade Agreement (NAFTA) rules of origin for imports from Canada and Mexico, and for imports from all other countries, the country where the cell was manufactured, as adjusted to reflect U.S. cells assembled into modules in a NAFTA country) , as the source for import data in this investigation. *See, e.g.,* Views on Injury at Section III.

[10] CR at V-2; PR at V-2; CR/PR at Figure V-1. The Federal Investment Tax Credit provided a 30 percent tax credit on capital expenditures for new solar photovoltaic systems on residential, nonresidential/commercial, and utility systems. CR/PR at Table V-21.

[11] CR/PR at Table V-21.

[12] *See* SolarWorld's Prehearing Remedy Brief at 23; SolarWorld's Posthearing Remedy Brief at 13; Transcript of Remedy Hearing at 215 (Prusa).

[13] CR/PR at Table II-6.

[14] *See, e.g.*, Suniva's Posthearing Injury Brief, Exh. 9, at 41; *Sunpreme bags deal to supply 150 MW of heterojunction solar modules to TGCM* in pv magazine (Sept. 12, 2017) (EDIS Document No. 623538) ("Analysts and solar developers have told pv magazine that most tier 1 PV makers have sold out of product through the end of the year, as installers and construction contractors hoard PV modules in anticipation of trade action by the Trump Administration."); *see also* Transcript of Remedy Hearing at *(continued…)*

B. Supply Conditions

The domestic CSPV products industry includes integrated producers, who produce both CSPV cells and modules, and non-integrated producers, who produce only CSPV modules. Non-integrated U.S. module producers relied largely on imports of CSPV cells during the period of investigation, as most U.S. production of CSPV cells is internally consumed by integrated producers for their CSPV module operations, and only a fraction of U.S.-manufactured CSPV cells are sold in the commercial market.[15] Nevertheless, during the period of investigation, the vast majority of U.S. imports of CSPV products were in module form; U.S. imports of CSPV modules as a share of total U.S. imports of CSPV products increased from *** percent in 2012 to *** percent in 2016, while the share of U.S. imports of cells correspondingly declined from *** percent in 2012 to *** percent in 2016.[16]

The *** domestic integrated producers during the period of investigation, SolarWorld Americas, Inc. ("SolarWorld") and Suniva, Inc. ("Suniva"), were in weak financial conditions at the end of the period of investigation.[17] Although SolarWorld continues to produce CSPV cells and modules, it ***, and its parent company, SolarWorld AG, went into bankruptcy proceedings in Germany.[18] Suniva ***, but filed for Chapter 11 bankruptcy in 2017 and suspended operations at its cell and module factories.[19] Another integrated producer, Tesla, Inc. ("Tesla"), reported that it opened a facility in Fremont, California, and began producing cells and modules there and is currently ramping up production at a large new factory in Buffalo, New York, that began producing modules in 2017. Tesla expects to produce 1.0 gigawatts of CSPV cells and modules in 2019.[20] Several U.S. producers have left the industry in whole or in part during the period of investigation, including ***, which ***, and Mission Solar, which shut down its U.S. cell production operations in September 2016, while continuing to produce modules.[21]

Responding foreign producers of CSPV cells and CSPV modules reported substantial and increasing capacity and excess capacity during the period of investigation.[22] The aggregate capacity reported by responding foreign producers consistently exceeded their combined

(…continued)
65, 69, 380 (Brightbill), 109 (Szamosszegi). Petitioners emphasize that improvements in cell and module efficiencies each year can quickly make inventories obsolete, increasing the incentive to offload inventories at low prices. SolarWorld's Posthearing Injury Brief at 12; SolarWorld's Prehearing Injury Brief at 88.

[15] CR at III-27; PR at III-15.

[16] CR/PR at Table II-4.

[17] CR/PR at Table III-5.

[18] CR/PR at Table III-2; CR at III-12; PR at III-7.

[19] CR/PR at Table III-2; CR at III-14 to III-15; PR at III-8.

[20] Tesla's Posthearing Remedy Brief at 4-6; CR at III-15 to III-17; PR at III-8 to III-9.

[21] CR/PR at Tables III-2, III-3; CR at III-10; PR at III-5.

[22] The responding foreign producers' collective CSPV cell capacity increased from 27.3 million kW in 2012 to 56.9 million kW in 2016. CR/PR at Table IV-89. Their collective CSPV module capacity increased from 25.2 million kW in 2012 to 66.6 million kW in 2016. CR/PR at Table IV-90.

production levels and is projected to continue to do so in 2017 and 2018.[23] The responding foreign producers' unutilized capacity grew between 2014 and 2016 and consistently exceeded the size of the entire U.S. market.[24]

The six largest firms producing CSPV cells and modules in China drove the increase in global overcapacity as they expanded their operations beyond China and Taiwan.[25] After the imposition of U.S. antidumping and countervailing duty orders on imports from China in December 2012 and on imports from China and Taiwan in February 2015,[26] CSPV imports from other countries substantially increased their presence in the U.S. market, almost doubling from 2014 to 2015 and continuing to grow in 2016.[27] Indeed, without closing any of their existing capacity in China, these six firms increased their global capacity to produce CSPV cells by *** percent between 2012 and 2016 with four of the six firms adding CSPV cell manufacturing capacity in one or more of the following five countries during that period: Korea, Malaysia, the Netherlands, Thailand, and Vietnam.[28] These same six firms also increased their global capacity to produce CSPV modules by *** percent between 2012 and 2016 without closing any of their existing capacity in China with four of the six firms adding CSPV module capacity in one or more of the following six countries: Canada, Indonesia, Korea, Malaysia, Thailand, and Vietnam.[29]

IV. Commitments Submitted By Firms in the Domestic Industry

Although the Commission received no adjustment plan from petitioners (or any other domestic producer) within the time frame specified in Section 202(a)(4) of the Trade Act,[30] each petitioner submitted commitments regarding actions it intends to take to facilitate positive adjustment to import competition. We have carefully examined the company-specific commitments by SolarWorld in its posthearing remedy brief, which outlined its plans for investing to increase capacity and capacity utilization and to improve cost-savings; its plans for innovation and technology upgrades; its plans for research and development ("R&D") partnerships; and its plans for solidifying and expanding its customer base.[31] We have also examined the "prospective forward-action plan" submitted by Suniva, which indicates that its prospective plan depends on a successful agreement of a reorganization plan in its Chapter 11 bankruptcy proceeding and may change as a result of such an agreement. Suniva's prospective plan includes such objectives as quickly reactivating its production capacity, producing at full

[23] *See* CR/PR at Tables IV-89, IV-90.

[24] *See* CR/PR at Tables IV-90, C-1b.

[25] Canadian Solar, Hanwha, JA Solar, Jinko, Trina, and Yingli Green. CR at IV-39 n.38; PR at IV-26 n.38.

[26] The antidumping and countervailing duty orders on imports from China and Taiwan had a restraining effect on imports from those countries, which maintained a presence in the U.S. market but at lower levels. *See, e.g.*, CR/PR at Table IV-3.

[27] CR/PR at Table IV-3, Table C-1b.

[28] CR/PR at Table IV-17.

[29] CR/PR at Table IV-18.

[30] 19 U.S.C. § 2252(a)(4).

[31] SolarWorld's Posthearing Remedy Brief, Exhibit 1, at pages 5-13.

capacity, becoming profitable, resuming its R&D efforts, ***.[32] We have also considered the responses of U.S. producers to the Commission's questionnaire regarding the adjustments they would make to their operations to compete more effectively with imports if import relief were to be granted.[33]

V. Recommended Relief

The statute authorizes the Commission to recommend several forms of action, including tariffs, tariff-rate quotas, quantitative restrictions, appropriate adjustment measures, as well as a combination of those remedies. In determining which of these forms would be most effective in remedying the serious injury and facilitating positive adjustment to import competition, we have examined closely the costs and benefits of each. We have determined that a tariff-rate quota remedy with respect to imports of CSPV products in cell form and a tariff remedy with respect to imports of CSPV products in module form would be the most appropriate forms of relief.[34]

A. Nature and Duration of Remedies

Petitioners Suniva and SolarWorld both proposed specific tariffs, rather than *ad valorem* tariffs, of $0.25 per watt on CSPV cells and $0.32 per watt on CSPV modules; the proposed tariffs would be in place for four years and would be phased down annually.[35] Suniva also proposed a floor price, or minimum import price, for imports of CSPV modules of $0.74 per watt; the proposed per-watt floor price would be in effect for four years and would be increased annually.[36] SolarWorld also proposed a quota on imports of CSPV cells of 0.22 GW as well as a quota on imports of CSPV modules of 5.70 GW; the proposed quotas would be in place for four years and would be increased annually.[37] [38]

By contrast, respondents generally urge that the Commission recommend no import relief and that any recommended remedy should be limited to technical, financial, and trade

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[32] Suniva's Posthearing Remedy Brief at Exh. 5, Attachment B.

[33] CR/PR at Table D-2.

[34] For purposes of these Views on Remedy, a CSPV module is a joined group of CSPV cells, regardless of the number of cells or the shape of the joined group, that are capable of generating electricity. The term "module" is frequently used interchangeably with the term "panel." A CSPV cell that has undergone any further processing, assembly, or interconnection (including, but not limited to, assembly into a laminate) is considered a module.

[35] SolarWorld's Prehearing Remedy Brief at 10-14; Suniva's Prehearing Remedy Brief at 3-6 and Exh. 1 at 1.

[36] Suniva's Prehearing Remedy Brief at 7-8 and Exh. 1 at 1.

[37] SolarWorld's Prehearing Remedy Brief at 14-19.

[38] SolarWorld also proposes that the President direct the Department of Labor to certify immediately workers from any of the U.S. solar facilities that shut down during the period of investigation for benefits and services under the Trade Adjustment Assistance program. SolarWorld's Prehearing Remedy Brief at 26-27.

adjustment assistance.[39] Respondents support the institution of an import license fee on imports of CSPV products in order to create a fund that could provide capital to the domestic industry.[40]

We find that none of the specific proposals by the parties as to import relief achieves the right balance between addressing the serious injury to the domestic industry and taking into account the interests of all members of the domestic industry. As noted, petitioners have proposed a tariff with a specific rate of duty on a per watt basis rather than an *ad valorem* tariff. While the U.S. statute contemplates that the Commission may recommend a remedy in the form of a specific rate of duty, we find that an *ad valorem* tariff would be a more appropriate remedy here, particularly given the characteristics of the CSPV products industry. Specific tariffs are less flexible in responding to fluctuations in value as a result of such factors as technology advances and improved production efficiency, factors that are characteristic of the CSPV products industry. In the event of continuing declines in CSPV prices as a result of such advances and efficiencies, a specific tariff may result in the ratio of the amount of duty collected to the price of a CSPV product increasing, which could result in the relief exceeding the amount necessary to remedy the serious injury, and could postpone the domestic industry's positive adjustment to import competition. Moreover, there may be problems of administration in applying Suniva's proposed specific duty.[41]

In addition, we find that Suniva's proposed "floor price" or minimum import price on imports of CSPV products in the form of modules is not an appropriate remedy in this case. Suniva described the price floor as a form of quantitative restriction, which under its proposal would prohibit the entry of any imports that did not meet a minimum price of $0.74 per watt in the first year and lower prices in the three following years.[42] We view this proposal as posing possible legal questions, including with respect to the limitations on quantitative restrictions in section 203(e)(4) of the Trade Act.[43] The proposal is also lacking in flexibility to ensure a sufficient supply of CSPV products in module form in the U.S. market. Specifically, Suniva's proposed "quota" on imports of CSPV products in module form may leave an insufficient supply of modules for the utility segment given respondents' contention that the domestic industry lacks sufficient capacity to produce 72-cell modules to meet domestic demand in that segment.[44] We also question whether the minimum import price requirement could be enforced and administered.[45]

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[39] *See* SEIA's Prehearing Remedy Brief at 4, 49-50; SEIA's Posthearing Remedy Brief at 12-15.

[40] *See, e.g.,* SEIA's Prehearing Remedy Brief at 56-59; SEIA's Posthearing Remedy Brief at 13-15 and Appendix A at 87-92; U.S. Polysilicon Industry's Posthearing Remedy Brief at 11-14; Tesla's Posthearing Remedy Brief at 9.

[41] Respondents argue that a specific tariff applied on a per-watt basis would be difficult to administer because imports of CSPV modules are reported on a per-unit basis at the time of entry. SEIA's Posthearing Remedy Brief, Appendix A, at 75.

[42] *See, e.g.,* Suniva's Posthearing Remedy Brief at 7.

[43] 19 U.S.C. § 2253(e)(4).

[44] SEIA's Posthearing Remedy Brief, Appendix A, at 80.

[45] Respondents assert that there may be problems in administering a per-watt minimum import price because, as previously noted, imports of CSPV modules are reported on a per-unit basis at the time *(continued…)*

We also find that SolarWorld's proposed quotas on imports of both CSPV cells and CSPV modules are too restrictive. Such quotas may create supply uncertainty and shortages in the U.S. market given the current reliance of non-integrated U.S. module producers on imported cells, the very limited supply of cells from U.S. producers, and the perceived limited capacity of U.S. producers to meet demand in the utility segment for 72-cell modules noted above.

On the other hand, we find that respondents' position that the Commission recommend only technical, financial, and trade adjustment assistance -- with no import restrictions or only minimal restrictions -- would not address the serious injury to the domestic industry that we have determined was caused by increased imports. Given the excess capacity of foreign producers of CSPV products and the demonstrated attractiveness of the U.S. market, we find it likely that injurious volumes of imports of CSPV products will continue in the absence of import relief and will cause the continued deterioration of the domestic industry and, further, that the industry will not survive for long in the absence of import relief.

We view the tariff-rate quota and *ad valorem* tariff that we are recommending as more flexible and more appropriate remedies than the specific rate of duty and the quantitative restrictions proposed by petitioners. In our analysis, we have tried to balance the needs of integrated CSPV producers with those of independent CSPV module producers, while also considering the effects of any remedy on upstream and downstream market participants.[46] As indicated in our discussion of supply considerations, Chinese producers control most global production of CSPV products, and the disappearance of domestic cell producers, domestic module producers, or both, would leave U.S. downstream market participants at the mercy of these and other foreign suppliers both in terms of price and supply.

We recommend a remedy on imports of CSPV products in module form that is more restrictive than our recommended remedy on imports of CSPV products in cell form, recognizing that the vast majority of U.S. imports of CSPV products have been in module form. Our recommended tariff with respect to imports of CSPV products in module form should lead to development of greater U.S. module production, which will benefit both integrated and non-integrated U.S. module producers. Given that current U.S. cell capacity is insufficient to supply non-integrated U.S. module producers, we have recommended a less restrictive tariff-rate quota with respect to imports of CSPV products in cell form so that those U.S. module producers will not face a supply shortage in cells.[47] In this way, our tariff-rate quota on imports of CSPV products in cell form should benefit integrated CSPV products producers without causing undue harm to independent module producers.

(…continued)

of entry and because the proposed minimum import price would be inclusive of the per-watt tariffs proposed. *See* SEIA's Posthearing Remedy Brief, Appendix A, at 79-80. Moreover, there is a question as to how effective a minimum import price on CSPV modules would be given that foreign producers might switch to focusing on shipping higher value CSPV module products to the U.S. market as a result of the minimum import price. *Id.* at 80; *cf.* Transcript of Remedy Hearing at 173 (Keeler).

[46] *See generally*, 19 U.S.C. § 2252(e)(5)(B)(iv); *see also* 19 U.S.C. § 2252(f)(2)(G)(i) and (ii).

[47] We note that the President may wish to provide further details as to any tariff-rate quota in any final remedy adopted, including a time allocation for the quota within each year as well as country allocations.

In determining the appropriate level of relief, we have considered all the information obtained in this investigation, including questionnaire responses, hearing testimony, and the briefs of parties as well as the results of an industry-specific partial equilibrium economic model that distinguished between CSPV cell production and trade and CSPV module production and trade. We used this model to estimate changes in prices and quantities of imported articles and domestic products that compete with them in the U.S. market for CSPV cells and modules and changes in the revenues and operating income of U.S. producers that would result from our remedy recommendations. By distinguishing between CSPV cell and module production, and by tracing the different international supply chains for CSPV cells and modules, the model was able to estimate the effects of the different remedies on imports of cells and imports of modules on U.S. producers of CSPV products in cell and module form.[48]

We also estimated the financial impact of each remedy on U.S. producers of CSPV cells and modules using a *pro forma* financial analysis of income statements and information on the fixed and variable shares of the domestic industry's cost of goods sold (COGS) and selling, general and administrative expenses (SG&A). The *pro forma* analysis takes the estimated changes in the volume and prices of U.S. producers from the remedy model as inputs. The financial calculations incorporate U.S. producer questionnaire data regarding the share of COGS and SG&A that are variable costs.[49]

We have used this model as a tool for analyzing the effects of various trade restrictions on import volumes, prices, and the revenue of U.S. cell and module producers; however, the model is subject to certain limitations. Key among these limitations is the fact that the model does not address the impact of our proposed remedies on upstream or downstream industries or on the rest of the U.S. economy. The model does provide an estimate of the percentage change in the deployment of modules under the various remedy scenarios, but it does not attempt to estimate the financial, employment, or any other effects of this change on any sector of the U.S. economy other than cell and module producers.[50] In considering the effect of the proposed trade remedies on other sectors of the U.S. economy, we have relied on hearing testimony, briefs, and questionnaire responses to inform our analysis.

The results of our industry-specific partial-equilibrium model indicate that our recommended remedies will restrict import volume and increase prices sufficiently for the domestic industry to increase its operating income, allowing it to invest in new capacity and achieve the economies of scale necessary to compete with imports. The results of the model show that the remedy we are recommending will allow U.S. imports of CSPV products in cell form to increase, which will benefit U.S. producers that use imported cells. Furthermore, the model shows that the remedy we are recommending will result in an increase in the price of imports of CSPV products in module form, which will benefit both U.S. module producers that

[48] *See* Memorandum EC-PP-023 (October 23, 2017). We also took into account the existing antidumping and countervailing duty orders on CSPV products from China and Taiwan. In setting the levels of our tariff rate quota and tariff recommendations, we considered the fact that these measures already provide some degree of protection to the domestic industry.

[49] *See* Memorandum EC-PP-023 (October 23, 2017).

[50] *See* Memorandum EC-PP-023 (October 23, 2017).

use imported cells and U.S. module producers that use cells produced in the United States.[51] Thus, the economic modeling results provide additional support for the safeguard remedies we are recommending.

Given the precarious condition of the domestic industry, we recommend the imposition of safeguard measures for four years to afford the industry sufficient time to make a positive adjustment to import competition. We recognize that relief of more than three years duration will require the Commission to conduct a mid-course review under 19 U.S.C. § 2254(a)(2). Such an investigation would provide the Commission with an opportunity to review formally, among other matters, the progress of firms in the domestic industry in implementing the commitments they submitted to the Commission. It would also provide the President, after receiving the Commission's report, with the opportunity to reduce or terminate relief if the industry has not made adequate efforts to make a positive adjustment to import competition.

Furthermore, in light of the many U.S. firms, workers, and communities that have been adversely affected by the injurious surge of imports of CSPV products, we recommend that the President direct the U.S. Department of Labor and the U.S. Department of Commerce to provide expedited consideration of any applications for trade adjustment assistance for workers and/or firms that have been affected by imports of CSPV products.

We note that the domestic industry's serious injury resulting from increased imports has left it with insufficient working capital and other financial resources to make the investments in capacity, R&D, and improved products and production processes necessary for the industry to compete with imports of CSPV products. We also note that domestic producers (both petitioners and non-petitioners) and SEIA and other respondents supported the need for the domestic industry to receive additional financial resources in order to adjust and compete[52] and that we took the possibility of such assistance into account in assessing the level of import relief we recommended. We accordingly recommend that the President consider any appropriate funding mechanisms that may facilitate a positive adjustment by the domestic industry to import competition.

B. Country Exclusions

Having made a negative finding with respect to imports of CSPV cells and modules from Canada under section 311 of the NAFTA Implementation Act for the reasons set out in the Commission's views on injury, we recommend that the President not include imports from Canada in any remedy action. Having made an affirmative finding with respect to such imports from Mexico, we recommend that the President include imports from Mexico within any remedy action.

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[51] *See* Attachment 1 hereto.

[52] *See* Suniva's Prehearing Remedy Brief at 16-18; SolarWorld's Posthearing Remedy Brief at 57-59; Suniva's Posthearing Remedy Brief at 9; Tesla's Posthearing Remedy Brief at 9; Auxin Solar Inc.'s Posthearing Remedy Brief at I-13 to I-14; Mission Solar's Posthearing Remedy Brief at 7; SEIA's Prehearing Remedy Brief at 56-59; SEIA's Posthearing Remedy Brief at 13-15 and Appendix A at 86-92; U.S. Polysilicon Industry's Posthearing Remedy Brief at 11-14.

Further, we recommend that the above tariff-rate quota and increased rates of duty not apply to imports from the following countries with which the United States has free trade agreements: Australia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Nicaragua, Panama, Peru, and Singapore. We also recommend that the tariff-rate quotas and increased rates of duty not apply to imports from the beneficiary countries under the Caribbean Basin Economic Recovery Act.

C. Requests for Product Exclusions

During the remedy phase of this investigation, the Commission was presented with a number of requests to exclude from any remedy particular products included in the scope of the investigation as to which the Commission made an affirmative determination in the injury phase of the proceedings. The parties making these requests generally contended that the products for which they were requesting exclusions were niche or specialty products either not produced by the domestic industry or produced in insufficient quantities to satisfy U.S. demand.[53] The petitioners argue that most of the products covered by these exclusion requests compete directly with products produced by the domestic industry, and that to exclude them will undermine any safeguard remedy and discourage U.S. investment in these technologies,[54] and we decline to recommend the exclusion of such products from our remedies. However, we recommend that the President consider certain requested product exclusions as to which petitioners have stated that they do not object.[55] Our recommendation is without prejudice to consideration by the President of proposals for exclusion of other products from any remedy imposed.[56]

VI. Short- and Long-Term Effects of Our Recommended Remedy

The tariff-rate quotas and tariff remedies and other measures that we are recommending will address the serious injury to the domestic CSPV products industry and will be most effective in facilitating the efforts of the domestic industry to make a positive

[53] *See* KOPIA's Prehearing Remedy Brief at 22-29; Prehearing Remedy Brief of the Government of Korea at 5-6; BYD's Prehearing Remedy Brief at 2-4; SunPower's Prehearing Remedy Brief at 13-16; SunPower's Posthearing Remedy Brief at 10-15; Solatube's Prehearing Remedy Brief at 1-15; Solatube's Posthearing Remedy Brief at 2-6; Goal Zero's Prehearing Remedy Brief at 2-21; Goal Zero's Posthearing Remedy Brief at 1-9; Enphase's September 27, 2017 Comments on Remedies at 1-4.

[54] *See S*olarWorld's Posthearing Remedy Brief, Exh. 2, at 67-69; Suniva's Posthearing Remedy Brief, Exh. 5, Attachment D.

[55] Petitioners indicated that they do not object to the requests by Goal Zero and Solatube for exclusion of certain low-wattage products and that they would work with these companies to draft appropriate product-specific exclusion language. SolarWorld's Posthearing Remedy Brief, Exh. 2, at 68; Suniva's Posthearing Remedy Brief, Exh. 5, Attachment D at 6-7.

[56] We note that the Office of the U.S. Trade Representative has recently issued a Federal Register notice soliciting public comments and scheduling a public hearing with respect to the Commission's remedy recommendations.

adjustment to import competition. They also do not exceed the amount necessary to remedy such serious injury.

Given the precarious position of the domestic industry as a result of the serious injury caused by increased imports, it is essential that the industry receive strong import relief in the short term and commence its adjustment efforts quickly to facilitate its survival. In the short term, the remedies we have recommended will give the domestic industry some protection from imports and allow a modest increase in U.S. prices. Accordingly, U.S. producers' cash flow and operating income will increase, giving them funds necessary for investments in increased capacity and production as well as in R&D and innovation. The survival of the domestic industry depends on its ability to innovate and improve both its products and its production processes and to expand production and capacity to achieve economies of scale so as to enable it to compete with imports of CSPV cells and modules.

SolarWorld's company-specific commitments indicate that if import relief is granted, it intends to ramp up its CSPV cell production to full capacity at its existing facilities by May 2018 with module production to follow suit. SolarWorld also intends to make longer-term plans for investments to increase capacity, capacity utilization, and cost-savings; spur innovation and technology upgrades; enter into R&D partnerships; and solidify and expand its customer base.[57] Suniva's prospective action plan -- which depends on agreement to a reorganization plan in its Chapter 11 bankruptcy proceeding -- envisions that, if granted, import relief would enable it to emerge from the Chapter 11 proceeding and, shortly thereafter, reactivate its production capacity. At the same time, the plan envisions that Suniva would move towards full capacity, profitability, and the resumption of its R&D efforts while in the longer term seeking to ***.[58]

The import relief we have recommended will also encourage additional private investment and new entrants in the domestic industry, including both integrated producers and non-integrated module producers. Information obtained during the investigation indicates that a number of domestic producers are planning or considering opening U.S. CSPV production facilities in anticipation of import relief, including ***, ***, ***, ***, and ***.[59]

As previously discussed, petitioners and respondents agree that the most relevant and reliable projections show that demand for CSPV products is expected to dip from 2016 levels in 2017 and 2018, but will resume growing in 2019 and afterwards, even in the event of somewhat higher U.S. prices.[60] Thus, any short-term adverse effect on U.S. downstream demand from higher U.S. prices as a result of import restrictions is unlikely to have a significant effect on the recovery of the U.S. industry from the serious injury or its positive adjustment to import competition.

In the longer term, by the end date of our recommended remedies, the increased capacity and production of domestic producers, their strengthened financial and working capital position, and their improved products and production processes should give them the

[57] SolarWorld's Posthearing Remedy Brief, Exhibit 1, at pages 5-13.

[58] Suniva's Posthearing Remedy Brief at Exh. 5, Attachment B.

[59] *See, e.g.,* SolarWorld's Posthearing Remedy Brief at 8 and Exh. 11; CR/PR at Table D-2.

[60] *See* SolarWorld's Prehearing Remedy Brief at 23; SolarWorld's Posthearing Remedy Brief at 13; Transcript of Remedy Hearing at 215 (Prusa).

ability to achieve the economies of scale necessary for them to bid on large utility projects. For all these reasons, we believe that our recommended remedies will enable the domestic industry to make a positive adjustment to import competition during the remedy period and emerge in a greatly strengthened competitive position over the long term.

VII. Short- and Long-Term Effects of Not Taking the Recommended Action

In the absence of relief, the injurious surge of imports would likely continue given the large and growing excess capacity of foreign producers and the attractiveness of the U.S. market to those producers. As a result, the domestic industry, including both CSPV cell and module producers, would likely cease to exist in the short term. The domestic industry suffered operating losses throughout the period of investigation, and those losses would likely continue and worsen in the absence of relief, leaving the domestic industry unable to invest in the innovation and R&D necessary for its long-term survival. This industry requires continual technological advances and efficiency increases, necessitating constant innovation aimed at both improving the product and the production process, all of which require substantial investments in R&D.

Moreover, the likely disappearance of the U.S. CSPV industry in the absence of import relief would have adverse consequences for other U.S. firms participating in the broader CSPV products market. As discussed above, downstream market participants would become more dependent on foreign suppliers of CSPV products in cell and module form, leaving them vulnerable both as to price and supply. Upstream U.S. producers that supply both U.S. CSPV cell and module producers would experience significant losses as their customers cut back or went out of business as they did during the period of investigation. We note that SKC, Inc., which had been the sole remaining U.S. supplier of ethyl vinyl acetate ("EVA") sheets to U.S. module producers, idled production of EVA sheets at its Covington, Georgia, facility in 2017 because of sharply declining orders from U.S. CSPV producers.[61] Similarly, upstream component supplier Ulbrich Specialty Wire and Solar Technologies ("Ulbrich"), a producer of engineered wires, including PV ribbon for solar panels, saw its business rapidly decline as its U.S. customers cut production, closed, or filed for bankruptcy; this in turn led Ulbrich to close its Hillsborough, Oregon, facility in August 2017.[62]

Furthermore, current CSPV cell and module technology is to a substantial degree a product of R&D and innovation in the United States, including by the petitioners.[63] The

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[61] Transcript of Injury Hearing at 132-135 (Byerson); August 22, 2017 Written Statement by SKC, Inc. at 1-4.

[62] Transcript of Remedy Hearing at 95-98 (Treglia).

[63] *See, e.g.*, CR/PR at Tables III-2, III-6; CR at III-9 to III-17, III-22; PR at III-5 to III-10; SolarWorld's Posthearing Injury Brief at 10; Hearing Tr. at 88, 90 (Stein); SolarWorld's Prehearing Injury Brief at 52; Suniva's Posthearing Injury Brief at 7-8, Exhibit 9 at 4. For example, SolarWorld was one of the earliest producers of monocrystalline products and the first producer of monocrystalline PERC products, and petitioners observe that the market now is strongly moving to monocrystalline PERC products where SolarWorld is a recognized leader. SolarWorld's Posthearing Injury Brief at 9, 10, Exhibit 1, section I at 1, section II at 9, Exhibit 9; Transcript of Injury Hearing at 220-21 (Stein), 222 (Card). SolarWorld also *(continued…)*

disappearance of the U.S. industry producing CSPV cells and modules would lead to a decline in U.S. R&D and innovation in the solar energy field, which has economic and social benefits in the United States far beyond the benefits to the specific firms conducting the R&D.[64] Indeed, the loss of the domestic industry, and the resulting reliance of downstream industries on foreign producers of CSPV products, could have significant long-term consequences for U.S. economic and national security.[65]

VIII. Other Steps to Facilitate the Industry's Positive Adjustment to Import Competition

In addition to their proposals for import relief, both petitioners also propose that the President issue an executive order directing all U.S. government agencies to require use of U.S. origin solar cells[66] and that the President initiate bilateral and multilateral negotiations to address global overcapacity in solar cells and modules.[67] Suniva proposes that the President direct his Administration to conduct a study of the cyber, electrical grid, and national security risks of using solar panels of foreign origin in the United States.[68] It also proposes that the domestic industry receive funds, which may come from collected U.S. antidumping and countervailing duties on imports of solar cells and modules from China and Taiwan that are currently under suspension, from any tariffs that are imposed as a result of this Section 201 proceeding, or from other sources.[69]

SolarWorld proposes that the Investment Tax Credit and other federal tax incentives be amended to stimulate U.S. solar demand and in particular for projects using domestically produced cells and panels.[70] SolarWorld also proposes that the President pursue settlement negotiations with respect to the U.S. antidumping and countervailing duty orders on solar cells and modules from China and Taiwan and the duty deposits collected under those orders currently under suspension. SolarWorld suggests that the proposed settlement negotiations encompass the antidumping and countervailing duty orders imposed by China on imports of solar-grade polysilicon from the United States.[71] Also, SolarWorld proposes that the President

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(…continued)
developed the p-type PERC bifacial cell in 2015, the next level of innovation that increases energy yield at the system level and has a greater impact on the cost of the delivered energy. SolarWorld's Posthearing Injury Brief at Exhibit 1, section I at 1-2. Suniva identified a number of innovations that the firm made throughout its history and the technology changes it implemented during the period of investigation to remain competitive. Suniva's Posthearing Injury Brief at Exhibit 9 at Question 6.

[64] *See* Suniva's Prehearing Remedy Brief at 25-27 and Exh. 6.

[65] *See* Suniva's Prehearing Remedy Brief at 23-28 and Exhs. 12-13; Transcript of Injury Hearing at 96-97 (Card); SolarWorld's Posthearing Remedy Brief, Exh. 2, at 81-84.

[66] SolarWorld's Prehearing Remedy Brief at 21-23; SolarWorld's Posthearing Remedy Brief, Exh. 1, at 60-64; Suniva's Prehearing Remedy Brief at 13-15.

[67] SolarWorld's Prehearing Remedy Brief at 24-25; Suniva's Prehearing Remedy Brief at 16.

[68] Suniva's Prehearing Remedy Brief at 15-16.

[69] Suniva's Prehearing Remedy Brief at 16-18.

[70] SolarWorld's Prehearing Remedy Brief at 23-24.

[71] SolarWorld's Prehearing Remedy Brief at 27-28.

direct the Department of Energy ("DOE") to fund the full cost of DOE SunShot Initiative research grants.[72]

We make no recommendation with respect to petitioners' additional proposals summarized above. Nevertheless, given the extent of the serious injury to the domestic industry and the need for a comprehensive solution, the President may wish to consider the proposals to the extent that they are consistent with U.S. law and would facilitate the domestic industry's positive adjustment to import competition.

[72] SolarWorld's Prehearing Remedy Brief at 29.

Attachment 1

Remedy Recommendations of Vice Chairman David S. Johanson and Commissioner Irving A. Williamson

Table 1 summarizes the remedy recommendation for each of the four years in the remedy period.

Table 1: Summary of Remedy Recommendations

	Year 1	Year 2	Year 3	Year 4
Ad Valorem Tariff on Imported Modules	30%	25%	20%	15%
Quota Amount in TRQ on Imported Cells	1 GW	1.2 GW	1.4 GW	1.6 GW
In-Quota Rate in the TRQ on Imported Cells	0%	0%	0%	0%
Out-of-Quota Rate in the TRQ on Imported Cells	30%	25%	20%	15%

Based on these assumptions, we estimated the recommended remedy will have the effects reported in table 2:

Table 2: Estimated Economic Effects over the 4 Years of the Recommended Remedy

	Year 1	Year 2	Year 3	Year 4
% Change in the Quantity of Imported Cells*	***	***	***	***
Change in the GW of Imported Cells	***	***	***	***
% Change in the Quantity of Imported Modules	***	***	***	***
Change in the GW of Imported Modules	***	***	***	***
% Change in the Quantity of U.S. Modules Using U.S. Cells	***	***	***	***
Change in the GW of U.S. Modules Using U.S. Cells	***	***	***	***
% Change in the Price of U.S. Modules Using U.S. Cells	***	***	***	***
% Change in the Overall Price of Modules in the U.S. Market	***	***	***	***
% Change in the Deployment of Modules in the U.S. Market	***	***	***	***
Change in Revenue from U.S. Modules Using U.S. Cells (million dollars)	***	***	***	***
Change in Operating Income from U.S. Modules Using U.S. Cells (million dollars)	***	***	***	***
Change in Revenue from U.S. Cells Used in Foreign Modules Exported to the United States (million dollars)	***	***	***	***
Change in Operating Income from U.S. Cells Used in Foreign Modules Exported to the United States (million dollars)	***	***	***	***
Change in Revenue from U.S. Modules Using Foreign Cells (million dollars)	***	***	***	***
Change in Operating Income from U.S. Modules Using Foreign Cells (million dollars)	***	***	***	***
Combined Change in Revenue from U.S. Production (million dollars)	***	***	***	***
Combined Change in Operating Income from U.S. Producers (million dollars)	***	***	***	***
Change in U.S. Tariff Revenues (million dollars)	***	***	***	***

Note: These effects are rounded to 0.1.

*This is the percentage change in the quantity of imported cells used in U.S. modules.

Assumptions used in the model:

- The baseline data for each year is based on GTM Research projected growth in total CSPV deployment in the U.S. market, assuming that the first year of the remedy is 2018 and the fourth year of the remedy is 2021.
- The price elasticity of total demand in the market is -1.
- The domestic supply elasticity is 4.
- The other elasticity values in the model are at the mid-points of the ranges in the final staff report.
- The remedy does not apply to imports from Canada or Singapore.

Views of Commissioner Meredith M. Broadbent on Remedy

I. Summary of Findings and Recommendations

On September 22, 2017, I found that increased imports of crystalline silicon photovoltaic cells (whether or not partially or fully assembled into other products) (CSPV products)[1] are being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing such articles. Over the five-year period covered by this safeguard investigation, U.S. producers of CSPV products have suffered operating losses as a result of low market prices that have prevented the expansion of production capacity necessary to compete successfully with imports. Many U.S. producers have shut down facilities. My recommendations are intended to address the serious injury while seeking to avoid inflicting additional damage on the broader solar energy industry in the United States. The U.S. solar energy industry has been a relative success story in making progress toward grid parity with a carbon neutral source of power. The United States is recognized as a global leader in this broader sector and U.S. taxpayers and policy makers have chosen to support this success over many years.

For the reasons set forth below, I recommend that the President:

(A) Impose a quantitative restriction on imports of CSPV products into the United States, including cells and modules, for a four-year period, administered on a global basis. I recommend that the quantitative restriction be set at 8.9 gigawatts in the first year, and increase by 1.4 gigawatts each subsequent year;[2]

(B) Administer these quantitative restrictions by selling import licenses at public auction at a minimum price of $0.01 per watt;

(C) To the extent permitted by law, authorize the use of funds equal to the amount generated by import license auctions to provide development assistance to domestic

[1] Although the scope definition includes other CSPV products which contain cells, such as laminates and building-integrated materials, the vast majority of in-scope merchandise and the like or directly competitive article is comprised of CSPV cells and finished modules.

[2] Having made an affirmative finding with respect to imports from Mexico under section 311(a) of the North American Free Trade Agreement (NAFTA) Implementation Act, I recommend that the President allocate no less than 720 megawatts of the global quantitative restriction to imports of CSPV products from Mexico during the first year, which would expand by 115 megawatts each year. Having made a negative finding with respect to imports from Canada under section 311(a) of the NAFTA Implementation Act, I recommend that the quantitative restriction not apply to imports from Canada. Furthermore, I recommend that the quantitative restriction not apply to imports from Australia, the countries that are signatories to the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR countries), Colombia, Israel, Jordan, Panama, Peru, Singapore, and the beneficiary countries under the Caribbean Basin Economic Recovery Act (CBERA).

CSPV product manufacturers for the duration of the remedy period, such as through authorized programs at the United States Department of Energy; and

(D) Implement other appropriate adjustment measures, including the provision of trade adjustment assistance by the United States Department of Labor and the United States Department of Commerce to workers and firms affected by import competition.

II. Remedy Recommendations

a. Competitive Conditions

I considered the following conditions of competition in the domestic and world markets in evaluating the various remedy options for the industry producing CSPV products.

i. China is driving global oversupply and price declines

The underlying factor driving the increase in U.S. imports of low-priced CSPV products has been a substantial and deliberate build-up of Chinese supply that consistently surpassed Chinese demand. CSPV cell production capacity in China increased from 40 GW in 2012 to 63 GW in 2016, whereas photovoltaic (PV) installations in China increased from 3.2 GW in 2012 to 34.5 GW in 2016.[3] In addition, CSPV module production capacity in China surpassed global PV installations in each year during the 2012-2016 period.[4] The supply-demand imbalance in China persisted throughout the period examined by the Commission, making China a substantial surplus producer and exporter of CSPV products, which flooded world markets.[5] According to the data gathered in response to foreign producer questionnaires, China's global exports of CSPV modules reached 13.9 GW in 2016, larger than apparent U.S. consumption in that year and accounting for nearly half of global exports reported by all countries.[6]

The success of Chinese CSPV manufacturers has been driven in large part by the economies of scale that they have been able to achieve, rather than by any comparative

[3] CR IV-33, IV-47–48; PR at IV-20, IV-30-31; Lv Fang, Xu Honghua, Wang Sicheng, *National Survey Report of PV Power Applications in China 2013*, IEA PVPS, September 13, 2014, pp. 14-15 (EDIS Doc. 627085 file ID 1238006); Lv Fang, Xu Honghua, Wang Sicheng, *National Survey Report of PV Power Applications in China 2016*, IEA PVPS, 2017, pp. 18-19 (EDIS Doc. 627085 file ID 1238006 at 44). In addition to CSPV products, PV installations include solar installations made from thin film, which is an out-of-scope photovoltaic product. CR at I-11, 15; PR at I-8, 11.

[4] SEIA Posthearing Remedy Brief, Exhibit 32.

[5] In each year between 2012 and 2016, annual Chinese production of PV modules was larger than annual Chinese PV installations by between *** and ***. SEIA Posthearing Remedy Brief, Exhibit 32.

[6] CR/PR at Table IV-22, Table IV-90, and Table C-1b. This data understates the size of the Chinese industry, and therefore China's global exports of CSPV modules were likely higher. CR at IV-36; PR at IV-23.

advantage inherent to the Chinese economy.[7] China's CSPV commercial production began to grow rapidly in the early 2000s, when Chinese companies began to serve the growing market in Europe, particularly Germany, which did not have sufficient capacity to meet demand.[8] After obtaining capital equipment, expertise, and R&D support from Europe, Chinese firms developed their own expertise and industrial models to supply demand growth elsewhere.[9] Chinese manufacturers are now among the largest in the world, with many of the largest cell and module producers being headquartered or having manufacturing operations in China.[10] These firms are innovative, vertically integrated companies with supply chains and investments throughout the world.[11]

However, the key driver of rapid growth and overcapacity in the Chinese industry has been a mixture of government-driven industrial policy and ad hoc provincial and local subsidies. Over four "five-year plans" covering 2001 to 2020, the Chinese government laid out priorities for the industry that initially focused on scaling up capacity, but later included improving and localizing R&D within China, reducing costs of manufacturing, and increasing both exports and domestic deployment of solar projects.[12] As determined by the United States Department of Commerce (DOC) in two separate countervailing duty (CVD) investigations, the Chinese national government and regional governments have provided an array of mechanisms for supporting the CSPV manufacturing industry, including rebates on value-added tax and corporate income tax, preferential policy lending, provision of grants, provision of inputs for less than adequate remuneration (including land, electricity, polysilicon, aluminum, and glass), and R&D support, among other incentives.[13]

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[7] Jeffrey Ball, Dan Reicher, Xiaojing Sun, Caitlin Pollock, *The New Solar System*, Stanford University, March 2017, 116-117 (EDIS Doc. 627084 file ID 1238000 at 85) ("*New Solar System*"); Hearing Tr. at 180 (Shea).

[8] Donald Chung, Kelsey Horowitz, and Parthiv Kurup, *On the Path to SunShot: Emerging Opportunities and Challenges in U.S. Solar Manufacturing*, DOE National Renewable Energy Laboratory (NREL), 11-14 (EDIS Doc. 627084 file ID 1238001 at 237) ("*On the Path to SunShot*"); *New Solar System* at 45.

[9] *Id*.

[10] CR/PR at IV-16; CR at IV-13, 16; PR at IV-9, 12.

[11] CR at IV-39-42; PR at IV-26-29; *New Solar System* at 40, 61.

[12] *New Solar System* at 86-95; *On the Path to SunShot* at 9; SolarWorld Prehearing Injury Brief at 75-76.

[13] U.S. DOC, "Issues and Decision Memorandum for the Final Determination in the Countervailing Duty Investigation on Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled into Modules, from the People's Republic of China," October 9, 2012 ("*CSPV I* I&D Memorandum"); U.S. DOC, "Issues and Decision Memorandum for the Final Determination in the Countervailing Duty Investigation on Crystalline Silicon Photovoltaic Products from the People's Republic of China," December 15, 2014 ("*CSPV II* I&D Memorandum"); *CSPV I* Confidential Staff Report ("*CSPV I* Staff Report") at I-6; *CSPV II* Confidential Staff Report ("*CSPV II* Staff Report") at I-7. *See also On the Path to SunShot* at 9-11; *New Solar System* at 122-133.

The two U.S. CVD investigations led to the imposition of duties on imports from China designed to remedy the unfair trade resulting from the subsidies discussed above.[14] Nonetheless, Chinese firms have taken deliberate steps to avoid these remedies and similar remedies in Europe, first by using cells produced in Taiwan while continuing to assemble modules in China, and then by investing heavily in production elsewhere in Asia, particularly Southeast Asia and South Korea.[15] Abrupt changes in Chinese government support for PV deployment in their domestic market also can have substantial indirect effects throughout the global market, with reductions in support leading to rapid increases in available global supply. For example, the December 2015 announcement that the Chinese feed-in-tariff would be reduced for projects completed after June 2016 caused a massive increase in Chinese PV installations in the first half of 2016 and a corresponding decline in installations in the second half of 2016, which affected global prices and exports.[16]

Respondents in this investigation have stated that Chinese PV installations will continue to increase substantially, leading to a greater orientation of the Chinese industry's shipments toward China's domestic market as opposed to export markets.[17] However, even assuming that demand in China will continue to increase, Chinese manufacturing firms are projected to substantially increase cell and module capacity in a manner that will far outstrip domestic demand.[18] Without a focused and coordinated Chinese government effort to reduce subsidization and rein in capacity growth, the global market will continue to bear the weight of Chinese oversupply.

ii. Demand for CSPV modules is price-sensitive due to the availability of low-cost alternatives to solar energy

Demand for CSPV modules is driven by new solar installations generating energy for residential, nonresidential, and utility customers. Grid-connected households, businesses, and utilities can use or produce electricity from a wide variety of alternative sources, ranging from

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[14] *CSPV I* I&D Memorandum; *CSPV II* I&D Memorandum; 77 Fed. Reg. 73017 (Dec. 7, 2012); 80 Fed. Reg. 8592 (Feb. 18, 2015); *CSPV I* Staff Report at I-6; *CSPV II* Staff Report") at I-7.

[15] CR/PR at Table IV-17 and Table IV-18 (showing Chinese companies' rapid increases in cell and module production capacity, particularly in South Korea and Malaysia); SolarWorld Prehearing Injury Brief at 18, 80-85; Suniva Posthearing Injury Brief, Exhibit 1 at 40; SolarWorld Posthearing Injury Brief, Exhibit 1 at 92 and Exhibit 40; SolarWorld Posthearing Remedy brief, Exhibit 2 at 72 and Exhibit 43.

[16] CR at IV-33-35; PR at IV-20-22. A feed-in-tariff offers a guarantee of payments to solar electricity developers for the electricity they produce. Payments are based on a certain price per kW/hour at which electricity is purchased, typically as part of a long-term agreement set over a period of 15-20 years. CR at V-54; PR at V-34. Therefore, the announcement in 2015 that projects completed after June 2016 would receive a lower guaranteed rate of return led to a concentration of 2016 Chinese installations within the first half of that year. CR at IV-34-35; PR at IV-22-23. As a result, there were far fewer Chinese installations in the second half of the year, which corresponded with a decline in U.S. and global prices. CR/PR at Figure V-13; SolarWorld AG, *Annual Group Report 2016*, 31-32 (EDIS Doc. 619376).

[17] CCCME Posthearing Remedy Brief at 10-12; SEIA Posthearing Remedy Brief, Appendix A at 63-64.

[18] SEIA Posthearing Remedy Brief, Exhibit 32.

traditional fossil fuels to other forms of renewable energy such as wind power. There are segments of the market that prefer solar energy for non-economic reasons or are encouraged to use it as a result of renewable portfolio standards and other programs.[19] However, aggregate demand for solar energy, and by extension CSPV modules, is primarily and increasingly dependent on the degree to which the long-term costs of producing solar electricity are competitive with those of alternative sources.

Between 2012 and 2016, the cost of installing new PV systems fell by 25.5 percent for the residential sector and by 48.1 percent for the utility sector.[20] These costs fell for a number of reasons, particularly declining costs of modules and "balance of system" (BOS) hardware, but also falling "soft costs" such as labor and overhead, greater module efficiency due to technological improvements, and larger PV installations benefiting from economies of scale.[21] In addition to upfront installation costs, long-term operational costs have continued to decline due to improvements in module durability, higher balance of system reliability, and lower operational and maintenance expenses.[22]

The striking decline in PV system costs has made solar energy competitive with other types of energy for price-sensitive customers, particularly in the utility segment of the market. The relative costs of producing different types of energy can be measured by the levelized cost of electricity (LCOE), which is the per-kilowatt (kW) hour cost of building and operating a power-generating installation over an assumed financial life.[23] The LCOE for a new combined-cycle natural gas-fired power plant, at about 4-5 cents per kW/hour, has set the benchmark for low-cost energy within the utility segment of the market.[24] On-shore wind installations, which benefit from federal tax credits, can have an LCOE of just over 3 cents per kW/hour.[25] By comparison, the LCOE for solar PV systems (incorporating federal tax credits) was just over 5

[19] CR at V-52-56; PR at V-31-35; Injury Hearing Tr. at 253-254 (Grace).

[20] Based on median installed costs. Barbose, Galen and Naïm Darghouth, *Tracking the Sun 10: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Berkeley, CA: Lawrence Berkeley National Laboratory, 2017, Data File Figure 7 and p. 13 (EDIS Doc. 627085 file IDs 1238007 (at 73) and 1238011 (at 253)) ("*Tracking the Sun*"); Bolinger, Mark, Joachim Seel, and Kristina Hamachi LaCommare, *Utility-Scale Solar 2016: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States*, Berkeley, CA: Lawrence Berkeley National Laboratory, Data File, Figure 8 (EDIS Doc. 623498 file ID 1229690 at 245). Nonresidential system costs also substantially declined, though at different rates depending on the size. *Id*.

[21] Ran Fu, David Feldman, Robert Margolis, Mike Woodhouse, and Kristen Ardani, *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017*, NREL, 39-40, 44 (EDIS Doc. 627084 file ID 1238001 at 59) ("*U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017*").

[22] *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017* at 41-42.

[23] CR at V-58-59; PR at V-37.

[24] CR/PR at Table V-25. A hearing witness from Bloomberg New Energy Finance stated that the operating cost of an efficient natural gas price was roughly $20-30 per MW/hour, or 2-3 cents per kW/hour. Injury Hearing Tr. at 252-253 (Grace).

[25] CR/PR at Table V-25.

cents per kW/hour, and was lower in many locations.[26] Solar energy is therefore essentially cost-competitive with other forms of electricity generation, which has supported robust growth in utility installations.[27] For the first time in 2016, solar power accounted for the largest share of new U.S. electricity generation, surpassing natural gas, coal, and wind with 39 percent of total added capacity.[28]

Similar dynamics have led to increased demand for solar energy in the residential and nonresidential segments of the market. These smaller PV systems do not benefit from the same efficiencies and economies of scale as in the utility sector, and therefore have higher levelized costs within the 6-11 cent per KW/hour range.[29] However, many of these customers are able to realize savings by offsetting the cost of using grid-provided electricity with household-generated energy.[30] According to one estimate, by 2020, residential consumers in 37 states and the District of Columbia will see net savings as a result of new rooftop solar installations.[31]

The rapid growth in demand for PV installations over the 2012 to 2016 period was driven in large part by these consistent cost declines, which increased competitiveness of solar energy with other types of electricity.[32] As a result, most solar energy demand is now driven by cost-conscious purchasers choosing between competing energy alternatives as opposed to purchasers interested in solar energy for non-economic reasons.[33] The current high level of

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[26] CR/PR at Table V-25; *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017* at 47 (showing different utility PV system LCOE across many regions, not including Investment Tax Credit) and Appendix B (showing LCOE between 2.7 and 4.0 cents per kW/hour across three different locations).

[27] Injury Hearing Tr. at 254-255 (Grace); Bloomberg New Energy Finance Injury Hearing Presentation, Slide 9 (EDIS Doc. 620615 at 99).

[28] CR/PR at Figure V-3.

[29] *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017* at Appendix B.

[30] Net metering allows residential and nonresidential customers that generate their own solar electricity to receive credit for excess electricity fed into the grid. In some states, utilities may offer net metering programs voluntarily or as a result of regulatory decisions. CR at V-55; PR at V-35.

[31] GTM Research Remedy Hearing Presentation, Slide 13 (EDIS Doc. 624718 at 145).

[32] SEIA Posthearing Remedy Brief, Exhibit 32 (GTM Research's actual and projected PV installations, by year). Between 2012 and 2016, apparent U.S. consumption of CSPV products increased by *** percent. CR/PR at Table IV-3. Apparent U.S. consumption grew substantially in each year of the period of investigation, and spiked in 2016 due to the anticipated expiration of the Federal Investment Tax Credit in December 2016, although the program was subsequently extended for several more years. CR at V-2; PR at V-2; CR/PR at Figure V-1 and Table V-21. Both petitioners and respondents agree that the most relevant and reliable projections anticipate that in 2017 and 2018 demand for CSPV products will dip below 2016 levels, but growth will resume in 2019 and afterwards. *See* SolarWorld's Prehearing Remedy Brief at 23; SolarWorld's Posthearing Remedy Brief at 13; Transcript of Remedy Hearing at 215 (Prusa).

[33] Bloomberg New Energy Finance estimates that 40 out of 52 GW of projected U.S. PV installations from 2018 to 2021 will be discretionary, and an additional 7 GW will be "agnostic" between different types of renewable energy, including wind power. GTM Research estimates that 72 percent of utility solar projects under development are driven by economic factors, with the remaining projects driven by (Continued…)

demand for solar energy remains heavily dependent on whether solar energy producers achieve and maintain "grid parity" with other renewable and conventional energy sources.

Many of the same factors contributing to the decline in PV installation and operational costs from 2012 to 2016 will continue to push solar energy costs lower in the future;[34] however, planned phase-downs and expirations of federal and state incentive programs, such as the federal Investment Tax Credit, will offset these cost declines.[35] Therefore, any shock to the market that causes the cost of solar energy to rise above cost benchmarks set by other energy sources will likely lead to a sharp reduction in demand for solar energy and the capital equipment used to produce it.

Petitioners assert that changes in the price of CSPV modules will have limited effects on demand for CSPV products because modules accounted for only a small share of the total cost of installed PV systems in 2016.[36] This assertion is not supported by evidence on the record in this investigation. CSPV modules accounted for by far the largest single hardware component of PV system costs in 2016, representing approximately 42 percent of costs for utility projects, 30 percent of nonresidential projects, and 22 percent of residential projects.[37] Therefore, any government action that causes a substantial increase in module prices would cause the largest component of installation costs to rise, which would cause demand for solar installations using these products to decline. Under the same dynamic, the decline in module prices over the

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(…Continued)
policy. Bloomberg New Energy Finance Injury Hearing Presentation, slide 9; GTM Research Remedy Hearing Presentation, Slide 12.

[34] *International Technology Roadmap for Photovoltaic ("ITRPV"), 2016 Results*, March 2017, p. 40 (EDIS Doc. 623322 file ID at 1226593); *The SunShot Initiative's 2030 Goal: 3¢ per Kilowatt Hour for Solar Electricity*, December 2016 (EDIS Doc. 627084 file ID 1238001 at 468); Remedy Hearing Tr. at 141-142 (Szamosszegi).

[35] The 30 percent investment tax credit will decline to 26 percent in 2020 and 22 percent in 2021. After 2021, residential projects receive zero tax credit while nonresidential and utility projects receive a 10 percent credit, though the start of construction clause will allow projects started prior to the end of 2021 to receive the higher credit if completed by the end of 2023. CR/PR at Table V-21. State and local government incentives have also declined over the 2012 to 2016 period, particularly for net metering programs. CR/PR at Table V-22; SEIA Posthearing Remedy Brief, Appendix A at 27-29.

[36] Remedy Hearing Tr. at 112-113 (Szamosszegi), 143-144 (McConkey), 146-147 (Kaplan); Capital Trade Remedy Hearing Presentation at 38; Suniva Posthearing Remedy Brief, Exhibit 5 at 12-14.

[37] *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017* at Appendix A. Similarly, U.S. producers reported that CSPV cells (not assembled into modules) accounted for 30 percent of costs for utility projects, 18 percent of nonresidential projects, and 19 percent of residential projects. CR/PR at Table V-2. The cost of CSPV modules as a share of PV system costs has declined substantially over time, particularly for utility PV installations where overhead costs are generally lower than in other market segments. These declines occurred as the price of CSPV modules fell to a greater extent than other costs, which also generally declined. *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017* at Appendix A.

2012 to 2016 period was a major contributor to the declining cost of and rising demand for solar energy, particularly from 2012 to 2013 and from 2015 to 2016.[38]

The extent to which future changes in CSPV module prices affect demand for solar energy will be somewhat mitigated by the availability of thin film, an alternative PV technology, as a substitute product. Large U.S. and foreign producers of thin film (particularly First Solar and Solar Frontier) supply the U.S. market. First Solar is currently adding additional capacity to supply the U.S. and global markets.[39] However, thin film capacity is likely to continue to account for a minority share of total PV installations even with capacity additions.[40] In addition, the degree to which thin film products can substitute for CSPV modules is generally dependent on the market segment, or even specific project, being supplied. Purchasers responding to the Commission's questionnaire provided mixed responses regarding the degree to which thin film can be substituted for CSPV products.[41] Thin film can be substituted for CSPV modules in many utility applications, but there is less substitutability within residential and nonresidential applications.[42]

In summary, any government action that leads to substantially higher prices for CSPV modules would likely cause cost-sensitive consumers, which now account for the majority of the market, to find alternatives for those modules. As a result, solar energy production would likely decline relative to traditional and other renewable forms of energy. Therefore, demand for CSPV modules is highly reactive to changes in price.

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[38] CR at V-14; PR at V-8. U.S. producers reported that the decrease in the price of solar generated electricity has been driven by CSPV market competition. CR at V-63; PR at V-42.

[39] Energy Acuity, *2016 Solar Report: Utility Scale*, 2017, p. 10 (EDIS Doc. 623321 file ID 1226579 at 76) ("*2016 Solar Report: Utility Scale*"); Seeking Alpha, "First Solar (FSLR) Q3 2017 Results - Earnings Call Transcript," October 26, 2017 (EDIS Doc. 627085 file ID 1238004 at 27) ("First Solar Q3 2017 Results"); Solar Frontier, "Solar Frontier Americas Enters Into 150 MW Solar Module Supply Agreement With Cypress Creek Renewables," News release, March 29, 2016 (EDIS Doc. 627084 file ID 1237995 at 57); Solar Frontier, "Solar Frontier Americas Nears Completion of 106 MW of Utility-Scale Solar Projects in Southern California," News release, December 13, 2016 (EDIS Doc. 627084 file ID 1237995 at 61).

[40] Petitioners assume that there will be 0.9 GW of thin film in 2018 in response to a restrictive trade remedy. SolarWorld Prehearing Remedy Brief at 16. Respondents estimate that there would be 3 GW of thin film in the U.S. market in 2018. Hearing Tr. at 217 (Prusa). In 2016, installations of First Solar's thin film modules in the United States totaled 1.7 GW. 8minuteenergy Posthearing Injury Brief, Exhibit 16. First Solar is projecting 2 to 3 GW of global production capacity in 2018, 3.5 GW in 2019 and 4 GW in 2020. A portion of First Solar's production during these years is booked for projects outside the United States. First Solar Q3 2017 Results. Solar Frontier's production capacity is 1.1 GW. Solar Frontier Website, http://www.solar-frontier.com/eng/company/production/index.html (accessed October 23, 2017) (EDIS Doc. 627085 file ID 1238007 at 53).

[41] CR at V-19; PR at V-12.

[42] First Solar was the largest individual PV module supplier to the utility segment in the U.S. in 2016. However, thin film accounted for less than 1 percent of installations in the residential and nonresidential segments. *2016 Solar Report: Utility Scale* at 10; *Tracking the Sun* Data File.

iii. Imports supply the U.S. market, and U.S. capacity will remain limited without substantial investment

In 2009, the first year of the period examined in *CSPV I*, the U.S. industry was the largest source of CSPV products to the U.S. market.[43] At that time, the U.S. market for CSPV products was considerably smaller than during the period covered by this investigation, and was characterized primarily by sales to the residential and nonresidential segments.[44] Most customers purchased renewable energy equipment for non-economic reasons, such as growing consumer interest in solar power and the existence of government renewable energy mandates.[45] Although sales to the utility sector were growing rapidly, these were primarily driven by state renewable portfolio standard requirements.[46]

The CSPV product market has grown substantially since that time, particularly within the past five years.[47] Although demand is still partially supported by consumer interest in renewable energy and government incentive programs, growth is now driven primarily by the increasing economic attractiveness of solar energy, as discussed above.[48] The drop in CSPV module costs was a major factor driving the increased cost-competitiveness of solar energy and the surge in demand for CSPV products. As stated in the Views of the Commission on Injury, the availability of low-priced imports of CSPV modules was the primary reason for the decline in CSPV module prices in the United States. However, declining module prices also led to consistent unprofitability, underinvestment, and substantial loss of market share for the domestic industry. In particular, domestic producers were unable to achieve levels of capacity necessary to compete for most utility projects, even as this market segment became the largest source of growth. As a result, the domestic industry accounted for a tiny portion of the market for CSPV products by 2016.[49]

As a result of the serious injury caused by imports, the existing U.S. industry will likely be able to supply only a small share of the U.S. market under current demand projections, even if imports substantially decline due to a restrictive trade remedy. In 2016, the domestic industry's reported CSPV module production was only 669 MW and its capacity was 1.25 GW, equivalent to *** percent and *** percent of apparent U.S. consumption, respectively, in that year.[50] However, even these volumes substantially overstate the industry's ability to serve the U.S. market due to the industry's comparatively small CSPV cell production capacity. The industry's CSPV cell production was *** and capacity was *** in 2016.[51] In addition, most of

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[43] *CSPV I* Confidential Views of the Commission ("*CSPV I* Views") at 37-38.

[44] *CSPV I* Staff Report at Figure II-1 (showing 195 MW of shipments to the residential sector in 2009, 241 MW to the nonresidential sector, and 30 MW to the utility sector) and Table C-7.

[45] *CSPV I* Views at 32-36.

[46] *CSPV I* Staff Report at II-3.

[47] CR/PR at Table C-1b.

[48] Bloomberg New Energy Finance Injury Hearing Presentation, slide 9; GTM Research Remedy Hearing Presentation, Slide 12.

[49] CR/PR at Table C-1b.

[50] CR/PR at Table III-7 and Table C-1b.

[51] CR/PR at Table III-4.

the industry's excess cell production capacity in 2016 was the result of Mission Solar ceasing commercial production in that year and Tesla producing only for R&D purposes.[52] Not counting these two firms' transitioning operations, the U.S. industry had minimal additional capacity to produce cells in 2016.[53]

Domestic module capacity has consistently remained underutilized due to the inability of module producers, particularly those without integrated cell production, to source sufficient volumes of cells. Domestic integrated cell producers have never made commercial quantities of cells available to independent module producers.[54] Independent module producers and even integrated producers have therefore had to rely on imported cells in order to produce modules domestically.[55] Many independent module producers responding to the Commission's questionnaire indicated that they did not support these petitions, or expressed concern regarding the degree to which any safeguard action would restrict CSPV cell imports.[56]

Petitioners project that the U.S. industry will substantially increase its CSPV cell production in 2018 and thereafter in order to supply the large majority of domestic module production, including independent module producers.[57] They project that domestic module capacity will increase from 1.25 GW in 2016 to 1.75 GW by 2018 due to an expectation that Tesla will substantially increase CSPV module production in that year.[58] In addition, petitioners estimate that domestic cell capacity will substantially increase from *** in 2016 to *** by 2018.[59] Even under these optimistic estimates, domestic producers' cell capacity would still account for only a small minority of expected U.S. PV installations in 2018 and thereafter.[60]

Petitioners' modest estimates for future CSPV cell production are also likely overstated.[61] Two of the firms included in petitioners' projections, Mission Solar and Suniva, were not, in fact, producing CSPV cells at the time of this investigation. Mission Solar ceased cell production in 2016 and has no stated plans to restart these operations.[62] Suniva ceased operations after filing for protection under Chapter 11 of the bankruptcy laws and has laid off

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[52] CR/PR at Table III-4; CR at III-10 and III-16; PR at III-5 and III-9.

[53] CR/PR at Table III-4.

[54] *CSPV I* Staff Report at Table III-6; *CSPV II* Staff Report at Table III-7; CR/PR at Table III-9.

[55] CR/PR at Table II-7.

[56] *See e.g.*, Mission Solar Posthearing Remedy Brief at 2-8; Tesla Posthearing Remedy Brief at 2-3, 8-9; Auxin Solar Posthearing Remedy Brief at I-8-12; CR/PR at Table I-2.

[57] SolarWorld Prehearing Remedy Brief at 17; Suniva Posthearing Remedy Brief, Exhibit 5 at 18; Remedy Hearing Tr. at 172 (Card).

[58] SolarWorld Prehearing Remedy Brief at 15, 17.

[59] SolarWorld Prehearing Remedy Brief at 17.

[60] *Compare* to CR/PR at Table C-1b (apparent U.S. consumption) and SEIA Posthearing Remedy Brief, Exhibit 32 (actual and projected PV installations, by year).

[61] For 2018, SolarWorld assumes that the domestic industry will have the same cell capacity as presented in the staff report, which contains information provided in response to the U.S. producer questionnaire, in addition to 300 MW of cell capacity added by Suniva in late 2016 and 500 MW of cell capacity for Tesla/Panasonic. SolarWorld Prehearing Remedy Brief at 17; CR/PR at Table III-4. *See also* Suniva Posthearing Remedy Brief, Exhibit 5 at 18.

[62] CR at III-10; PR at III-5; Mission Solar Posthearing Remedy Brief at 8.

its workforce.[63] Although Suniva reports that it could restart operations in a few months, this would be contingent upon the company emerging successfully from bankruptcy with sufficient financing to restart commercial operations, gaining new customers, and hiring a full new workforce.[64] Collectively, these two firms account for *** of petitioners' cell capacity projections for 2018.[65] In addition, Tesla has stated that it will likely produce *** of CSPV cells that petitioners asserted Tesla would produce that year.[66] Although Tesla has ambitious plans to increase its CSPV cell production ***.[67]

As petitioners and respondents recognize, U.S. producers would have to substantially increase capacity in order to compete successfully with imports after any safeguard actions terminate.[68] Producers with higher capacity and productive output are able to achieve lower fixed costs on a per-unit basis, obtain lower prices for raw materials, and operate more efficiently, and are therefore in a better position to compete more effectively against low-priced competitors.[69] Higher capacity also allows producers to compete for utility projects, particularly the largest installations which require substantial volumes on relatively short timetables.[70] In addition, the domestic industry would have to be able to supply sufficient quantities of the types of products demanded by utility customers, including 72-cell CSPV modules.[71]

At the Commission's hearing on remedy, the CEO of SolarWorld stated that his vision for a healthy U.S. industry would include five to six CSPV producers each with one GW or more of integrated cell and module capacity.[72] In order to achieve these capacity levels, more than *** the amount of any current U.S. producer, new and existing producers would have to attract massive amounts of additional investment.[73] Petitioners assert that several foreign firms will

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[63] CR at III-15; PR at III-8; Hearing Tr. at 95-96 (Card).

[64] CR at III-14-15; PR at III-8; Suniva Posthearing Remedy Brief, Exhibit 5.

[65] SolarWorld Prehearing Remedy Brief at 17; CR/PR at Table III-4.

[66] Tesla Posthearing Remedy Brief at 16; SolarWorld Prehearing Remedy Brief at 17; CR/PR at Table III-4.

[67] Tesla Posthearing Remedy Brief at 15-16.

[68] SolarWorld Posthearing Remedy Brief, Exhibit 1 at 6; Remedy Hearing Tr. at 72, 122-123 (Stein), 140 (Brightbill), 359 (Cornelius); Suniva Posthearing Remedy Brief, Exhibit 5, Attachment B at 8; SEIA Prehearing Remedy Brief at 3, 51.

[69] Remedy Hearing Tr. at 122 (Stein), 350-351 (Fenster); *New Solar System* at 116-117.

[70] Injury Hearing Tr. at 260 (Cornelius), 334 (Shugar). According to the U.S. Energy Information Administration (EIA), the average utility project increased from 10 MW in 2014 to more than 17 MW in 2016, and according to respondent SEIA, 82 percent of utility installations in 2016 were greater than 20 MW, and 13 percent were less than 10 MW. CR at V-3 at n.10; PR at V-2 at n.10.

[71] Hearing Tr. at 174, 217 (Messer), 259 (Cornelius), 278 (Dougan). In 2016, U.S. producers accounted for *** percent of 72-cell modules sold in the United States.

[72] Remedy Hearing Tr. at 72, 122-123 (Stein).

[73] SolarWorld estimates that adding an additional ***. SolarWorld Posthearing Remedy Brief, Exhibit 1. An executive from NRG Renewables referenced that building a new manufacturing facility would require $500 million over 18 months. Hearing Tr. at 343 (Cornelius).

start producing CSPV products in the United States if a restrictive remedy is imposed.[74] However, almost all of these future investments referenced by petitioners would be in CSPV module manufacturing, which would not address the shortage of U.S.-produced CSPV cells or result in the creation of additional large integrated producers.[75] Other than current U.S. producers, no firm has made any representation before the Commission that that it would invest in or produce CSPV products here in the United States. The lack of tangible interest demonstrated by new suppliers detracts from petitioners' arguments that there will be a large domestic CSPV industry with multiple integrated manufacturers within the foreseeable future.

As ambitious as they are, current U.S. producers' investment plans would continue to leave most of the market reliant on imports, even if those firms were able to attract sufficient capital. SolarWorld and Suniva each stated that they anticipate *** additional CSPV cell and module manufacturing capacity as a result of a restrictive safeguard action, with *** over the course of their proposed four-year adjustment period.[76] However, SolarWorld plans to continue to serve primarily nonresidential and residential customers despite the utility segment being by far the largest market segment.[77] As discussed above, Suniva is currently heavily in debt and working through Chapter 11 bankruptcy proceedings, and therefore its ability to attract additional financing for ambitious expansion plans is uncertain.[78] Tesla, which opposes import restrictions, anticipates producing *** of CSPV cells, *** of solar roof tiles, and *** of CSPV modules by 2019. Tesla emphasizes, however, that it ***.[79] Likewise, all of the other current U.S. producers that identified additional investments were independent module producers that rely primarily on imported CSPV cells.[80]

In light of these considerations, it is clear that the U.S. market will rely heavily on imported CSPV modules throughout the next several years at least. Even the most optimistic U.S. production targets for CSPV modules would not lead to U.S. producers accounting for more than a small share of total sales in the market. In addition, U.S. production of CSPV modules at much higher levels will require substantial volumes of imported CSPV cells.

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[74] SolarWorld Posthearing Remedy Brief, Exhibit 2 at 6-8. SolarWorld's assertions are primarily derived from a single news article referring to several foreign CSPV cell and module makers that said that they were exploring options for U.S. production without making any concrete commitments. SolarWorld Prehearing Remedy Brief, Exhibit 1. SolarWorld also draws on several other vague sources of information, including *** as well as a foreign producer's short press release announcing an undefined investment in the United States. SolarWorld Posthearing Remedy Brief, Exhibits 11 and 25.

[75] SolarWorld Posthearing Remedy Brief, Exhibit 2 at 6-8.

[76] SolarWorld Posthearing Remedy Brief, Exhibit 1; Suniva Posthearing Remedy Brief, Exhibit 5 at Attachment B.

[77] SolarWorld Posthearing Remedy Brief, Exhibit 1 at 11-12.

[78] Suniva stated that it cannot submit a formal "adjustment plan" because it is subject to bankruptcy court supervision, and is in the process of negotiating with existing creditors regarding the terms of a potential plan of reorganization. See Suniva Posthearing Remedy Brief, Exhibit 5, Attachment B at 1; Remedy Hearing Tr. at 118-120 (Card).

[79] Tesla Posthearing Remedy Brief at 15-16.

[80] CR/PR at Table II-7 and Table D-2.

iv. The broader solar industry is a major source of new employment

Despite producing only 1.4 percent of net U.S. electricity generation in 2016, solar power accounted for the largest share of new U.S. electricity generation in 2016, with 39 percent of new generating capacity.[81] Because of this rapid growth, the broader U.S. industry has developed supply chains to support the expanding deployment of solar energy across the residential, nonresidential, and utility sectors. As a result, the solar energy sector is a vibrant source of new employment in the United States. According to the U.S. Energy Information Administration (U.S. EIA), there were 373,807 U.S. workers in January 2017 that spent "some portion of their time working to manufacture, install, distribute, or provide professional services to solar technologies across the nation."[82]

Most employment within the solar energy sector is located at the end of the value chain, specifically in installation and development of utility, residential, and nonresidential projects. There were several thousand residential and nonresidential solar installing firms in the United States in 2015. Although a few installers held substantial market shares, most installers were small businesses with ten or fewer employees.[83] The utility segment is more concentrated, but is similarly diverse, with a variety of firms engaged in project development and/or engineering, procurement, and construction (EPC).[84] Solar installers include many types of workers, but are primarily those in the building trades, such as electricians and construction laborers.[85] There were an estimated *** workers specifically in CSPV installation and project development in the residential, nonresidential, and utility sectors in 2016.[86]

The supply chain includes producers of the capital equipment used in PV installations, such as CSPV cells and modules but also many other "Balance of System" (BOS) hardware components, such as racking and mounting equipment for modules, tracking systems for use in many utility projects, and inverters for converting direct current produced from the modules into grid-usable alternating current.[87] In response to the Commission's U.S. producer questionnaires, manufacturers reported that there were *** workers in cell production operations and 1,253 workers in module assembly in 2016.[88] In addition to these workers, there were an estimated *** workers in the BOS hardware manufacturing industries supporting

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[81] CR/PR at Figure V-2 and Figure V-3.

[82] U.S. EIA, *U.S. Energy and Employment Report*, January 2017 at 37 (EDIS Doc. 627084 file ID 1238001). In addition to employment in the CSPV supply chain, EIA's figure includes employment across other photovoltaic and Concentrating Solar Power (CSP) technologies. *Id*.

[83] CR at I-39-40; PR at I-29-30; SEIA Prehearing Injury Brief, Exhibit 6 ("Solar Jobs Census") at 17.

[84] CR at I-41; PR at I-30.

[85] Solar Jobs Census at 17.

[86] This estimate is based on firm-level and project-level employment information on the record of this investigation. Employment information was available for more than 80 percent of CSPV installations in 2016. The remaining employment was estimated based on the labor intensity of installations by market segment (distributed and utility) for the more than 80 percent of projects for which information was available.

[87] CR at I-17, 33; PR at I-12-13, 24-25; Solar Jobs Census at 23.

[88] CR/PR at Table III-16 and Table III-17.

CSPV installations specifically in 2016, almost *** times the number employed in cell and module production.[89]

Thousands of services workers also work to support CSPV deployment. These include employees at wholesale and retail trade establishments engaged in selling solar and other ancillary services to customers, as well as distributors that warehouse and distribute U.S. and foreign-made solar goods to installers.[90] In addition, there are a number of professional services workers engaged in R&D activities, financing projects, and training.[91]

Further upstream, there are a number of suppliers of the raw materials used to produce CSPV equipment, including polysilicon ingots and wafers used in cells as well as glass, aluminum, wire, and paste used to produce finished modules.[92] Manufacturers of these goods are reliant to a degree on CSPV product manufacturing in the United States.[93] However, many upstream producers also export materials to foreign CSPV cell and module manufacturers, including those that export CSPV products to the United States.[94] Therefore, while some upstream suppliers would be positively affected by improvements in domestic production of CSPV products as a result of import restrictions, those integrated into global supply chains would be negatively affected.

Any government action causing a sharp decline in demand for CSPV products will likely lead to proportionally fewer firms and workers engaged in manufacturing, selling, researching, and installing equipment used in support of CSPV deployment. A decline in CSPV deployment may be mitigated somewhat by an increase in thin film PV deployments, which may partially limit job displacement, particularly in the sectors supporting utility projects. However, the overall employment within the greater PV industry is likely to be negatively affected by any substantial decline in CSPV demand, given the dominant share of all PV projects which currently use CSPV products.

[89] This estimate is based on available information on the record of this investigation for employment at racking, mounting, and tracking manufacturers and their suppliers, as well as employment at U.S. inverter and combiner box manufacturers. This does not include all balance of system components. Employment was adjusted to exclude thin film-related manufacturing.

[90] Solar Jobs Census at 27.

[91] Solar Jobs Census at 33. The President and CEO of SunPower stated that although his firm produces CSPV products overseas, it employs over one thousand people in the United States, with many engaged in robust R&D innovation. Injury Hearing Tr. at 247 (Werner).

[92] CR at I-25-28, 31-32; PR at I-18-21, 24; Posthearing Remedy Brief of the U.S. Polysilicon Industry; Letter to the Commission from DuPont Photovoltaics & Advanced Materials; Injury Hearing Tr. at 131-135 (Byerson); Remedy Hearing Tr. at 95-98 (Ulbrich).

[93] Injury Hearing Tr. at 131-135 (Byerson); Remedy Hearing Tr. at 95-98 (Ulbrich).

[94] Posthearing Remedy Brief of the U.S. Polysilicon Industry at 14; Letter to the Commission from DuPont Photovoltaics & Advanced Materials.

v. U.S. government programs have played a role in the industry's development

The U.S. government has supported and encouraged adoption of solar energy as an alternative energy source for over six decades. In 1954, the first CSPV cell was created in the United States by Bell Labs,[95] and early CSPV products were used primarily in space applications by the National Aeronautics and Space Administration (NASA).[96] Beginning in the early 1970s and thereafter, U.S. government support largely was focused on reducing costs of deployment, improving solar energy technology, and demonstrating applications for solar energy.[97]

As the market for CSPV products rapidly expanded over the last fifteen years, the U.S. Congress has enacted legislation providing tax credits and other incentives designed to encourage U.S. manufacturing and deployment of CSPV products, among other renewable energy products. The Energy Policy Act of 2005 made investment in solar projects eligible for a 30 percent investment tax credit which continues to be one of the primary incentives encouraging solar energy deployment.[98] In addition, the Advanced Energy Manufacturing Tax Credit, which was included in the American Recovery and Reinvestment Act of 2009 (ARRA), provided a 30 percent tax credit to advanced energy manufacturers that invested in new, expanded, or reequipped manufacturing facilities built in the United States.[99] In 2010, multiple CSPV cell and module producers were awarded tax credits, including SolarWorld ($82 million) and Suniva ($6 million).[100]

Beyond tax incentives, government efforts to improve domestic solar technology and increase domestic production have been driven largely by programs at the U.S. Department of Energy (DOE). The Energy Policy Act of 2005 provided for loan guarantees to new or innovative energy technologies not commercially available. ARRA temporarily authorized DOE to provide loan guarantees for renewable energy projects using commercially available technologies,

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[95] State of California, California Energy Commission & California Public Utilities Commission, "History of Solar Energy in California," (EDIS Doc. 623277 file ID 1226486 at 593); Michaela D. Platzer, *U.S. Solar Photovoltaic Manufacturing: Industry Trends, Global Competition, Federal Support*, Congressional Research Service, January 27, 2015, at 26 (EDIS Doc. 627084 file ID 1238001 at 466) ("*U.S. Solar Photovoltaic Manufacturing*").

[96] *U.S. Solar Photovoltaic Manufacturing* at 26.

[97] Varadi, Peter F., "Terrestrial Photovoltaic Industry: The Beginning," in Solar Power for the World, 2014, p. 204-205 (EDIS Doc. 623463 file ID 1229643 at 18-19); EDIS Doc. 623277 file ID 1226487.

[98] Injury Hearing Tr. at 253 (Grace). The Investment Tax Credit for solar was first adopted as part of the Energy Tax Act of 1978, and has been continuously available since that time, with retroactive application of the credit during occasional lapses. However, it was the Energy Policy Act of 2005 that introduced the 30 percent credit. The current Investment Tax Credit has been extended twice since that time, as part of the Emergency Economic Stabilization Act of 2008 and under the Consolidated Appropriations Act of 2016. *U.S. Solar Photovoltaic Manufacturing* at 23; Lynn J. Cunningham, *Renewable Energy and Efficiency Incentives: A Summary of Federal Programs*, Congressional Research Service, December 14, 2016, at 22 (EDIS Doc 627084 file ID 1238001 at 404) ("*Renewable Energy and Efficiency Incentives*").

[99] *U.S. Solar Photovoltaic Manufacturing* at 22.

[100] EDIS Doc. 623277 file ID 1226486 at 371, 624, 860.

including to PV projects and manufacturers.[101] Before the program expired in September 2011, four PV product manufacturers received loan guarantees under this program with mixed results, although none of these firms were CSPV cell or module manufacturers.[102]

DOE also oversees the Solar Energy Technologies Program, which has been referred to as the Solar America Initiative (instituted in 2006) and the SunShot Initiative (instituted in 2011).[103] Under this program, DOE is required to "conduct a program of research, development, demonstration, and commercial application for solar energy, including photovoltaics" and other types of solar energy.[104] SunShot, the most recent initiative under this program, was created to help accomplish a number of goals in the solar sector, including to: 1) "increase PV solar cell efficiency, reduce production costs, and open new markets for solar energy"; 2) "shorten the amount of time it takes to move promising new solar technologies from development to commercialization"; and 3) "strengthen the U.S. supply chain for manufacturing and commercializing cutting-edge PV technologies."[105] Under this initiative, DOE has provided funds to projects led by universities, companies, and national laboratories designed to ensure American technological leadership, lower costs, and strengthen U.S. economic competitiveness.[106] SolarWorld and Suniva have been among the largest recipients of SunShot awards among PV manufacturers, with most of these projects relating to product development.[107] Between 2011 and 2016, these companies were awarded funds in the amount of $20.4 million under this program.[108]

In short, the U.S. government has a long history of providing substantial, if inconsistent, support to the CSPV industry and related industries involved in solar energy production. As government programs have sought to reduce costs for solar energy generation, they have also supported technological improvements and expanded production in the manufacturing sector. The U.S. government, and DOE in particular, has acquired substantial experience and expertise in advancing the viability and growth of this sector, which can inform focused efforts to facilitate the domestic industry's adjustment to import competition.

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[101] EDIS Doc. 623277 file ID 1226486 at 514.

[102] 1366 Technologies, a producer of crystalline silicon wafers (an upstream input into CSPV cells), received a loan of $150 million. 1366 Technologies remains an active producer. Solopower, a producer of a thin film technology product, was deobligated prior to withdrawing funds from a loan of $185 million. By contrast, two producers of thin film technology products, Solyndra and Abound Solar, received federally guaranteed loans of between $400 million and $535 million, and both firms ultimately defaulted and went bankrupt. EDIS Doc. 623277 file ID 1226486 at 500, 835.

[103] *Renewable Energy and Efficiency Incentives* at 5-6, 40; *U.S. Solar Photovoltaic Manufacturing* at 24; EDIS Doc. 623277 file ID 1226487 at 12-15, 25-29.

[104] 42 U.S. Code § 16231(2)(A).

[105] DOE, "The SunShot Initiative: Making Solar Energy Affordable for All Americans," June 2016 (EDIS Doc. 623277 file ID 1226486 at 1133).

[106] *Id*.

[107] DOE, SunShot Solar Projects Download, May 17, 2017 (EDIS Doc. 623277 file ID 1226486 at 286).

[108] *Id*. ***. SolarWorld Posthearing Remedy Brief, Exhibit 2 at 65.

b. Industry Adjustment Plans and Commitments

Although the Commission received no adjustment plan from petitioners (or any other domestic producer) within the 120-day time frame specified in Section 202(a)(4) of the Trade Act,[109] each petitioner subsequently submitted commitments regarding actions it intends to take to facilitate positive adjustment to import competition. I have carefully examined the company-specific commitments by SolarWorld in its posthearing remedy brief. SolarWorld outlined plans for investing to increase capacity, capacity utilization, and cost-savings; its plans for innovation and technology upgrades; its plans for R&D partnerships; and its plans for solidifying and expanding its customer base.[110] I have also examined the "prospective forward-action plan" submitted by Suniva, which indicates that its prospective plan depends on a successful agreement of a reorganization plan in its Chapter 11 bankruptcy proceeding and may change as a result of such an agreement. Suniva's prospective plan includes such objectives as quickly reactivating its production capacity, producing at full capacity, becoming profitable, resuming its R&D efforts, ***.[111] I have also considered the responses of U.S. producers to the Commission's questionnaire regarding the adjustments they would make to their operations to compete more effectively with imports if import relief were to be granted.[112]

c. Recommended Relief

i. Safeguard Action Proposals

Petitioners Suniva and SolarWorld have both proposed specific tariffs, rather than *ad valorem* tariffs, of $0.25 per watt on CSPV cells and $0.32 per watt on CSPV modules; the proposed tariffs would be in place for four years, and would be phased down annually.[113] Suniva has also proposed a minimum import price for imports of CSPV modules of $0.74 per watt which would be implemented in the form of a quota that would exclude all imports under that price; the proposed per-watt floor price would be in effect for four years, and would be increased annually.[114] SolarWorld has also proposed a quota on imports of CSPV cells of 0.22 GW, as well as a quota on imports of CSPV modules of 5.70 GW. The proposed quotas would be in place for four years, and would be increased annually.[115]

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[109] 19 U.S.C. § 2252(a)(4).

[110] SolarWorld's Posthearing Remedy Brief, Exhibit 1, at pages 5-13.

[111] Suniva Posthearing Remedy Brief, Exhibit 5, Attachment B.

[112] CR/PR at Table D-2.

[113] SolarWorld's Prehearing Remedy Brief at 10-14; Suniva's Prehearing Remedy Brief at 3-6 and Exhibit 1 at 1.

[114] Suniva's Prehearing Remedy Brief at 7-8 and Exhibit 1 at 1.

[115] SolarWorld's Prehearing Remedy Brief at 14-19. In addition to their proposals for import relief, petitioners also propose that the President take the following additional actions: 1) issue an executive order directing all U.S. government agencies to require use of U.S. origin solar cells; 2) initiate bilateral and multilateral negotiations to address global overcapacity in solar cells and modules; 3) direct his Administration to conduct a study of the cyber, electrical grid, and national security risks of using solar (Continued…)

By contrast, respondents generally urge that the Commission recommend no import relief, and that any recommended remedy should be limited to technical, financial, and trade adjustment assistance.[116] Some respondents support the institution of a small import license fee on imports of CSPV products in order to create a fund that could provide capital for investment in the domestic industry.[117]

ii. Cells and Modules Remedy Model[118]

In order to assess different remedy options on CSPV cells and modules, including tariffs, tariff-rate quotas, and quantitative restrictions, Commission staff constructed an innovative economic model of the CSPV cells and modules industry. This industry-specific partial equilibrium model is designed to estimate changes in prices and quantities of imported and domestic products, deployment of CSPV products, changes in the revenues and operating income of U.S. producers, and changes in U.S. tariff revenues that would result from potential trade remedies.[119] The remedy model in this investigation distinguishes between cell production and module production, rather than combining them into one CSPV product, and tracks different supply chains in order to allow for the model to provide estimates of different remedies on imports of cells and imports of modules.

For all of the scenarios which I analyze, I adopt several uniform assumptions. The domestic supply elasticity for both CSPV cells and modules was estimated to be between 2 and 4,[120] and I utilize *** as the domestic supply elasticity. The import supply elasticity was

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(…Continued)
panels of foreign origin in the United States; 4) provide funds to the domestic industry, which may come from collected U.S. AD/CVD duties on imports of solar cells and modules from China and Taiwan that are currently under suspension, or from any tariffs that are imposed as a result of this Section 201 proceeding, or from other sources; 5) consider taking actions to amend the Investment Tax Credit and other Federal tax incentives to stimulate U.S. solar demand and in particular for projects using domestically produced cells and panels; 6) pursue settlement negotiations with respect to the U.S. AD/CVD antidumping and countervailing duty orders on solar cells and modules from China and Taiwan and the duty deposits collected under those orders currently under suspension, as well as antidumping and countervailing duty orders imposed by China on imports of solar-grade polysilicon from the United States; 7) direct the DOE to fund the full cost of DOE SunShot Initiative research grants; and 8) direct DOL to immediately certify workers from any of the U.S. solar facilities that shut down during the period of investigation for benefits and services under the Trade Adjustment Assistance program. SolarWorld Prehearing Remedy Brief at 21-29; Suniva Prehearing Remedy Brief at 13-18.

[116] *See* SEIA's Prehearing Remedy Brief at 4, 49-50; SEIA's Posthearing Remedy Brief at 12-15.

[117] SEIA's Prehearing Remedy Brief at 56-59; SEIA's Posthearing Remedy Brief at 13-15 and Appendix A at 87-92; U.S. Polysilicon Industry's Posthearing Remedy Brief at 11-14; Tesla's Posthearing Remedy Brief at 9.

[118] *See* Memorandum EC-PP-023 (October 23, 2017).

[119] The model used in this investigation is more elaborate than remedy models in most past safeguard investigations. Those models were partial equilibrium models used to estimate the effects of trade restrictions on single industries.

[120] CR at V-25-26; PR at V-17-18.

estimated to be between 6 and 8,[121] and I utilize *** as the import supply elasticity. The demand elasticity for installed CSPV products was estimated to be between -1.5 and -1.0.[122] ***. In addition, the data used in the model is derived from the year 2016; however, because any first-year remedy would likely occur in 2018, I assume that ***.[123]

Due to my ultimate recommendation that the remedy exclude imports from specific countries that are members of certain free trade agreements and benefit from certain preferential trade programs, I exclude imports from Singapore and Canada from all remedies that I have modeled.[124]

Modeling results are presented in an appendix to these views.

iii. Impact of Restrictive Remedies on Firms and Workers

In any market for merchandise goods, tariffs increase import prices directly by applying a duty upon entry at the U.S. border, and in doing so generally lead to reduced import volumes and higher market prices. As a result, tariffs generally also result in improvements in domestic producers' output, revenues, and operating income, even as demand declines. Quantitative restrictions, or quotas, limit the supply of imports in the U.S. market, and therefore have similar effects. Tariff-rate quotas, which apply a higher tariff for imports entering beyond specified levels, also lead to similar results by combining elements of both quotas and tariffs. However, due to the competitive conditions discussed above, I find that the market for CSPV products is poorly suited to these types of trade restrictive actions. A consideration of the likely effects of petitioners' proposed remedies illustrates why this is the case.

Petitioners' requested $0.32/watt tariff on modules and $0.25/watt tariff on cells would have the effect of substantially increasing import prices,[125] and since imports comprise most of

[121] CR at V-26; PR at V-18.

[122] CR at V-27; PR at V-18.

[123] I used ***. My estimates focus on first-year effects because any remedy measures will likely have the most pronounced effects in that year, both in terms of benefits and costs.

[124] As discussed below, I recommend that that the remedy not apply to imports of CSPV products from Canada (defined based on module country of origin), as well as imports from Australia, the CAFTA-DR countries, Colombia, Israel, Jordan, Panama, Peru, Singapore, and CBERA countries (defined based on cell country of origin). With the exception of Canada and Singapore, import volumes from these countries were zero or *de minimis*, and therefore cannot be excluded from the model. *See* Views of the Commission on Injury, Section V.B.3.

[125] The model results indicate that imported cell prices are *** percent higher than baseline levels under petitioners' proposed remedies, while prices for imported modules are *** percent higher. SolarWorld's proposed quantitative restrictions of 5.7 GW for modules and 0.22 GW for cells in the first year are not "binding" in the model results; that is, they do not restrict imports or cause additional economic effects beyond those caused by petitioners' proposed tariffs. Similarly, petitioners' proposed tariffs lead to prices rising to a higher level than Suniva's proposed module price floor of $0.74 per watt, and therefore the price floor would not be binding if accompanied by those tariffs. Therefore, for purposes of this discussion, I focus on the effects of petitioners' proposed tariffs, although I recognize that the quota and price floor proposed by petitioners may have additional restrictive effects as conditions differ from 2016. For example, to the extent that prices are lower in the first year of the (Continued…)

the U.S. market, overall market prices for CSPV modules will rise substantially.[126] Demand for CSPV products is highly reactive to changes in price due to the fact that solar energy competes head-to-head with other forms of electricity, and PV installations using CSPV products will be less attractive to cost-conscious purchasers downstream. As a result of the price increases for CSPV modules, deployment of CSPV products will fall dramatically,[127] which is consistent with the decline in imports of CSPV modules.[128]

U.S. producers that have integrated cell producing operations will see increased prices, output, and operating income under this high tariff scenario.[129] However, their output gains will be limited by the extremely small size of the cell producing industry in the United States. Moreover, these benefits will not extend to most U.S. producers of CSPV products, which rely on imported CSPV cells to manufacture modules in the United States. These producers, which already operate at low capacity utilization rates and have accounted for most of the industry's closures over the last five years, will see both output and operating income decline as a result of the high tariff on imported CSPV cells proposed by petitioners.[130] It is likely that many of these producers will exit the market or will be unable to undertake planned expansions as a result of highly restrictive trade remedies.

While certain CSPV producers will likely experience modest benefits from restrictive tariffs, these benefits will be short lived. Safeguard relief is generally limited to four years or fewer, and tariffs, quotas, or TRQs must be phased out. In order to make a long-term positive adjustment to import competition, U.S. producers will have to quickly translate short-term profits into substantial investments needed to scale up operations. However, even under the most stringent remedies that petitioners have proposed, the industry will struggle to break even.[131] Therefore, U.S. producers hoping to use the remedy period to make significant

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(…Continued)
remedy than in 2016, Suniva's proposed price floor may lead to more restrictive effects than those referred to here.

[126] The model results indicate that overall market prices for CSPV modules are *** percent higher than baseline levels under petitioners' proposed remedies.

[127] The model results indicate that deployment of CSPV modules is ***, or *** percent, lower than baseline levels under petitioners' proposed remedies.

[128] The model results indicate that imports of CSPV modules are ***, or *** percent, lower than baseline levels under petitioners' proposed remedies.

[129] The model results indicate that output of U.S. modules using U.S. cells is *** percent higher than baseline levels under petitioners' proposed remedies. The price of U.S. modules using U.S. cells is *** percent higher baseline levels. U.S. producers' operating income from U.S. modules using U.S. cells is higher by $***.

[130] The model does not distinguish between the volume of imports of foreign cells and the output quantity of U.S. modules using foreign cells. The model results indicate that output of U.S. modules using foreign cells is *** percent lower than baseline levels, and U.S. producers' operating income from selling U.S. modules using foreign cells is $*** lower.

[131] The model results indicate that the domestic industry's overall operating income, including from U.S. modules produced from U.S. and foreign cells as well as foreign modules using U.S.-produced cells, is $*** higher under petitioners' proposed remedies. By contrast, the industry's operating loss in 2016 was $***. CR/PR at Table C-1b. The industry's operating loss in 2016 was due in part to *** which, due (Continued…)

investments will likely find it difficult to attract the additional capital needed to substantially expand capacity. Investors will not likely be drawn to the modest profits offered by U.S. producers given their knowledge that the U.S. market will once again be exposed to global oversupply conditions upon the termination of the remedy.[132]

Similarly, the model demonstrates that U.S. producers' short-term benefits from restrictive tariffs will likely come at the cost of a sizable decline in demand, as measured by deployment of CSPV products.[133] Although petitioners argue that changes in demand will be minimal and that any short-term impact on demand will likely reverse after the safeguard remedies expire,[134] many market participants testified that they expect these adverse effects on demand for solar energy to have long-term impacts on the market. Many long-term utility projects that would have otherwise been served by CSPV modules will likely lose bids to suppliers of alternative sources of energy.[135] In addition, the Investment Tax Credit, which is scheduled to begin phasing out after 2019, would be considerably less of an incentive by the time the remedy terminates.[136] A restrictive trade remedy would also inject uncertainty into the marketplace and affect the flow of capital into the overall sector.[137] Finally, the short-term effects on demand caused by a four-year restrictive trade remedy would cause many businesses in the greater sector, including those with substantial cutting-edge expertise and invested capital, to go out of business or otherwise leave the market.[138] Therefore, any temporary gains made by certain U.S. producers as a result of petitioners' proposed remedies

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(…Continued)
to its nature, cannot occur again. CR at III-53; PR at III-27. If the domestic industry's operating loss in 2016 excludes this ***, it would be $***. Modified table C-1b, EDIS Doc. No. 628217. Therefore, the operating income gains made by the industry as a result of petitioners' proposed tariffs would barely allow the domestic industry to break even, if at all.

[132] As stated in the Views of the Commission on Injury, there have been many shutdowns of CSPV cell and module producers over the 2012 to 2016 period. CR/PR at Table III-3. An executive for NRG Renewables, an independent power producer, stated that there has been "massive destruction" of venture capital and private equity capital in the solar industry over the last ten years as a result of losses in the manufacturing sector, which has led to less investor enthusiasm for new solar manufacturing projects. Remedy Hearing Tr. at 343 (Cornelius).

[133] The model results indicate that deployment of CSPV products declines to *** in 2018 as a result of petitioners' proposed remedies, down from a baseline of *** in that year. This result is consistent with modeling results provided by external sources. For example, the IHS Markit Deployment/JEDI Jobs model provided by SEIA indicates that Petitioners' proposed remedies result in CSPV deployment of 4.9 GW in 2018, down from *** projected in that year. Joint Respondents' Remedy Hearing Presentation at 26. The GTM Research model shows that a $0.30 per watt tariff results in PV deployment, including thin film, of 7.7 GW in 2018 compared to baseline installations of 10.9 GW in that year. SEIA Posthearing Remedy Brief, Exhibit 2 at 36.

[134] SolarWorld Prehearing Remedy Brief at 41; SolarWorld Posthearing Remedy Brief, Exhibit 2 at 49-50 Suniva Posthearing Remedy Brief, Exhibit 5 at 11-12.

[135] Hearing Tr. at 299-300 (Shiao), 300-301 (McLaughlin).

[136] Hearing Tr. at 300 (Shiao).

[137] Hearing Tr. at 301-303 (O'Sullivan).

[138] Hearing Tr. at 300-301 (Werner, O'Sullivan).

would likely have lasting adverse impacts on demand for CSPV products, which would limit the degree to which the industry can make a positive adjustment to import competition after the remedies expire.

Finally, many of the businesses and workers comprising the broader solar industry in the United States would be adversely affected by any significant decrease in demand caused by petitioners' proposed remedies. Based on the model results, which indicate a dramatic decrease in deployment of CSPV products in the first year, I estimate that petitioners' proposed remedies would displace as many as 30,914 workers in the industries manufacturing BOS equipment and installing/developing CSPV projects.[139] In addition, thousands of jobs in other parts of the broader solar industry rely on high domestic deployment, including those involved in R&D, sales and distribution, and other services.[140] These jobs would also likely be adversely affected by a substantial decline in CSPV deployment. By contrast, there were substantially fewer jobs in the CSPV product manufacturing sector in 2016.[141] Therefore, the increase in domestic output of CSPV products resulting from petitioners' proposed remedies would not likely lead to substantial increases in employment within the CSPV manufacturing sector relative to the losses experienced elsewhere within the solar sector.[142]

Changes in employment within the broader solar industry, or in the CSPV manufacturing industry, are not net employment effects and may not meaningfully affect national unemployment rates. Displaced CSPV installation and development workers may find work supporting other types of electricity generation, in other areas of the construction sector, or in other industries. In addition, some workers may not lose their jobs if declining CSPV deployment is partially offset by increasing use of thin film in PV installations. However, this does not mitigate adverse displacement effects, as potentially hundreds of firms and tens of thousands of workers would see their economic opportunities within the CSPV sector severely diminished as a result of the remedies proposed by petitioners. In addition, CSPV products are

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[139] There were approximately *** workers in the installation/project development sectors, and *** workers in the BOS sector in 2016. ***. Therefore, I use a *** workers, which is *** employment. I conclude that petitioners' preferred remedies, which result in first-year deployment being *** percent lower in our model results, could lead to displacement of 30,914 fewer workers within these sectors.

[140] Solar Jobs Census at 27, 33.

[141] In 2016, CSPV manufacturers reported that there were *** workers in cell production operations and 1,253 workers in module assembly in the United States. CR/PR at Tables III-16 and III-17.

[142] Petitioners also argue that additional manufacturing of CSPV products in the United States will lead to increased employment in upstream manufacturing sectors, including those producing polysilicon, glass, aluminum, and paste. SolarWorld Prehearing Remedy Brief at 40; Exhibit 26. Respondents assert that upstream employment is driven by deployment of CSPV products, like all other sectors within the supply chain. Remedy Hearing Tr. at 365-366 (Prusa). Upstream suppliers have provided testimony supporting both arguments on this issue. Injury Hearing Tr. at 131-135 (Byerson); Remedy Hearing Tr. at 95-98 (Ulbrich) (stating that their upstream manufacturing output would increase in response to higher U.S. CSPV product manufacturing); Posthearing Remedy Brief of the U.S. Polysilicon Industry at 14; Letter to the Commission from DuPont Photovoltaics & Advanced Materials (stating that their upstream manufacturing output would be adversely affected by declining demand for CSPV products as a result of a restrictive remedy).

unique among energy-generating equipment, in that modules can be installed easily on residential structures in a way that is not as feasible for other types of equipment, including certain thin film modules.[143] As a result, the residential segment of the CSPV installation sector has been a substantial source of the employment created in the broader solar energy industry.[144] Although the most severe demand effects would likely be in the utility segment due to the direct cost competition with other sources of energy,[145] cost-conscious consumers in the residential segment would also likely demand fewer CSPV modules in response to lower savings.[146] Therefore, it is likely that a rapid increase in prices for CSPV products and a decline in CSPV deployment would have devastating effects for many of the small firms and construction workers engaged in residential installations.

In summary, under petitioners' proposed remedies or any restrictive alternative remedy, only a small portion of the CSPV industry would benefit, and many other firms and workers within and outside the CSPV industry would be much worse off. In addition, even those few producers of CSPV products that would benefit under these remedies would experience only temporary and modest performance improvements, accompanied by substantial and potentially lasting damage to their own market. Under these conditions, it is unlikely that the industry will be able to attract sufficient investment to be able to make a positive adjustment to import competition upon termination of the remedies.

Although petitioners' proposed remedies offer an extreme scenario, lower tariffs will also have dramatic effects on demand and prices in the market, while leading to fewer gains in output and profitability for U.S. producers.[147] In light of the unique competitive conditions in the U.S. market for CSPV products, I do not recommend the imposition of a duty, TRQ, or a trade-limiting quantitative restriction. Instead, as discussed below, I recommend a quantitative restriction set at levels that will not disrupt expected growth in CSPV demand but will help address the serious injury to the domestic industry by stabilizing import levels and preventing further surges.

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[143] As noted above, thin film accounted for less than 1 percent of residential installations in 2016. First Solar, the largest global thin film producer, primarily supplies products to the nonresidential and utility market segments. NREL, Tracking the Sun Public Data File, Tracking the Sun Public Data File, September 21, 2017; First Solar, "Form 10-K," Annual Filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2016, pp. 2, 5-7, 10.

[144] SolarWorld Posthearing Remedy Brief, Exhibit 2 at 79-80; Injury Hearing Tr. at 269 (Fenster).

[145] SolarWorld Posthearing Remedy Brief, Exhibit 2 at 78.

[146] At the Commission's hearing on remedy, witnesses for GTM Research and Sunrun explained that when residential households see less than 10 percent savings relative to the cost of buying energy from utilities, they frequently forego household solar installations. GTM Research Remedy Hearing Presentation, Slides 13-14; Remedy Hearing Tr. at 213 (Shiao), 233-235 (Fenster). *See also* Cory Honeyman, MJ Shiao, and Benjamin Gallagher, *U.S. Solar Outlook Under Section 201*, GTM Research, 11-13 (EDIS Doc. 623265).

[147] For example, I considered model results from a 25 percent tariff on CSPV modules and a 0 percent tariff on CSPV cells, which are presented in the "25/0 % AVT" scenario in the Appendix. These results demonstrate that the domestic CSPV manufacturing industry would experience lower overall gains than the scenario described above, while deployment will still decline substantially.

iv. Quantitative Restriction

I recommend that the President impose a quantitative restriction on imports of CSPV products into the United States, including cells and modules, for a four-year period. I recommend that the quantitative restriction be set at 8.9 gigawatts in the first year, and increase by 1.4 gigawatts each subsequent year.[148] I recommend that the President administer quantitative restrictions on a global basis, as opposed to a country-specific basis due to the rapidly changing nature of available global supply. I also make several recommendations on whether and how the quantitative restriction should apply to specific countries under the implementing statutes of certain free trade agreements and under statutory provisions related to certain preferential trade programs, which I discuss in greater detail below.

As discussed above with respect to petitioners' proposed remedies, I find that any action that severely restricts imports or causes import prices to increase will likely lead to higher overall market prices and lower CSPV deployments, while providing only very limited benefits to U.S. producers of CSPV products. For this reason, I do not recommend any measure that is likely to result in substantially lower imports than would likely occur under projected conditions. That said, my proposed quantitative restriction for the first year is set at a volume intended to stabilize imports at a level lower than the volume that occurred in 2016. I have also recommended increasing the annual quantitative restriction steadily in each successive year to accommodate expected growth. These remedies will help address the serious injury to the domestic industry by preventing further surges in imports in response to changes in U.S. demand or in response to higher than expected global supply.

In accordance with Section 1102 of the Trade Agreements Act of 1979 and the President's authority in section 203(a)(3)(F) of the Trade Act, I also recommend that the President administer these quantitative restrictions by selling import licenses at public auction at a minimum price of $0.01 per watt. The license program could be administered using the expertise of the DOE in conjunction with the U.S. Department of Treasury or U.S. Customs and Border Protection. Such import license auctions offer several advantages. Because the quantitative restrictions are set at a level consistent with projected PV installations, it is likely that there will be sufficient licenses to meet domestic demand for imports, and most auctions will not result in additional costs to importers beyond the $0.01 per watt minimum.[149] Both

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[148] A quantitative restriction must permit the importation of a quantity or value of the article "which is not less than the average quantity or value of such article entered into the United States in the most recent 3 years that are representative of imports of such article and for which data are available." Section 203(e)(4) of the Trade Act. As discussed in greater detail within the Views of the Commission on Injury, imports in 2016 were at far higher levels than in prior years due in part to the expectation that the Investment Tax Credit would expire that year. Therefore, using 2013 to 2015 as the "the most recent 3 years that are representative of imports" of CSPV products, the average quantity of CSPV products imported into the United States was ***. CR/PR at Table C-1b. The quantitative restriction that I have recommended is higher than this threshold quantity.

[149] I use the Cells and Modules Remedy Model to analyze the likely economic effects of this remedy for the first year. Using the assumption that PV deployments would decline by *** percent, I project that baseline demand for imported CSPV cells and modules from countries other than Singapore and (Continued…)

petitioners and respondents assert that a $0.01 per watt import license fee will not limit trade.[150] However, if there is greater demand for imports than expected, there will likely be greater competition for available import licenses. Under most quotas, import prices would increase under these circumstances, leading to economic rents being captured by foreign exporters. However, if import licenses are auctioned, those rents are collected as U.S. government revenues instead. Such auction prices under the proposed quantitative restriction also have benefits over tariffs, in that they would only cause increased market prices in response to unexpected increases in demand.[151]

Having made an affirmative finding with respect to imports from Mexico (with imports of CSPV modules from Mexico defined based on the country where the module was produced) under section 311(a) of the NAFTA Implementation Act, section 312(d) requires that any action proclaiming a quantitative restriction shall permit the importation of a quantity of the article that is not less than the quantity of such article imported during the most recent period that is representative of imports of such article, with allowances for reasonable growth.[152]

I recommend that the President allocate no less than 720 megawatts of the global quantitative restriction to imports of CSPV products from Mexico during the first year, which would expand by 115 megawatts each year. Importers from Mexico would need to buy import licenses at a minimum price of $0.01 per watt. As stated above, I recommend that the remainder of the quantitative restriction be administered on a global basis. However, I also recommend that the President allow importers from Mexico to acquire import licenses under the public auction system from the remainder of the global allocation, if there are no longer available import licenses within the Mexico-specific allocation.

Having made a negative finding with respect to imports from Canada (with imports of CSPV modules from Canada defined based on the country where the module was produced)

(…Continued)
Canada would be *** in 2018. Because an 8.9 GW quantitative restriction on all CSPV products would therefore not be binding under this scenario, I did not include that restriction in the model. However, I did include a $0.01 per watt “tariff” on CSPV cells and modules, which had minimal effects on all relevant economic indicators. The model results indicate that the quantity of imported cells would fall by *** percent and the quantity of imported modules would fall by *** percent, while deployment would fall by *** percent. Overall market prices would increase by *** percent and the industry’s overall operating income would increase by about $***.

[150] Suniva Posthearing Remedy Brief, Exhibit 5 at 22; SolarWorld Posthearing Remedy Brief, Exhibit 2 at 58-59; SEIA Posthearing Remedy Brief, Attachment 1 at 87-88.

[151] Importers could seek to gain an advantage in the U.S. market by acquiring licenses at high auction prices and then importing less than the amount they have licenses for after effectively shutting out other importers. However, this risk could be mitigated by penalizing importers engaging in this practice using monetary fines or other deterrents.

[152] Imports from Mexico increased in uneven amounts during the 2012 to 2016 period, rising most significantly between 2012 and 2013 and between 2014 and 2015. Therefore, no individual year or set of years within this five-year period is more representative of imports from Mexico than any other. The average annual import quantity entering from Mexico was *** between 2012 and 2016, which I consider to be representative for this period. CR/PR at Table C-1b.

under section 311(a) of the NAFTA Implementation Act, I recommend that the quantitative restriction not apply to imports from Canada. Furthermore, I recommend that this quantitative restriction not apply to imports from Australia, the CAFTA-DR countries, Colombia, Israel, Jordan, Panama, Peru, Singapore, and the CBERA beneficiary countries.

v. Assistance to Facilitate Production Activities in the CSPV Industry

The Commission is authorized to recommend one or more appropriate adjustment measures, including the provision of trade adjustment assistance.[153] Such measures may include a variety of industry support programs, including programs used to support positive adjustment for both workers and firms.[154]

As discussed above, I recommend that the President impose a quantitative restriction on imports of CSPV products in the amount of 8.9 GW in the first year, to be administered on a global basis, using an import license auction program with a minimum price of $0.01 per watt. If all import licenses are sold at this price, it will generate U.S. government revenues of $89 million in the first year, and this amount would increase each year along with the number of available licenses under my proposed remedy.[155] Therefore, if all import licenses are sold at the minimum auction price, it will generate $440 million in government revenues over four years, a number which could potentially be far greater if there is competition for those licenses.

U.S. producers have submitted information about the types of investments that they plan to undertake over the next several years. These include cell and module capacity increases, technological improvements, and the rehiring of workers, and are anticipated to cost several hundred million dollars. As asserted by both petitioners and respondents, and as discussed in greater detail above, the U.S. industry will need to make these investments in order to achieve the economies of scale, maintain technological superiority, and reach maximum efficiency needed to be globally competitive with foreign producers. I have found that the domestic CSPV industry will likely not be able to attract investments or benefit in the long term if restrictive remedies result in lasting damage to the CSPV market. However, such investment is nonetheless necessary for the industry to make a positive adjustment to import competition.

In order to encourage these investments, I recommend that the President, to the extent permitted by law, authorize that the use of funds equal to the amount generated by import license auctions be provided for development assistance to domestic CSPV producers for the duration of the remedy period. The $440 million in additional revenues derived from the sale

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[153] 19 USC 2252(e)(2)(D).

[154] *Omnibus Trade and Competitiveness Act of 1988 (OTCA), Conference Report to Accompany H.R. 3*, Rept. 100-576, 100t h Cong. 2d Sess. (1988) at 675. "The term 'adjustment measures' refers to any existing authority to provide adjustment assistances, such as community assistance programs or manpower programs, not only trade adjustment assistance. In this context, the remedy of trade adjustment assistance means benefits other than those to which workers are already entitled under chapter 2 of the Trade Act of 1974, as amended."

[155] The model results for my proposed remedy project a slight trade limiting effect from a $0.01 per watt "tariff," which would result in slightly lower first-year government revenues of $***.

of import licenses would far surpass the domestic industry's gains in operating income under even the most restrictive remedies.[156] Such assistance would therefore be far more effective than a restrictive remedy in facilitating the domestic industry's investments in its own future competitiveness, and also far less destructive to the market.

Several current domestic producers are owned by foreign entities with their own financial concerns. Therefore, any federal resources provided to the domestic industry should be devoted solely to investments in productive pursuits related to domestic CSPV product manufacturing. Such investments could include the purchase and installation of production equipment located in the United States, the hiring of U.S. production workers, and U.S.-based research and development in improved product and production engineering technologies. In order to ensure the most effective use of resources, I recommend that the President rely on the DOE's depth of experience in advancing the viability and growth of this sector. Although current DOE support for this industry is limited primarily to R&D funding programs, DOE also has extensive experience, including both successes and failures, in providing more direct financing to U.S. solar manufacturers. I recommend that the President take actions that utilize authorized programs at the DOE to the extent practicable, and work with Congress to the extent necessary to authorize and appropriate any additional resources required to accomplish these objectives.

I also recommend that the President implement other appropriate adjustment measures, including the provision of trade adjustment assistance by the United States Department of Labor (DOL) and the United States Department of Commerce (DOC) to workers and firms affected by import competition.

Workers whose positions have been eliminated because of the impact of direct trade competition are eligible for additional unemployment compensation, retraining assistance, and healthcare through Trade Adjustment Assistance (TAA) for Workers, a program administered by DOL. Given that the domestic CSPV manufacturing industry has experienced a large number of closures and idling of capacity, many workers have lost their jobs and have taken advantage of this program. Since 2012, 2,124 workers have been certified as eligible for TAA, although only 244 workers have actually participated in the program. Suniva reports that its factory in Norcross, Georgia has not yet been certified for TAA for Workers by the DOL.[157] In order for dislocated workers in the industry to experience an orderly transition to productive pursuits, as required by section 201(b)(1)(B) of the Trade Act, I recommend that the President ensure that displaced workers are able to take full advantage of TAA programs.

Companies that have been negatively affected by trade may also be eligible for technical assistance through regional TAA Centers as part of a program administered by DOC. ***.[158] Therefore, I also recommend that the President ensure that CSPV producing companies have access to technical assistance provided by the TAA for Firms program.

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[156] As discussed above, the model indicates that petitioners' proposed remedies results in the industry's operating income being *** higher than baseline projections for the first, most restrictive year of the remedy.

[157] Suniva Posthearing Remedy Brief, Exhibit 5 at 27.

[158] ***.

III. Short- and Long-Term Effects of Proposed Remedies

The decision not to take the recommended actions would likely have adverse effects on the U.S. industry, its workers and the communities where production facilities of the industry are located, and on other industries. The domestic CSPV industry, facing consistent unprofitability and underutilization of capacity, would likely continue to experience shutdowns without additional financial support and investment. The producers within the domestic industry currently have insufficient capacity to compete effectively against large foreign producers that benefit from government incentives, established supply chains, and massive economies of scale. Regardless of whether no action is taken or a restrictive remedy is applied, the domestic industry would continue to face this reality in both the short and long term without a concerted effort to facilitate the industry's planned investments, particularly those allowing it to scale up production.

As discussed above, many sectors of the broader solar industry, from installers and project developers to producers of BOS equipment, as well as an array of service providers and upstream suppliers, have benefited substantially from increased CSPV deployments. However, these firms also benefit from increasing efficiencies and technological improvements within the supply chain, of which CSPV products account for the largest share of total value added.[159] A thriving and growing CSPV cell and module manufacturing sector will help the United States continue to drive innovation within the solar energy sector. Therefore, other U.S. industries would not benefit in either the short or long term from continued serious injury to the domestic CSPV industry.

The actions I have recommended would likely result in the continued growth of the U.S. CSPV cell and module industry while avoiding damage to the broader solar industry. My proposed actions would address the serious injury to the domestic industry and facilitate positive adjustment to import competition in several ways. The quantitative restriction that I have proposed would stabilize the market and prevent further surges of imports from occurring. Although continued growth of imports would be permitted, imports of CSPV products would not overtake or outpace projected PV installations under these restrictions. To the extent that U.S. demand increases beyond these projections, the effect would be price increases rather than an injurious surge of low-priced imports, as occurred in 2016.

In addition, the domestic industry producing CSPV products would continue to face import competition, but would be supported by resources equal to the revenues generated from the sale of import licenses. These funds would be substantial, and would help the domestic industry make the investments needed to reach its own targets for production capacity, technological advancement, and employment, which both petitioners and respondents agree are necessary for the industry to be globally competitive. Firms that are successful in using these resources to make necessary investments would likely be able to

[159] SolarWorld Prehearing Remedy Brief, Exhibit 16.

compete successfully with imports after these actions terminate, given the domestic industry's strong track record of producing innovative, highly efficient CSPV products.[160]

These recommended actions would not cause reduced deployment of CSPV products or corresponding lower employment within the broader solar industry. By contrast, a more restrictive trade remedy, such as those proposed by petitioners, would cause severe damage to industries and workers relying on the continued growth of solar power as the largest source of new energy installations. In addition, higher prices for CSPV products would affect U.S. consumers that increasingly rely on solar power as an alternative source of home-generated energy, allowing them to save money on utility bills. My recommended actions would preserve this technology's successes while creating an opportunity for the domestic CSPV industry to benefit as well.

[160] See section IV.F.1 of the Views of the Commission on Injury for more detailed discussion of the domestic industry's technological leadership. The U.S. CSPV market will continue to change and evolve, and certain U.S. producers may shut down as others begin operations. I have recommended the provision of TAA for workers to provide adjustment assistance to dislocated workers.

Appendix: Modeling Results and Estimated Effects of Various Remedies

The modeling results presented here are from three remedy scenarios, which are:

- **Broadbent remedy**: My remedy includes a one cent per watt minimum import license auction price and a quota on all CSPV products that will not likely be binding under current demand projections. Therefore, I use a $0.01/watt specific tariff on both CSPV modules and cells as a proxy for estimating the economic effects of my remedy.
- **25/0 % AVT**: I considered a 25 percent ad valorem tariff on CSPV modules and a 0 tariff on CSPV cells to assess the effects of a more moderate remedy than that proposed by petitioners.
- **Petitioner remedy**: SolarWorld's proposed remedies, which Suniva agreed with, include a $0.32/watt specific tariff and 5.70 GW quota on CSPV modules as well as a $0.25/watt specific tariff and 0.22 GW quota on CSPV cells.

Additional notes and assumptions:

- All remedies modeled here assume exclusion of imports from Singapore and Canada. All other imports excluded from the remedy recommendations are *de minimis* or zero, and therefore are not excluded from the model.
- Estimates of downstream employment are derived from my own calculations based on modeling results for CSPV deployment. I assumed that downstream employment in the BOS manufacturing and project development/installation sectors would decline proportionally with CSPV deployment.
- All results are for the first year of the remedy, which would correspond most directly with 2018 based on the timing of this investigation.
- Baseline quantity and employment estimates are ***.
- I use a domestic supply elasticity of ***, an import supply elasticity of ***, and a demand elasticity of *** for all scenarios.
- Imports of modules, as presented in the results below, include CSPV modules imported from covered sources subject to the remedies, in addition to imports from countries not covered by the remedies and imports of CSPV modules made from U.S. cells.

Quantities (***)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
Imports of modules	***	***	***	***
Total CSPV module deployments	***	***	***	***

Change in Quantities (***)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
Imports of modules	***	***	***	***
Total CSPV module deployments	***	***	***	***

Change in Quantities (%)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
Imports of modules	***	***	***	***
Total CSPV module deployments	***	***	***	***

Change in Prices (%)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
Imports of cells	***	***	***	***
Imports of modules	***	***	***	***
All CSPV modules	***	***	***	***

Change in Operating Income ($ *)**

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
U.S. cells used in foreign-produced imported modules	***	***	***	***
Total U.S. operating income	***	***	***	***
***				

Estimates of Downstream Employment (Number of Workers)

Factor	***	***	***	***
Project Development/Installation	***	***	***	***
Balance of System Manufacturing	***	***	***	***
Total Downstream Employment	***	***	***	***

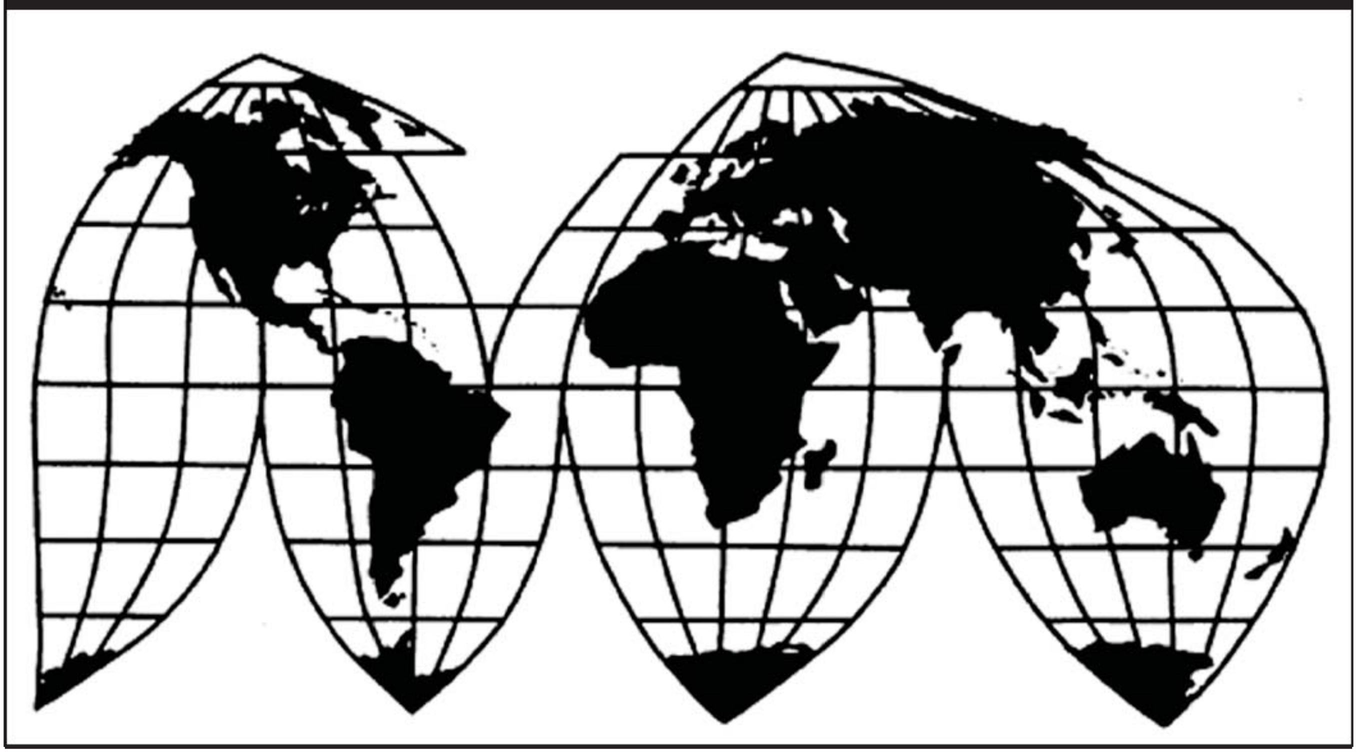
Crystalline Silicon Photovoltaic Cells (Whether or not Partially or Fully Assembled into Other Products)

Investigation No. TA-201-75

VOLUME II: INFORMATION OBTAINED IN THE INVESTIGATION

Publication 4739 **November 2017**

U.S. International Trade Commission



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Crystalline Silicon Photovoltaic Cells (Whether or not Partially or Fully Assembled into Other Products)

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Note.—Information that would reveal confidential operations of individual concerns may not be published and therefore has been deleted. Such deletions are indicated by asterisks.

PART I: INTRODUCTION

BACKGROUND

This safeguard investigation results from a petition, as amended, and properly filed on May 17, 2017, under section 202(a) of the Trade Act of 1974 (“The Act”) (19 U.S.C. § 2552(a)) by counsel for Suniva Inc. (“Suniva”). The petition alleges that certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products (“CSPV products”),[1] are being imported into the United States in such increased quantities as to be a substantial cause of serious injury, or threat thereof, to the domestic industry producing an article like or directly competitive with the imported article.[2] [3]

The following tabulation presents information relating to the background and schedule of this proceeding:[4]

Effective date	Action
May 17, 2017	Petition properly filed with the Commission; institution of inv. No. TA-201-75 (82 FR 25331, June 1, 2017)
August 15, 2017	Commission’s hearing on injury
September 22, 2017	Commission’s vote on injury
October 3, 2017	Commission’s hearing on remedy
October 31, 2017	Commission’s vote on remedy
November 13, 2017	Commission’s findings and recommendations to the President

[1] See the section entitled “The Imported Articles Described in this Investigation” in *Part I* of this report for a complete description of the merchandise subject to this investigation.

[2] Suniva initially submitted a petition to the Commission on April 26, 2017. In a May 1, 2017 letter, the Commission requested that Suniva clarify the description of the imported articles, provide more details about petitioner’s representativeness of the industry within the meaning of section 201(a)(1) of the Trade Act (19 U.S.C. § 2252(a)(1)), and supply additional data on the domestic industry’s performance indicators. In an amended petition submitted on May 12, 2017, Suniva provided additional information, including an affidavit indicating that the petition was also supported by ***. In response to telephone conferences held with Commission staff on May 15, 2017 and May 17, 2017, Suniva further amended its petition on May 17, 2017 to provide a revised description of the imported articles. The Commission determined that the petition, as amended, was properly filed as of May 17, 2017.

[3] On May 25, 2017, SolarWorld and Suniva notified the Commission that SolarWorld was joining Suniva as co-petitioner in this investigation. Letter to Secretary Barton, *Re: Petition for Global Safeguard Relief Pursuant to Sections 201-202 of the Trade Act of 1974 - Crystalline Silicon Photovoltaic Cells (Whether or Not Fully Assembled into Other Products) - Adding Petitioner and Submission of Additional Data*, May 25, 2017.

[4] The Commission’s notice of institution and scheduling are referenced in appendix A and may also be found at the Commission’s web site (internet address *www.usitc.gov*). The list of witnesses that appeared at the Commission’s injury hearing is presented in appendix B.

STATUTORY CRITERIA AND ORGANIZATION OF THE REPORT

Under the statute, the Commission considers whether "an article is being imported into the United States in such increased quantities as to be a substantial cause of serious injury, or the threat thereof, to the domestic industry producing an article like or directly competitive with the imported article."[5] Under section 202 of the Trade Act, imports have increased when the increase is "either actual or relative to domestic production."[6] This information is addressed in *Part II* of this report.

Section 202(c)(1)(A) of the Act provides that in making its determination with respect to serious injury the Commission shall take into account all economic factors which it considers relevant, including (but not limited to) "(i) the significant idling of productive facilities in the domestic industry, (ii) the inability of a significant number of firms to carry out domestic production operations at a reasonable level of profit, and (iii) significant unemployment or underemployment with the domestic industry."[7] Section 202(c)(1)(B) of the Act provides that in making its determination with respect to threat of serious injury the Commission shall take into account all economic factors which it considers relevant, including (but not limited to) "(i) a decline in sales or market share, a higher and growing inventory (whether maintained by domestic producers, importers, wholesalers, or retailers), and a downward trend in production, profits, wages, productivity, or employment (or increasing underemployment) in the domestic industry, (ii) the extent to which firms in the domestic industry are unable to generate adequate capital to finance the modernization of their domestic plants and equipment, or are unable to maintain existing levels of expenditures for research and development, {and} (iii) the extent to which the United States market is the focal point for the diversion of exports of the article concerned by reason of restraints on exports of such article to, or on imports of such article into, third country markets."[8] These factors are addressed in *Part III* of this report, except for restraints on imports in third-country markets, which are addressed in *Part I* of the report and information on market share declines, if any, which are addressed in *Part IV* of the report.

With respect to substantial cause, the Commission shall consider an increase in imports (either actual or relative to domestic production) and a decline in the proportion of the domestic market supplied by domestic producers.[9] The presence or absence of any factor that the Commission is required to consider is "not necessarily dispositive."[10] The statute also directs the Commission to consider "the condition of the domestic industry over the course of the relevant business cycle … " and provides that the Commission shall consider "factors other than imports which may be a cause of serious injury, or threat of serious injury, to the domestic

[5] Section 202(b)(1)(A) of the Trade Act; 19 U.S.C. § 2252(b)(1)(A).
[6] 19 U.S.C. § 2252(c)(1)(C).
[7] 19 U.S.C. § 2252(c)(1)(A).
[8] 19 U.S.C. § 2252(c)(1)(B).
[9] Section 202(c)(1)(C); 19 U.S.C. § 2252(c)(1)(C).
[10] Section 202(c)(3); 19 U.S.C. § 2252(c)(3).

industry."[11] Information on apparent U.S. consumption and respective market shares is provided in *Part IV* of this report, and available information on foreign industries and their participation, if any, in the U.S. market during the period of investigation is also provided in *Part IV* of this report. Information on other competitive dynamics in the U.S. market, including information on any relevant business cycle, is provided in *Part V* of this report.

SUMMARY DATA

Information obtained during the course of the investigation that relates to the applicable statutory criteria is presented throughout this report. Unless otherwise noted, data concerning the U.S. industry are based on the questionnaire responses of 16 firms that are estimated to have accounted for all known U.S. production of CSPV cells and 63.9 percent of U.S. production of CSPV modules during 2015.[12] U.S. import data are based on the questionnaire responses of 56 firms that are estimated to have accounted for 82.6 percent of U.S. imports of CSPV cells and CSPV modules during 2016.[13]

Foreign industry data are based on the questionnaire responses of 100 producers/exporters of CSPV products as follows:

- **Brazil:** 1 firm accounting for less than *** percent of 2016 module production capacity in Brazil.[14]
- **Canada:** 5 firms accounting for approximately 89 percent of 2016 module capacity in Canada.[15]

[11] Section 202(c)(2); 19 U.S.C. § 2252(c)(2).

[12] Based on a comparison of U.S. producers' reported production of CSPV modules of *** kW in 2015 with total 2015 U.S. production of modules of 864,985 kW (latest available) as reported in Energy Information Administration ("EIA"), Solar Photovoltaic Cell/Module Shipments Report, September 2016, table 6. EIA's reported production includes thin film products. Since EIA's estimate of total U.S. production of modules includes thin film products and is likely somewhat overstated for purposes of a coverage calculation for U.S. module production in this investigation, the questionnaire responses received from U.S. module producers likely account for a higher percentage of U.S. CSPV module production.

[13] Based on a comparison of the total value of 2016 U.S. imports of CSPV cells and modules from all countries reported in the responses to the Commission's U.S. importer questionnaire ($7.06 million) with total landed-duty paid value ($8.55 million) of 2016 U.S. imports of cells and modules as reported by official Commerce import statistics (HTS 8541.40.6030 and 8541.40.6020). Questionnaire data coverage presented may be imprecise because the official Commerce statistics may include other products not within the scope of this investigation, such as thin film solar products.

[14] Based on announced and publicly reported capacity by firms in Brazil.

[15] There is no known cell production in Canada. Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017; Poissant, Y. and P. Bateman, "National Survey Report of PV Power Applications in Canada," IEA PVPS, p, 20, http://www.iea-pvps.org/?id=93. One of the five responding firms in Canada (Hanwha Q Cells Canada Corp.) provided a questionnaire response with data

(*continued*...)

- **China:** 35 firms accounting for approximately 57 percent of CSPV cell production and 67 percent of module production in 2016 in China.[16]
- **Germany:** 6 firms accounting for all known CSPV cell capacity and 51 percent of module production capacity in Germany in 2016.[17]
- **India:** 5 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of module production capacity in India.
- **Indonesia:** 3 firms accounting for approximately *** percent of module production capacity in Indonesia.[18]
- **Japan:** 1 firm accounting for approximately *** percent of CSPV cell production and *** percent of module production in Japan in 2016.
- **Korea:** 4 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of module production capacity in Korea in 2016.[19]
- **Malaysia:** 10 firms accounting for all known CSPV cell capacity and 93 percent of module capacity in 2015 in Malaysia.[20]
- **Mexico:** 3 firms accounting for about *** percent of CSPV cell capacity in Mexico and approximately *** percent of module capacity in Mexico in 2016.[21]

(…*continued*)
on exports from Canada; however, the firm reported that it is not a producer of CSPV products in Canada.

[16] LV Fang, Xu Honghua, and Wang Sicheng, *National Survey Report of PV Power Applications in China 2015*, IEA Photovoltaic Power Systems Programme (IEA PVPS), pp. 16–17.

[17] The 100-percent coverage for cells is based on responses provided by all cell producers in Germany in 2016. *Photovoltaics–Made In Germany*, Germany Trade & Invest, October 2016, https://www.powerhouse-eastern-germany.de/PEG/Content/DE/Zukunftsfelder/Cleantech-Industrie/pdf_solar.pdf?v=2.

[18] Production and capacity data for Indonesia are not readily available, but there are reportedly additional producers that did not provide questionnaire responses. For a list of the six manufacturers as of 2014, see Global Business Guide, "Solar Panels in Indonesia: A Bright Future?" July 21, 2014, http://www.gbgindonesia.com/en/main/business_updates/2014/upd_solar_panels_in_indonesia_a_bright_future_.php. In addition, Canadian Solar subsequently opened a PV manufacturing plant in Indonesia. Canadian Solar, "Form 20-F," Annual Filing to the Securities and Exchange Commission, April 27, 2017, p. 63, http://investors.canadiansolar.com/phoenix.zhtml?c=196781&p=irol-sec.

[19] Chinho Park, Kang Won Kim, Jaehong Seo, Jaechon Song, and Deugyoung Jeong, *National Survey Report of PV Power Applications in Korea 2015*, IEA PVPS, September 2016, p. 21, http://www.iea-pvps.org/?id=93.

[20] The 100-percent coverage for cells is based on the fact that all known producing firms responded to the questionnaire. Sustainable Energy Development Authority Malaysia, *National Survey Report of PV Power Applications in Malaysia 2015*, IEA PVPS, p. 19. An eleventh firm in Malaysia (Canadian Solar (Malaysia)) provided a questionnaire response with data concerning exports from Malaysia; however, the firm reported that it is not a producer of CSPV products in Malaysia.

[21] IUSASOL Website, http://www.iusasol.mx/Home/why_us (accessed July 13, 2017); Manufacturer, "Desde México, Solartec se Abre Paso Por el Mundo," August 10, 2016, http://www.manufactura.mx/industria/2016/08/10/desde-mexico-solartec-se-abre-paso-por-el-mundo; Solartec Website, http://solartec.mx/index.php (accessed July 13, 2017); Solarvatio Website,
(*continued*...)

- **Netherlands:** 1 firm accounting for all known production in the Netherlands.[22]
- **Philippines:** 1 firm accounting for all known production in the Philippines.[23]
- **Singapore:** 1 firm accounting for all known production in Singapore.[24]
- **Taiwan:** 15 firms accounting for approximately 82 percent of CSPV cell capacity and 31 percent of module capacity in Taiwan in 2016.[25]
- **Thailand:** 4 firms accounting for approximately 52 percent of CSPV cell production capacity in 2016 and 44 percent of module capacity in Thailand in 2016.[26]
- **Vietnam:** 5 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of module capacity in Vietnam in 2016.[27]

A summary of data collected on CSPV products in this investigation is presented in appendix C.[28] Responses by firms to a series of questions concerning competitive efforts and

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(…*continued*)
http://solarvatio.com/energy/proceso/ (accessed July 13, 2017); PV Magazine, "Mexico's Solartec Opens up Shop in Texas," October 23, 2014, https://www.pvmagazine.com/2014/10/23/mexicossolartecopensupshopintexas_100016906/; Osborne, Mark, "Flex Confirms Solar Business with SunEdison Went From US$500 Million to Zero," PV Tech, January 27, 2017, https://www.pv-tech.org/news/flex-confirms-solar-business-with-sunedison-went-from-us500-million-to-zero; Grajeda, Jose, "Ciudad Juarez Dominates Solar Panel Manufacturing in Mexico," August 4, 2015, https://www.tecma.com/solar-panel-manufacturing-in-mexico-is-dominant-in-ciudad-juarez/.

[22] The 100-percent coverage is based on the fact that all known producing firms responded to the questionnaire. Bloomberg New Energy Finance database, https://about.bnef.com/.

[23] The 100-percent coverage is based on the fact that all known producing firms responded to the questionnaire. Bloomberg New Energy Finance database, https://about.bnef.com/.

[24] The 100-percent coverage is based on the fact that all known producing firms responded to the questionnaire. Bloomberg New Energy Finance database, https://about.bnef.com/.

[25] Percentage is based on commissioned capacity as of April 2017. Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017.

[26] Mints, Paula, "Seven Key Solar PV Industry Metrics and What they Mean to You," *Renewable Energy World*, March 29, 2017, http://www.renewableenergyworld.com/articles/2017/03/four-key-solar-pv-industry-metrics-and-what-they-mean-to-you.html.

[27] Wu, Chung-Han, "Vietnam: The New Powerhouse for Cell Manufacturing in Southeast Asia," Boviet Solar, June 2, 2017, https://www.slideshare.net/Jupiter276/vietnam-the-new-powerhouse-for-cell-manufacturing-in-southeast-asia.

[28] Tables presented in appendix C include (1) summary data concerning the U.S. market (country-of-origin based on cell manufacture location, as well as that based on module manufacture location for modules assembled in NAFTA countries), (2) summary data concerning the merchant U.S. market for cells, (3) summary data concerning the U.S. market for CSPV modules (country-of-origin based on cell manufacture location, as well as that based on module manufacture location for modules assembled in NAFTA countries), (4) apparent consumption and market share data for modules by channel of distribution, (5) apparent consumption and market share data by 60-cell vs. 70-cell modules, (6)
(*continued*...)

proposed adjustments are presented in appendix D. Responses by firms to a series of questions concerning the effects of imports on U.S. producers' existing development and production efforts, growth, investment, research and development, and ability to raise capital are presented in appendix E. Responses by firms to a series of questions concerning the significance of existing antidumping and countervailing duty orders are presented in appendix F.

PREVIOUS AND RELATED INVESTIGATIONS

Crystalline Silicon Photovoltaic Solar Cells and Modules from China (Investigation Nos. 701-TA-481 and 731-TA-1190) (November 2012)

In November 2012, the Commission determined that an industry in the United States was materially injured by reason of imports of crystalline silicon photovoltaic solar cells and modules from China that the U.S. Department of Commerce ("Commerce") found were sold at less than fair value ("LTFV") in the U.S. market and subsidized by the Government of China ("*CSPV 1*").[29] Those investigations resulted from antidumping and countervailing duty petitions filed by SolarWorld on October 19, 2011. Effective December 7, 2012, Commerce issued antidumping and countervailing duty orders on those imports.[30] Commerce determined that the country of origin of CSPV modules was the country of manufacture of the CSPV cells. Therefore, the scope of the orders did not include U.S. imports of CSPV modules assembled in China from CSPV cells made in a country other than China.[31]

Certain Crystalline Silicon Photovoltaic Solar Cells and Modules from China and Taiwan (Investigation Nos. 701-TA-511 and 731-TA-1246-1247) (February 2015)

In February 2015, the Commission determined that an industry in the United States was materially injured by reason of imports of certain crystalline silicon photovoltaic solar cells and modules from Taiwan that Commerce found were sold in the U.S. market at LTFV and imports from China that Commerce found were sold at LTFV and subsidized by the Government of

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(…*continued*)
apparent consumption and market share data by mono-crystalline vs. multi-crystalline modules, and (7) U.S. imports compiled from official U.S. import statistics.

[29] C*rystalline Silicon Photovoltaic Cells and Modules from China*, Inv. Nos. 701-TA-481 and 731-TA-1190 (Final), USITC Publication 4360, November 2012 (all six Commissioners reached affirmative determinations).

[30] *Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled Into Modules, From the People's Republic of China: Countervailing Duty Order*, 77 FR 73017, December 7, 2012; *Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled Into Modules, From the People's Republic of China: Amended Final Determination of Sales at Less Than Fair Value, and Antidumping Duty Order*, 77 FR 73018, December 7, 2012.

[31] USITC Publication 4519 at 3-4.

China ("*CSPV 2*").[32] Those investigations resulted from antidumping and countervailing duty petitions filed by SolarWorld on December 31, 2013.[33] Effective February 18, 2015, Commerce issued antidumping and countervailing duty orders on those imports from China and an antidumping duty order on those imports Taiwan.[34]

In its final *CSPV 2* determinations, Commerce defined the subject merchandise from China to include U.S. imports of the following: (1) CSPV modules assembled in China from CSPV cells made in Taiwan and (2) CSPV modules assembled in China from CSPV cells made in third countries. Commerce defined the subject merchandise from Taiwan to include U.S. imports of: (1) CSPV cells made in Taiwan; (2) CSPV modules assembled in Taiwan from CSPV cells made in Taiwan; and (3) CSPV modules assembled in third countries other than China from CSPV cells made in Taiwan. Therefore, the module assembly location mostly determined the country of origin for U.S. imports of modules (and laminates), except for modules covered by the prior *CSPV 1* orders (which were considered nonsubject merchandise from China), modules assembled in Taiwan with CSPV cells made in nonsubject countries (which were excluded from the scope of the Taiwan investigation and considered nonsubject merchandise from Taiwan), and modules assembled in third countries with CSPV cells made in Taiwan (which were considered subject merchandise from Taiwan).[35]

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[32] *Certain Crystalline Silicon Photovoltaic Cells and Modules from China and Taiwan*, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Publication 4519, February 2015 (Chairman Schmidtlein, Vice Chairman Johanson, and Commissioners Williamson and Pinkert voted in the affirmative. Commissioner Broadbent voted in the affirmative with respect to CSPV modules from China and Taiwan and in the negative with respect to CSPV cells from Taiwan (CSPV cells from China were not included in the scope as they were already covered by the *CSPV 1* orders). Commissioner Kieff did not participate in the *CSPV 2* investigations).

[33] Effective October 1, 2014, SolarWorld Industries America, Inc. changed its name to SolarWorld Americas, Inc. The petitions stated that they were also supported by the Coalition for American Solar Manufacturing, which included U.S. producers SolarWorld, ***.

[34] *Certain Crystalline Silicon Photovoltaic Products From the People's Republic of China: Antidumping Duty Order; and Amended Final Affirmative Countervailing Duty Determination and Countervailing Duty Order*, 80 FR 8592, February 18, 2015; *Certain Crystalline Silicon Photovoltaic Products From Taiwan: Antidumping Duty Order*, 80 FR 8596, February 18, 2015.

[35] *Countervailing Duty Investigation of Certain Crystalline Silicon Photovoltaic Products From the People's Republic of China: Final Affirmative Countervailing Duty Determination*, 79 FR 76962, December 23, 2014; and *Certain Crystalline Silicon Photovoltaic Products From the People's Republic of China: Final Determination of Sales at Less Than Fair Value*, 79 FR 76970, December 23, 2014; *see also* USITC Publication 4519 at 3-4, 6. The U.S. Court of International Trade affirmed Commerce's scope determinations, as further explained by the agency on remand. *See Sunpower Corp. v. United States*, CIT Ct. No. 15-00067, Slip Op. 17-89 (Ct. Int'l Trade Jul. 21, 2017); *Kyocera Solar, Inc. v. United States*, CIT Ct. No. 15-00081, Slip Op. 17-90 (Ct. Int'l Trade Jul. 21, 2017).

THE PRODUCT

The imported articles described in this investigation

The imported articles covered by this safeguard investigation are CSPV cells, whether or not partially or fully assembled into other products, including, but not limited to, modules, laminates, panels, and building-integrated materials. The investigation covers imports of CSPV cells of a thickness equal to or greater than 20 micrometers, having a p/n junction (or variant thereof) formed by any means, whether or not the CSPV cell has undergone other processing, including, but not limited to cleaning, etching, coating, and/or addition of materials (including, but not limited to, metallization and conductor patterns) to collect and forward the electricity that is generated by the CSPV cell.

Included in the scope of the investigation are imports of photovoltaic cells that contain crystalline silicon in addition to other photovoltaic materials. This includes, but is not limited to, passivated emitter rear contact ("PERC") cells, heterojunction with intrinsic thin-layer ("HIIT") cells, and other so-called "hybrid" cells.[36]

Articles under consideration also may be described at the time of importation as components for final finished products that are assembled after importation, including, but not limited to, modules, laminates, panels, and building-integrated materials.

Excluded from the scope of investigation are imports of CSPV cells, whether or not partially or fully assembled into other products, if the CSPV cells were manufactured in the United States.

Also excluded from the scope of investigation are imports of thin film photovoltaic products produced from amorphous silicon (a-Si), cadmium telluride (CdTe), or copper indium gallium selenide (CIGS).

Also excluded from the scope of the investigation are imports of CSPV cells, not exceeding 10,000mm^2 in surface area, that are permanently integrated into a consumer good whose function is other than power generation and that consumes the electricity generated by the integrated CSPV cell. Where more than one CSPV cell is permanently integrated into a consumer good, the surface area for purposes of this exclusion is the total combined surface area of all CSPV cells that are integrated into the consumer good.[37]

Like or directly competitive articles

In determining whether an article is being imported into the United States in such increased quantities as to be a substantial cause of serious injury or the threat thereof to the

[36] For a detailed description of these items, see the section in *Part I* of this report titled "Discussion of specific products."

[37] *Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products): Institution and scheduling of safeguard investigation and determination that the investigation is extraordinarily complicated*, 82 FR 25331, June 1, 2017.

domestic industry, Commission first defines "the domestic industry producing an article that is like or directly competitive with the imported article."[38] In assessing what constitutes the product(s) that is/are like or directly competitive with the imported article(s), the Commission takes into account such factors as (1) the physical properties of the article, (2) its customs treatment, (3) its manufacturing process (i.e., where and how it is made), (4) its uses, and (5) the marketing channels through which the product is sold. Information relating to these factors is presented in the sections that follow.

In the previous *CSPV 1* and *CSPV 2* antidumping and countervailing duty determinations, where the imported products were similar in scope to the imported articles covered by the current safeguard investigation, the Commission found one like domestic product consisting of CSPV cells and CSPV modules but not including thin film products.[39] In its *CSPV 1* investigations, the Commission determined not to define CSPV cells and CSPV modules as separate domestic like products, and no party argued otherwise.[40]

In the *CSPV 2* investigations, the Taiwan respondents argued that the Commission should define CSPV cells and CSPV modules as separate domestic like products based on a "semi-finished" domestic like product analysis.[41] In its analysis under the "semi-finished products" factors in *CSPV 2*, the Commission found that (1) the upstream article (i.e., CSPV cells) is dedicated for use in the production of the downstream article (i.e., CSPV modules), (2) there are no separate markets for CSPV cells and CSPV modules, (3) CSPV cells and CSPV modules share the same primary physical characteristics and functions, (4) CSPV cells undergo

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[38] 19 U.S.C. § 2252(b)(1)(A).

[39] In antidumping and countervailing duty investigations, the domestic like product is defined as "a product which is like, or in the absence of like, most similar in characteristics and uses with, the article subject to an investigation." 19 U.S.C. § 1677(10). The Commission generally considers a number of factors in antidumping and countervailing duty investigations, including (1) physical characteristics and uses, (2) interchangeability, (3) channels of distribution, (4) customer and producer perceptions, (5) manufacturing facilities, processes, and employees, and where appropriate, (6) price. *Nippon Steel Corp. v. United States*, 19 CIT 450, 455 n.4 (1995). The Commission found that due to differences in their underlying raw materials, manufacturing facilities, manufacturing processes, and production employees, CSPV and thin film products differ significantly in physical characteristics, conversion efficiency, output, and other capabilities. The Commission noted that these physical limitations affect their relative prices, limit their interchangeability, and limit any overlap in channels of distribution, particularly for non-utility sales. *Crystalline Silicon Photovoltaic Cells and Modules From China, Inv. Nos. 701-TA-481 and 731-TA-1190 (Final)*, USITC Publication 4360, November 2012, pp. 4-12; *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final)*, USITC Publication 4519, February 2015, pp. 8-15.

[40] USITC Publication 4360 at 6; USITC Publication 4295 at 10-11.

[41] Under the semi-finished domestic like product analysis, the Commission considers whether the upstream product is dedicated for use in the downstream product, whether the upstream and downstream products are sold in separate markets; differences in physical characteristics and functions of the upstream and downstream products; differences in value; and extent of the processes used to transform upstream into downstream articles. *Live Cattle from Canada and Mexico, Inv. Nos. 701-TA-386 and 731-TA-812 and 813 (Preliminary)*, USITC Publication 3155, February 1999, p. 6.

only one major manufacturing step (assembly) to become CSPV modules and that process does not change the essential characteristics of the CSPV cells, and (5) CSPV cells represent a substantial portion of the total cost of finished CSPV modules.[42]

In its petition in the current safeguard investigation, Suniva asks the Commission to find a "single" domestically produced article that is "the same as the imported articles subject to {the} petition."[43] In its prehearing brief, Suniva argues that "there is a single domestic article—CSPV cells and CSPV modules."[44] It notes that CSPV cells are dedicated for use in modules and that most domestically produced CSPV cells are consumed in the production of modules by the U.S. CSPV cell producers themselves. It adds that, although the manufacturing process for CSPV modules is more technologically sophisticated and more labor intensive than that for CSPV cells, the added value to the product does not change the basic function of the CSPV cell, but enhances the CSPV product.[45] SolarWorld similarly argues in its prehearing brief that "domestic CSPV cells and modules are like the imported CSPV cells and modules that are the subject of this investigation."[46] Both Suniva and SolarWorld argue that thin film products are distinct from CSPV cells and modules and should not be considered part of the same domestic product.[47] No firm requested that the Commission collect data concerning other possible alternative products in their comments on the Commission's draft questionnaires[48] and no respondent interested party requested a different definition at the injury hearing or in their prehearing or posthearing injury briefs.

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[42] The Commission concluded that CSPV cells are dedicated for use in CSPV modules, and the vast majority of the CSPV cells manufactured in the United States are consumed by the CSPV cell manufacturer in its own production of CSPV modules. It found further that the fraction of CSPV cells manufactured in the United States that are sold in the commercial market are used to manufacture CSPV modules, thereby indicating a lack of separate markets for the upstream and downstream products. The Commission noted that the processes used to manufacture CSPV modules from CSPV cells are technologically sophisticated, more labor intensive than manufacturing CSPV cells, and add value to the product, but they enhance rather than change the basic function of the CSPV cells, which is to convert sunlight into electricity. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final)*, USITC Publication 4519, February 2015, pp. 8-15 (Commissioner Broadbent dissenting and finding that CSPV cells and CSPV modules were separate domestic like products).

[43] *Petition for Global Safeguard Relief Pursuant to Sections 201-202 of the Trade Act of 1974 - Crystalline Silicon Photovoltaic Cells and Modules ("Petition")*, April 26, 2017, pp. 5 and 9.

[44] Suniva's prehearing brief, p. 6.

[45] Ibid., pp. 5-6.

[46] SolarWorld's prehearing brief, exhibit 1, p. 7.

[47] Suniva's prehearing brief, p. 6.; SolarWorld's prehearing brief, exhibit 1, p. 8.

[48] Comments on the draft questionnaires were submitted on behalf of the following: (1) Canadian Solar Inc. and Canadian Solar (USA) Inc., (2) Tesla, Inc. and its subsidiary, SolarCity Corporation, (3) the Government of Canada, (4) Goal Zero, LLC, (5) Korea Photovoltaic Industry Association, Hanwha Q CELLS Korea, LG Electronics, and Hyundai Green Energy, (6) Auxin Solar, Inc., (7) Suniva, Inc., (8) Sunrun Inc., (9) SolarWorld Americas, Inc., and (10) Solar Energy Industries Association ("SEIA").

Physical properties

CSPV cells use crystalline silicon to convert sunlight to electricity and are the basic elements of a module (figure I-1). They have a positive layer, a negative layer and a positive-negative junction (p/n junction). Electricity is generated when sunlight strikes the CSPV cell, knocking electrons loose that flow onto thin metal "fingers" that run across the CSPV cell and conduct electricity to the busbars.[49] Most CSPV cells, as of 2016, were 156.0 mm by 156.0 mm (6.14 inches by 6.14 inches) or 156.75 mm by 156.75 mm (6.17 inches by 6.17 inches).[50] As of 2017, CSPV cells typically have wattages[51] ranging from 4 watts to more than 5 watts per CSPV cell.[52] Cells are the essential element in CSPV modules (also commonly referred to as panels), which in turn are the main components of CSPV systems. Solar CSPV systems[53] convert sunlight into electricity for on-site use or for distribution through the electric grid.

Figure I-1
CSPV cells

Source: SolarWorld Website, http://www.solarworld.de/en/group/from-sand-to-module/solar-cells/ (accessed July 6, 2017).

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[49] USITC Publication 4519, p. I-19.

[50] CSPV wafers are also referred to by nomenclature related to their size (e.g., M0, M1, and M2). M2 wafers have a larger diameter and more surface area than M0 and M1 wafers. International Technology Roadmap for Photovoltaic ("ITRPV"), 2016 Results, March 2017, pp. 32–33, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a; Atecom Technology, Company Introduction, n.d., p. 7, https://file01.itaiwantrade.com/7c4db5dd-d9f6-4dc4-926f-dcec9603a2e7/Atecom_Company_Introduction_-_Solar_wafer_2016.pdf (accessed July 31, 2017).

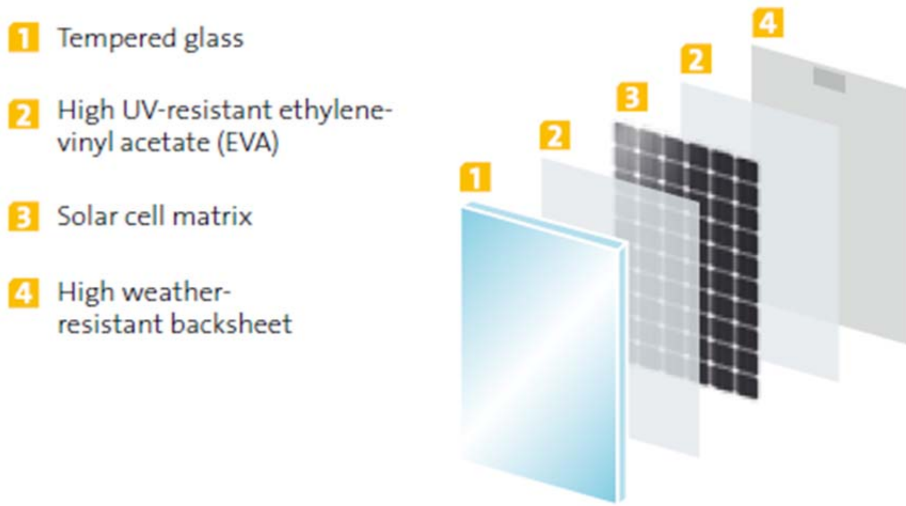
[51] This report will discuss data in terms of watts (W), kilowatts or kW (equal to 1,000 watts), megawatts or MW (1,000 kW), and gigawatts or GW (1,000 MW).

[52] Compiled from company product data sheets.

[53] In addition to CSPV products, there is commercial production of thin film photovoltaic products (which are not included in the scope of the investigation). Thin film cells and modules use a several micron thick layer of a photosensitive semiconductor material such as amorphous silicon (a-Si), cadmium telluride (CdTe), copper indium (gallium) (di)selenide (CIS or CIGS) to convert sunlight to electricity. USITC Publication 4360, p. I-20.

CSPV laminates consist of the CSPV cells that are connected, encapsulated in an ethyl vinyl acetate ("EVA") film,[54] and covered with a glass front sheet and a back sheet (figure I-2).[55] The back sheet is most commonly a plastic film composite, though glass is also used in some applications such as bifacial modules (see below for a discussion of bifacial technology).[56]

Figure I-2
Layers of a typical CSPV laminate



Source: SolarWorld, "SolarWorld Quality," brochure, May 2014, 10, https://www.solarworld-usa.com/~/media/www/files/brochures/sw-01-7182us-flyer-solarworldquality.pdf.

CSPV modules typically consist of the laminate that is typically "framed" in aluminum, and then attached to a junction box. CSPV modules can be used in both ground-mounted and rooftop-mounted systems and in both the off-grid market segment and the three on-grid market segments—residential, nonresidential, and utility.[57] The junction box can be connected

[54] There are other encapsulation materials that are used, but EVA accounted for more than 90 percent of the market in 2016. ITRPV, 2016 Results, March 2017, p. 17, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a.

[55] ITRPV, 2016 Results, March 2017, pp. 13, 17, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a; SolarWorld, "SolarWorld Quality," brochure, May 2014, 10, https://www.solarworld-usa.com/~/media/www/files/brochures/sw-01-7182us-flyer-solarworldquality.pdf.

[56] ITRPV, 2016 Results, March 2017, pp. 17, 36, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a.

[57] Photovoltaics (PV) do not include solar water heat and concentrated solar power (CSP). While PV uses a photosensitive semiconductor material to convert sunlight directly to electricity, solar water heat uses sunlight to heat water and CSP uses reflected sunlight to generate steam or a vapor that turns a turbine to generate electricity. USITC Publication 4519, p. I-18.

to other modules, an inverter (which converts the direct current generated by the system to alternating current), or, in the case of off-grid modules, a charge controller (which controls battery charging) and battery.[58] Typical on-grid modules have 60, 72, or 96 CSPV cells, though in some instances CSPV cells are cut in half resulting in 120 or 144 half-cut CSPV cells (see the discussion of specific products section) (figure I-3).[59] CSPV 60 cell modules are, on average 65 inches long and 39 inches wide, and are typically 1.5 to 2 inches in depth. CSPV 60 cell modules commonly weigh between 33 to 51 pounds. CSPV 72 cell modules are generally around 78 inches long, 39 inches wide, and 1.5 to 2 inches thick.[60] CSPV 72 cell modules generally weigh from 45 to 61 pounds.[61]

Figure I-3
CSPV 60 cell module (left) and 72 cell module (right)

Source: Suniva, Suniva Optimus Series Monocrystalline Solar Modules, OPT Series: OPT 72 cell modules (silver frame), brochure, January 18, 2017, http://suniva.com/documents/[SAMD_0060]%20Suniva%20Optimus%2060%20Silver%20OCOF%20Rev%205%202017%2001%2018.pdf; Suniva, Suniva Optimus Series Monocrystalline Solar Modules, OPT Series: OPT 60 cell modules (silver frame), brochure, January 18, 2017, http://suniva.com/documents/[SAMD_0051]%20Suniva%20Optimus%2072%20cell%2038mmOCOF%20-%20Rev%209%20-%202017%2001%2018.pdf.

The two main types of CSPV cells and modules are monocrystalline silicon and multicrystalline (or polycrystalline) silicon, though there are various products within these two

[58] USITC Publication 4519, p. I-19.
[59] Schwartz, Joe, "High-Power c-Si PV Module Specifications," *SolarPro*, Issue 10.3, May/June 2017, pp. 48–59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A.
[60] EnergySage, "What is the Average Solar Panel Size and Weight?" n.d., http://news.energysage.com/average-solar-panel-size-weight/ (accessed July 7, 2017).
[61] Schwartz, Joe, "High-Power c-Si PV Module Specifications," *SolarPro*, Issue 10.3, May/June 2017, 48–59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A.

categories (see the discussion of specific products section). Monocrystalline cells are made from a single grown crystal and tend to convert sunlight into electricity more efficiently. Multicrystalline cells have a random crystal structure and tend to have a lower conversion efficiency.[62]

The conversion efficiency of CSPV modules has increased over time, with the median efficiency of modules installed in U.S. residential systems, for example, increasing from 15.3 percent in 2012 to 16.7 percent in 2015 (figure I-4).[63] The median efficiency of multicrystalline modules (the only type for which separate data were available) installed in U.S. residential systems increased from 14.5 percent to 16.0 percent during 2012–15.[64] There are a range of conversion efficiencies for monocrystalline and multicrystalline modules. For example, efficiencies for 72 cell or more multicrystalline modules listed in SolarPro's 2017 module specifications range from 15.2 to 17.8 percent, while efficiencies for monocrystalline modules range from 15.5 to 21.5 percent (figure I-5).[65]

Multicrystalline 60 cell modules commonly range from around 240 to 290 watts, while monocrystalline 60 cell modules commonly range from around 260 to 320 watts.[66] The average output of 72 cell multicrystalline modules listed in SolarPro's 2017 module specifications was 319 watts, while the average power output of 72 cell monocrystalline modules was 340 watts.[67]

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[62] Conversion efficiency is the percent of sunlight that is converted to electricity. USITC Publication 4519, p. I-19.

[63] These data may include some thin film products. Barbose, Galen and Naïm Darghouth, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Data file, Lawrence Berkeley National Laboratory, 2016, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price.

[64] Barbose, Galen and Naïm Darghouth, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Data file, Lawrence Berkeley National Laboratory, 2016, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price.

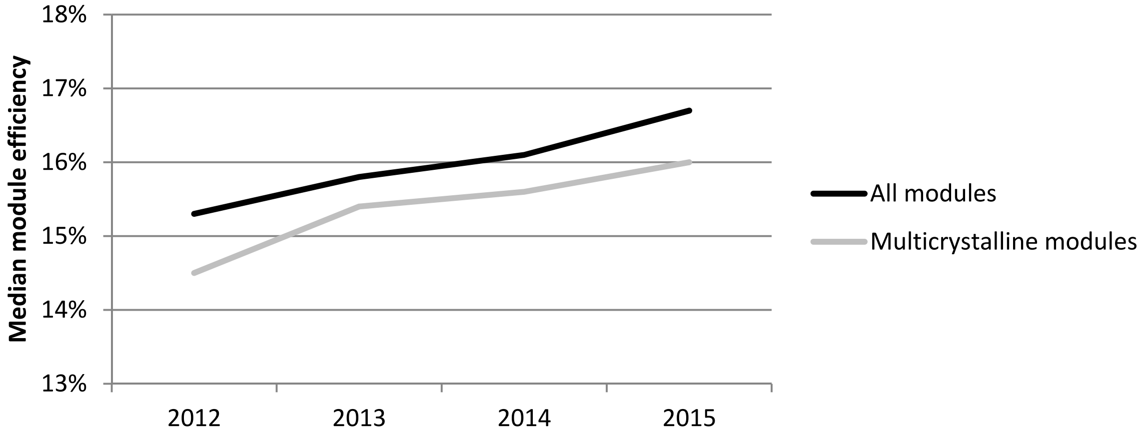
[65] Schwartz, Joe, "High-Power c-Si PV Module Specifications," *SolarPro*, Issue 10.3, May/June 2017, pp. 48–59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A.

[66] Compiled from company module data sheets downloaded in 2017.

[67] SolarPro's module specifications only include modules of 300 watts or more. Data presented here for 72 cell modules include those with 144 half-cut cells. Schwartz, Joe, "High-Power c-Si PV Module Specifications," SolarPro, Issue 10.3, May/June 2017, pp. 48–59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A.

Figure I-4

CSPV: Median efficiency of modules installed in residential systems, by year of installation

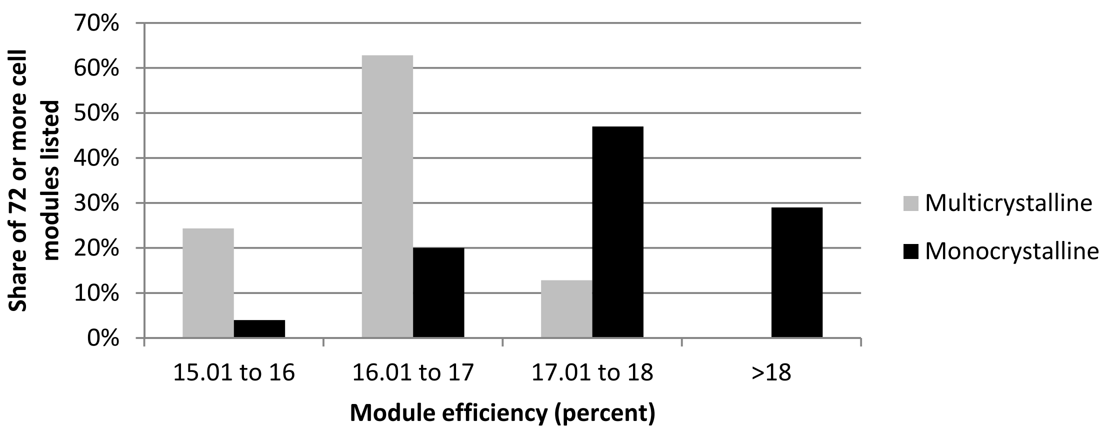


Note: The “all modules” category may include some thin film products.

Source: Barbose, Galen and Naïm Darghouth, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Data file, Lawrence Berkeley National Laboratory, 2016, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price.

Figure I-5

CSPV: Efficiencies of modules (72 or more cells, 300 or more watts) listed in SolarPro’s 2017 module specifications



Note: According to SolarPro, its 2017 list of CSPV module specifications includes “232 models with rated outputs of 300 W STC and greater from 29 manufacturers. The included models are listed and available for deployment in US-based projects. This c-Si specifications table is not intended to be exhaustive or all-inclusive; rather, our goal is to present comparative information on a wide cross-section of high-power PV solutions for utility, commercial and select residential projects.” For comparison purposes, the data presented here include the models with 72 or more CSPV cells and for which a module efficiency was included.

Source: Schwartz, Joe, “High-Power c-Si PV Module Specifications,” SolarPro, Issue 10.3, May/June 2017, pp. 48–59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A.

In addition to standard size modules, CSPV cells can be used in building integrated PV ("BIPV modules" or "BIPV products"). BIPV products are materials integrated into the building envelope, such as the façade or roof, containing CSPV cells. These building integrated materials replace conventional construction materials, such as glass or roof shingles, taking over the function that conventional materials would otherwise perform while also producing electricity (figure I-6).[68]

Figure I-6
Building integrated CSPV

Source: Photo courtesy of U.S. Department of Energy (DOE)/National Renewable Energy Lab (NREL), credit Atlantis Energy, Inc.; USITC Publication 4519, p. I-19.

[68] Steven Strong, "Building Integrated Photovoltaics," Whole Building Design Guide, October 19, 2016, https://www.wbdg.org/resources/building-integrated-photovoltaics-bipv; Polysolar Ltd., *Guide to BIPV*, 2015, p. 1, http://www.polysolar.co.uk/documents/2017%20Guide%20to%20BIPV.pdf.

CSPV modules are also used in off-grid applications. In many instances, modules typically used in on-grid applications may also be used in off-grid applications. For example, a house that is not connected to the grid could use the same modules as a house that is grid-connected.[69] However, there are a broad range of off-grid applications, such as power generation in remote locations, mobile power solutions, telecommunications power and lighting systems, and portable consumer goods (such as systems for recharging consumer electronics like tablets and phones) (figure I-7). The CSPV modules used in some of these applications may be different from those typically used in on-grid applications. For example, these products are often designed for specific power and portability requirements, and some modules have different wattages than modules used in grid-connected applications.[70]

Figure I-7
CSPV: Off-grid solar lighting

Source: Photo courtesy of DOE/NREL.

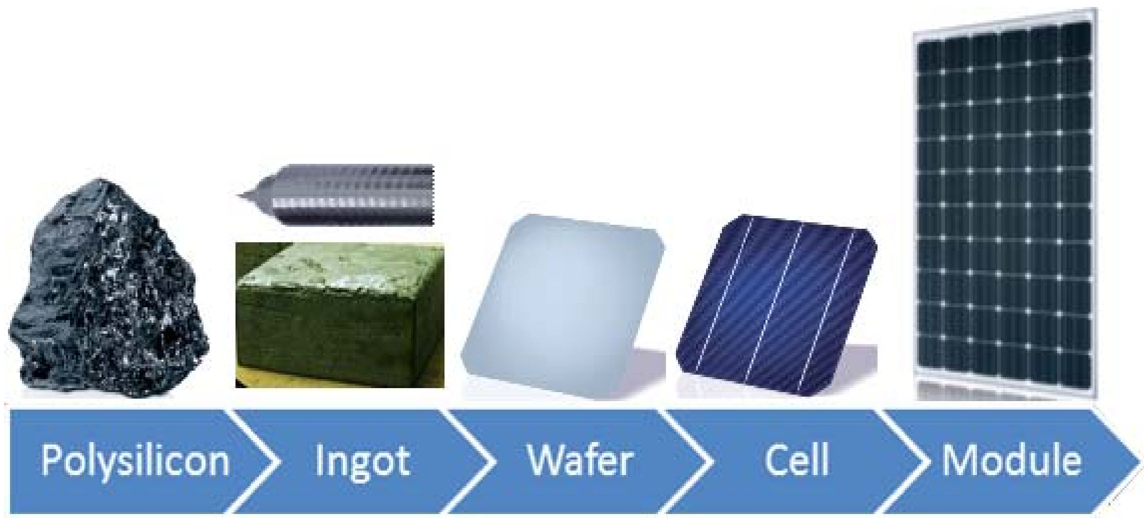
[69] USITC Publication 4519, pp. I-20–21.

[70] Ameresco Solar Website, http://www.amerescosolar.com/solar-power-systems-grid-kits-and-battery-backup (accessed July 9, 2017); Solar Electric Power Company Website, http://www.sepco-solarlighting.com/systems/solarviper?hsCtaTracking=3ee71ee4-b88f-4b28-a65e-ca229920c533%7C33d1f599-7389-4913-be23-d083febf832e (accessed July 9, 2017); Solar Stik Website, http://www.solarstik.com/products/power-generation/ (accessed July 9, 2017); Goal Zero Website, http://www.goalzero.com/solar-panels (accessed July 9, 2017).

Manufacturing facilities and processes[71]

There are five principal stages to manufacture CSPV products. First, polysilicon is refined, then it is formed into ingots, which are sliced into wafers, converted to CSPV cells, and assembled into the finished product, modules (figure I-8). These are discrete production steps that may be done in different plants or locations. Companies may source products at each stage of the value chain or produce the products in-house. CSPV cells and modules are tested and inspected during the production process.[72] The ingot and wafer production process differs for monocrystalline and multicrystalline cells, as discussed below.

Figure I-8
CSPV production process



Note: For ingots, the top picture is a crystal used in monocrystalline wafers, while the bottom picture is an ingot used in making multicrystalline wafers.

Source: SolarWorld, “Energy for You and Me” brochure, pp. 6–7, 9; ingot photo courtesy of DOE/NREL, credit John Wohlgemuth, Solarex; USITC Publication 4519.

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[71] This section is primarily from USITC Publication 4519, pp. I-25–29. References are to any additional sources used for changes to the write-up as it appeared in publication 4519.

[72] SolarWorld, “Real Value,” 2016, https://www.solarworld-usa.com/why-choose-solarworld/the-solarworld-standard#Product_certifications.

Silicon refining

The first step in the CSPV value chain is refining polysilicon. There are multiple approaches to polysilicon refining. This discussion will focus on the Siemens method, which accounted for more than 85 percent of global production in 2016, and fluidized bed reactor (FBR) technology, which accounts for most of the remaining market.[73]

In the first step in the Siemens process, quartz (silicon dioxide) and carbon are heated to around 1,800 degrees Celsius. The carbon reacts with the oxygen, resulting in carbon dioxide and silicon with a purity of around 98 to 99 percent. The silicon is then combined with hydrogen chloride gas at 300 to 350 degrees Celsius, with the reaction resulting in the liquid trichlorosilane. Next, heated silicon rods are inserted into a Siemens reactor, where they are further heated to 1,000 degrees Celsius or more. Hydrogen and trichlorosilane gas are fed into the reactor. The silicon from the trichlorosilane is deposited onto the rods, which steadily increase in size until they are removed from the reactor about a week later. The resulting products are high purity polysilicon chunks or rocks.

Instead of inserting rods, "FBR uses seed granules of purified silicon. The seed granules are fed into a chamber that has heated silane gas entering from below and exiting above. The flow of gas 'fluidizes' the silicon granules, causing them to flow like a liquid, as the silane gas breaks down and deposits silicon layers on them. The granules grow larger and heavier and exit when they are sufficiently large. As they do so, new seed granules and gas are introduced into the chamber and the process continues."[74] The FBR process, which is newer than the Siemens process, uses 80 to 90 percent less energy, requires a smaller footprint, is a continuous process, takes up less space in shipping, and can increase downstream production efficiency.[75] However, the process is difficult to scale and achieve high purity production at low cost.[76]

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[73] ITRPV, 2016 Results, March 2017, p. 9, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a.

[74] REC Silicon website, http://www.recsilicon.com/technology/rec-silicons-fluidized-bed-reactor-process (accessed June 12, 2017).

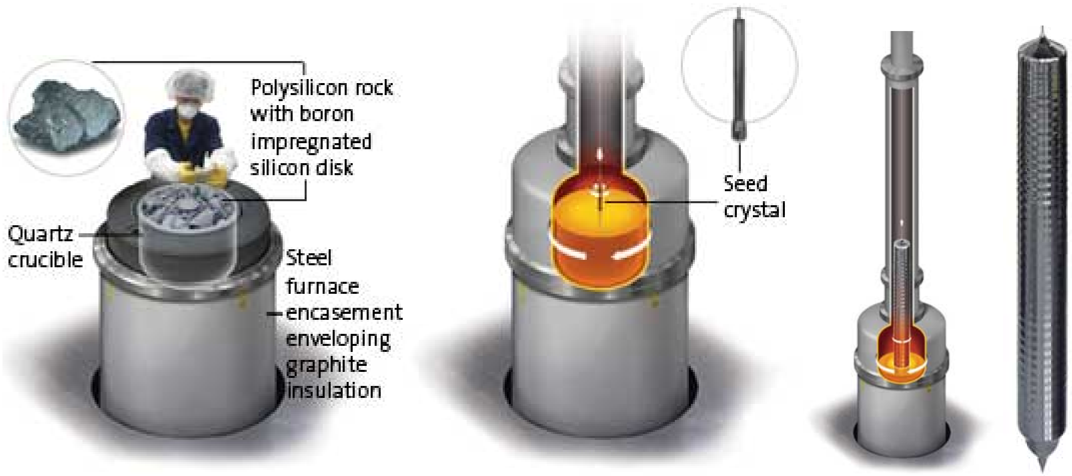
[75] REC Silicon website, http://www.recsilicon.com/technology/rec-silicons-fluidized-bed-reactor-process (accessed June 12, 2017); IHS Markit, "Fluidized Bed Reactor Technology Stakes Its Claim in Solar Polysilicon Manufacturing," News release, May 7, 2014, http://news.ihsmarkit.com/press-release/design-supply-chain-media/fluidized-bed-reactor-technology-stakes-its-claim-solar-poly.

[76] IHS Markit, "Fluidized Bed Reactor Technology Stakes Its Claim in Solar Polysilicon Manufacturing," News release, May 7, 2014, http://news.ihsmarkit.com/press-release/design-supply-chain-media/fluidized-bed-reactor-technology-stakes-its-claim-solar-poly.

Ingots and wafers for monocrystalline cells

In the Czochralski process[77] for producing crystals used in monocrystalline wafers, polysilicon rocks are first placed into a quartz crucible along with a small amount of boron, which is used to provide a positive electric orientation (figure I-9). The crucible is then loaded into a Czochralski furnace and heated to about 2,500 degree Fahrenheit. Once the polysilicon is melted, a seed crystal is lowered into the material and rotated, with the crucible rotated in the opposite direction. The melt starts to solidify on the seed and the seed is slowly raised out of the melt—creating a single long crystal. The crystal is then cooled before it is moved onto the next step. The process of growing the crystal takes about 2.5 days.[78]

Figure I-9
Czochralski process, crucible loading/charging (left), seed crystal (second from left), crystal growing (second from right), and finished crystal (right)



Source: SolarWorld Website, https://www.solarworld-usa.com/solar-101/making-solar-panels (accessed July 15, 2017).

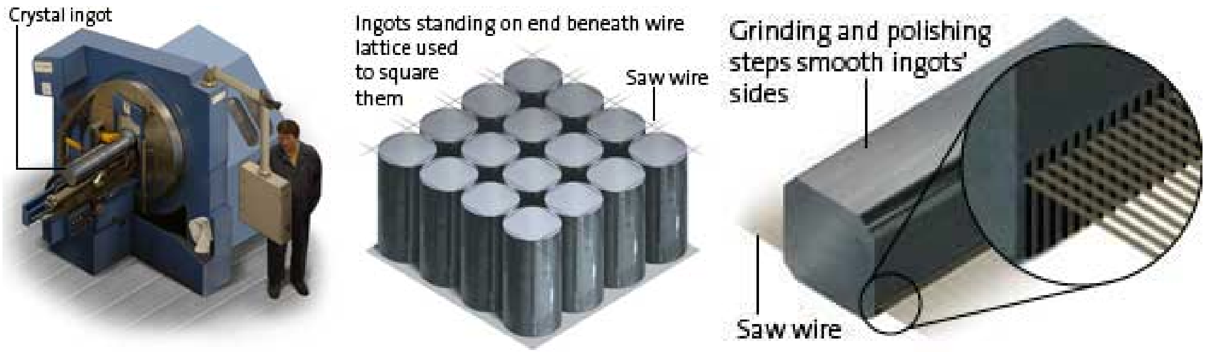
[77] This discussion will focus on the Czochralski process, which accounted for more than 95 percent of production in 2016. ITRPV, 2016 Results, March 2017, p. 19, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a.

[78] SolarWorld Website, https://www.solarworld-usa.com/solar-101/making-solar-panels (accessed July 15, 2017).

Once the crystal has cooled, it is processed into wafers. The top and tail (each end of the cylindrical crystal) are cut off (figure I-10).[79] The remaining portion of the crystal (or ingot) is cut into equal length pieces and squared. In squaring, the rounded sides of the ingot are cut into four flat sides, leaving only rounded corners. A wire saw then slices the ingots into wafers. A majority of global manufacturers have switched to diamond wire saws for monocrystalline wafer slicing, which has several benefits including increasing the speed of the production process.[80] The wafers are then cleaned, dried, and inspected.[81]

Figure I-10

Wafer production: Cutting off the top and tail (left), squaring (middle), and slicing into wafers (right)



Source: SolarWorld Website, https://www.solarworld-usa.com/solar-101/making-solar-panels (accessed July 15, 2017).

Ingots and wafers for multicrystalline cells

For multicrystalline ingots, the first step is also loading polysilicon into a crucible. This crucible is then loaded into a directional solidification systems ("DSS") furnace, where it is cast into ingots. The ingot is then cut into blocks. These blocks are tested and any parts of the block that do not pass these tests are cropped off. The blocks are sliced into wafers using a wire saw.

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[79] These tops and tails can be re-used. Yingli Solar, Form 20-F, Annual Filing to the Securities and Exchange Commission, May 16, 2017, p. 64, http://ir.yinglisolar.com/phoenix.zhtml?c=213018&p=irol-sec.

[80] ITRPV, 2016 Results, March 2017, pp. 8–9, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a; Meyer Burger Website, https://www.meyerburger.com/gb/en/technologies/photovoltaics/high-efficiency-technologies/diamond-wire/ (accessed July 15, 2017); Roselund, Christian, "SolarWorld Invests in Diamond Wire Saws for German Wafering," *PV Magazine*, January 16, 2017, https://www.pv-magazine.com/2017/01/16/solarworld-to-invest-in-diamond-wire-saws-for-german-wafer-production/.

[81] JA Solar, "Form 20-F," Annual Filing to the Securities and Exchange Commission," April 26, 2017, p. 43, http://investors.jasolar.com/phoenix.zhtml?c=208005&p=irol-sec.

Finally, the wafers are cleaned, dried, and inspected.[82] This process results in square wafers, while the monocrystalline process results in wafers with rounded corners.

CSPV cells[83]

The monocrystalline and multicrystalline wafers, which are 180 to 200 micrometers thick, are next processed into CSPV cells. CSPV cell production is capital intensive and requires a skilled workforce. Some firms use a highly automated manufacturing process, while others mix automation and manual labor in their production processes.[84] The main steps[85] in CSPV cell production are as follows:

- **Cleaning and texturing:** First, the wafers are cleaned, then the surface of the wafer undergoes a chemical treatment that reduces the reflection of sunlight and increases light absorption (figure I-11).
- **Diffusion:** In the next step, "phosphorus is diffused into a thin layer of the wafer surface. The molecular-level impregnation occurs as the wafer surface is exposed to phosphorus gas at a high heat, a step that gives the surface a negative potential electrical orientation. The combination of that layer and the boron-doped layer below creates a positive-negative, or P/N, junction–a critical partition in the functioning of a PV cell."[86]
- **Edge isolation:** A thin layer of silicon is then removed from the edge of the CSPV cell to separate the positive and negative layers.
- **Coating:** Next, a silicon nitride antireflective coating is added to the PV cells to increase the absorption of sunlight.
- **Printing:** Metals are then printed on the solar CSPV cell to collect the electricity. On the front of the CSPV cell these metals are printed in thin metal strips called fingers, which are connected to the rest of the module via busbars. A metal layer, typically aluminum, is also printed on the back of the CSPV cell.[87]

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[82] JA Solar, "Form 20-F," Annual Filing to the Securities and Exchange Commission," April 26, 2017, p. 43, http://investors.jasolar.com/phoenix.zhtml?c=208005&p=irol-sec.

[83] The cell manufacturing process varies by company and technology.

[84] JA Solar, "Form 20-F," Annual Filing to the Securities and Exchange Commission," April 26, 2017, p. 42, http://investors.jasolar.com/phoenix.zhtml?c=208005&p=irol-sec.

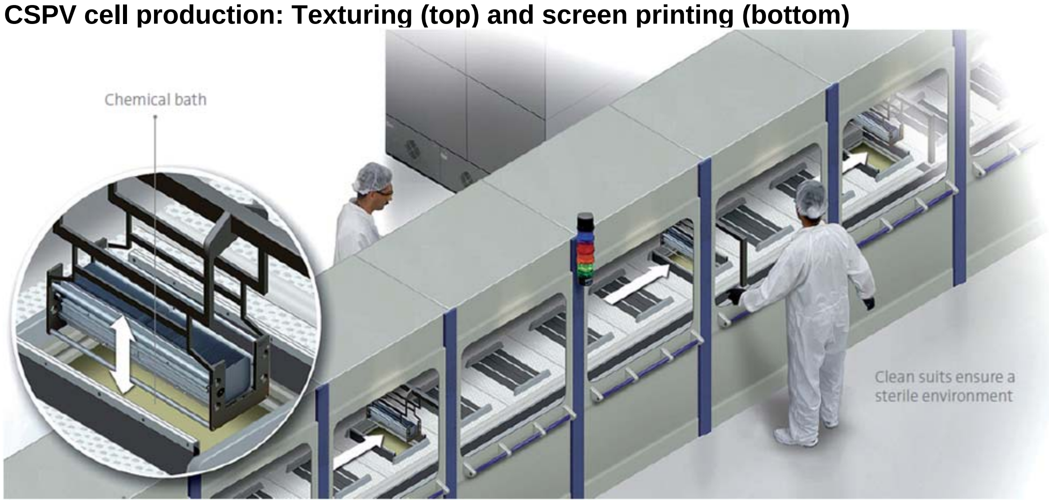
[85] This section will discuss the general manufacturing process. There may be additional steps for some of the specific technologies discussed below.

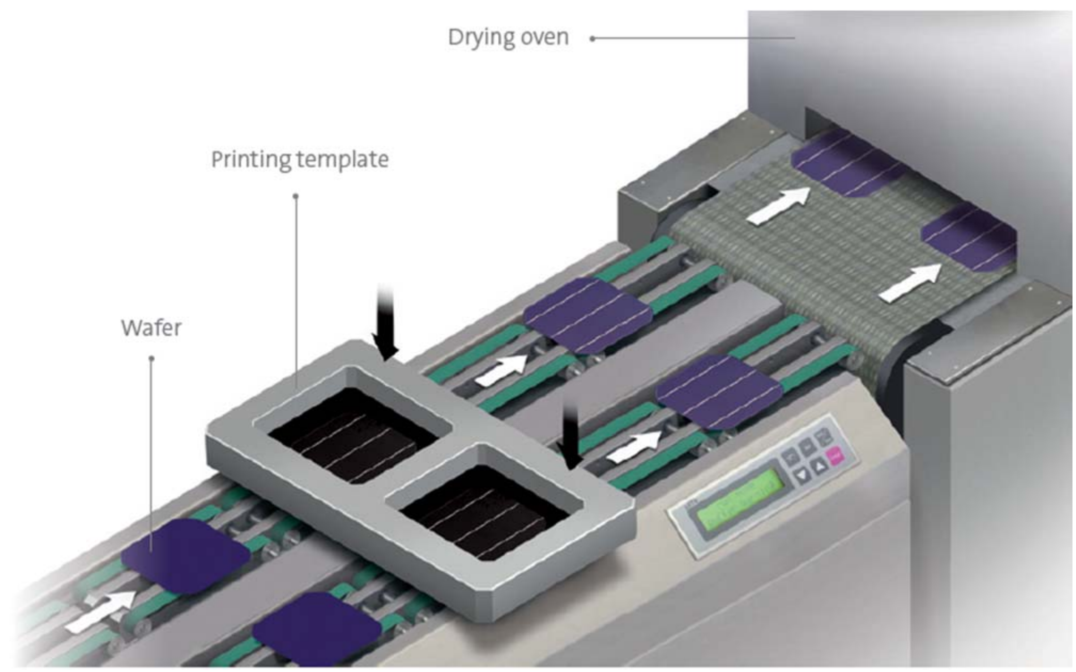
[86] SolarWorld, "Energy for You and Me" brochure, p. 12.

[87] JA Solar, "Form 20-F," Annual Filing to the Securities and Exchange Commission," April 26, 2017, p. 42, http://investors.jasolar.com/phoenix.zhtml?c=208005&p=irol-sec; E-Ton Solar Website, http://www.e-tonsolar.com.tw/Technology.asp?le=english&fid=63 (accessed June 9, 2017).

- **Co-firing:** The CSPV cells then enter a furnace, where the "high temperature causes the silver paste to become imbedded in the surface of the silicon layer, forming a reliable electrical contact."[88]
- **Testing and sorting:** The final step in the process is the testing and sorting of the CSPV cells based on their characteristics and efficiency.

Figure I-11
CSPV cell production: Texturing (top) and screen printing (bottom)





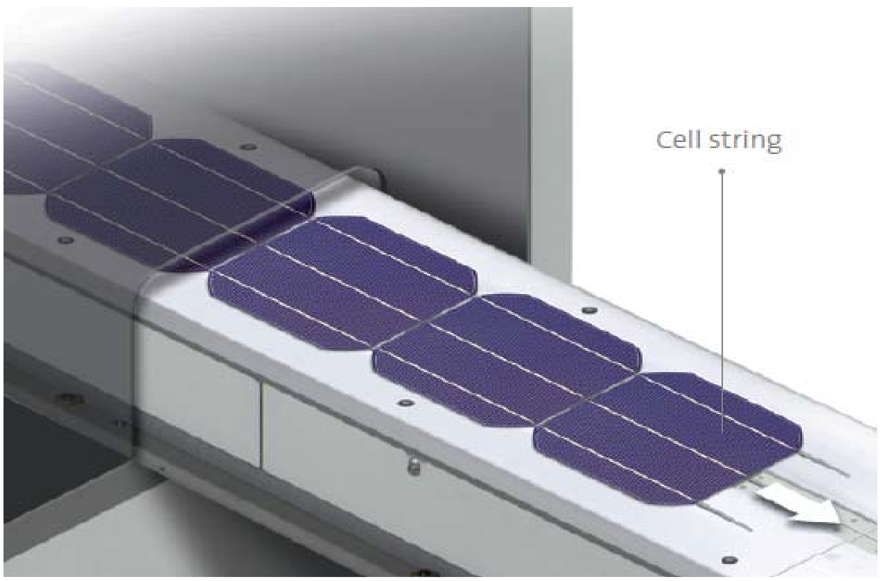
Source: SolarWorld, "Energy for You and Me" brochure, pp. 12–13.

[88] JA Solar, "Form 20-F," April 16, 2013, p. 41.

Modules

The CSPV cells are next assembled into modules. The extent of automation and manual labor involved in module assembly varies depending on the company, though it is generally the most labor intensive part of the manufacturing process. First, a string of CSPV cells is soldered together (figure I-12). A piece of glass is placed on the production line, on top of which is added a piece of ethyl vinyl acetate (“EVA”). The CSPV cells are laid out in a rectangular matrix that will provide the appropriate wattage and power requirements. Typically a sealant is added, often EVA, and a back sheet is added. The CSPV cells are then laminated in a vacuum and are cured. At this stage the CSPV cells are referred to as a “laminate.” Frames are then usually attached to the laminate, and a junction box is attached to the back. In the final step, modules are cleaned and inspected.

Figure I-12
Soldering CSPV cells together into strings



Source: SolarWorld, “Energy for You and Me” brochure, pp. 12–13.

Uses[89]

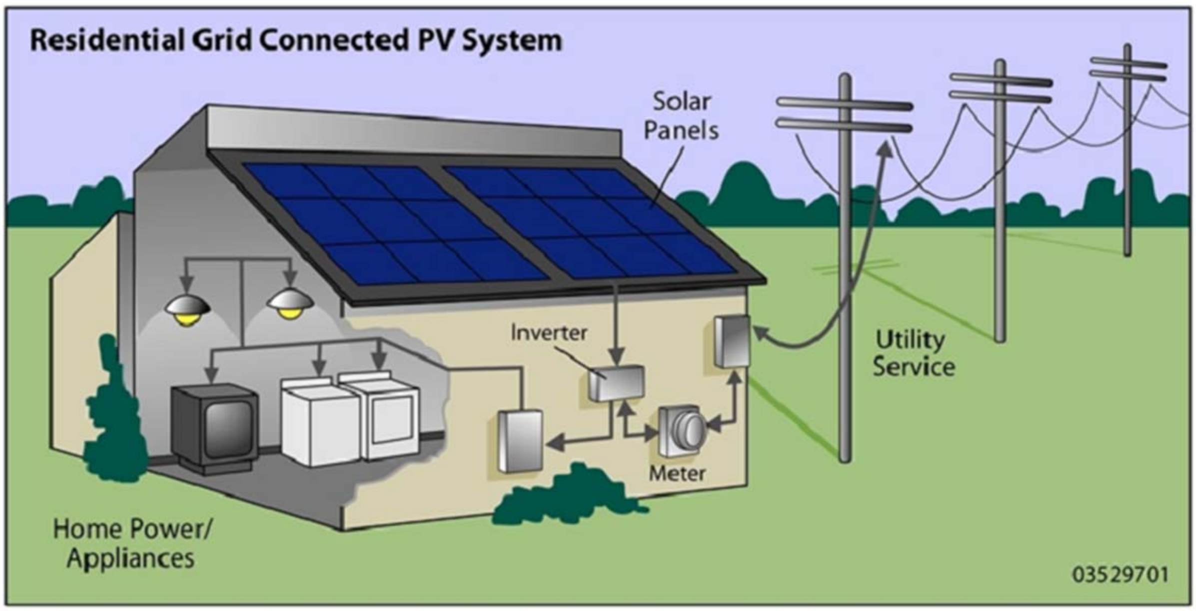
There are four primary market segments for CSPV products. There are three grid-connected market segments–residential, nonresidential, and utility–and an off-grid market. In the grid-connected market, installations are usually either ground-mounted or roof-mounted. In addition to the module, there are a number of other components of the installation called

[89] This section is primarily from USITC Publication 4519, pp. I-21–25. References are to any additional sources used for changes to the analysis as it appeared in publication 4519.

the balance of system ("BOS"). The BOS includes components such as the inverter, and the racking on which the system is installed.[90]

Residential grid-connected systems are installed at individual homes. CSPV modules are typically installed on the roof, though they can also be ground-mounted, and connected to an inverter. The system can use a central inverter, which converts the power from multiple modules, or each module can have its own microinverter attached. In residential installations, the electricity generated by the system is used for power in the individual home (figure I-13). Homeowners use grid energy when solar electricity generation is not sufficient to meet demand and often feed energy back into the grid when solar electricity generation exceeds home use. In the United States, the median size of a residential PV installation increased from 5.5 kilowatts ("kW") in 2012 to 6.1 kW in 2015.[91] [92]

Figure I-13
Residential grid-connected CSPV system



Source: DOE, Office of Energy Efficiency and Renewable Energy (EERE) Website, http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10720 (accessed November 9, 2011); USITC Publication 4519, p. I-22.

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[90] In addition to equipment, there are a number of services associated with installing a PV system such as site assessment and design, permitting, financing, and the system installations, as well as operations and maintenance services after the installation is completed.

[91] Barbose, Galen and Naïm Darghouth, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Data file, Lawrence Berkeley National Laboratory, 2016, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price.

[92] 1,000 watts equals 1kW; 1,000 kW equals 1 MW; 1,000 MW equals 1 GW; and 1,000 GW equals 1 TW.

Nonresidential systems are installed at commercial, industrial, government, and similar buildings and sites (figure I-14). Nonresidential installations are typically larger than residential installations—for nonresidential systems 500 kW or less, the median size in 2015 was 31 kW, though systems can be substantially larger.[93] However, they function similarly to residential installations, providing electricity to meet onsite needs, pulling additional electricity from the grid when needed, and feeding excess electricity back into the grid when it is not needed.[94]

Figure I-14
Installation of a nonresidential CSPV system

Source: Photos courtesy of DOE/NREL, credit Dennis Schroeder; USITC Publication 4519, p. I-23.

[93] Nonresidential systems can also be substantially larger. The *Tracking the Sun* report also includes the median size of systems 500 kW or larger, which was 1.1 GW in 2015. However, their definition of system size likely includes systems that would be classified as utility projects in other definitions. Barbose, Galen and Naïm Darghouth, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Data file and report, Lawrence Berkeley National Laboratory, 2016, pp. 7, 11, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price.

[94] Sherwood, Larry, *U.S. Solar Market Trends 2013*, July 2014, p. 16, http://www.irecusa.org/wp-content/uploads/2014/07/Final-Solar-Report-7-3-14-W-2-8.pdf.

Utility systems are generally the largest systems, and provide electricity directly to the electric grid for sale to customers rather than for on-site use (figure I-15). The median size of utility projects was 4.9 MW and the mean size was 17.15 MW during 2012-16.[95] These systems are generally ground-mounted and currently tend to use central inverters rather than microinverters. CSPV utility systems may involve fixed tilt, single axis tracking (panels rotate to follow the east-west movement of the sun), or dual axis tracking (panels also move to follow the north-south movement of the sun during the year). During 2012–15, 72 percent of installed systems larger than 5 MW used tracking, with most systems using single axis tracking.[96] While prior to 2012 most utility systems installed in the United States were 600 volts, higher 1,000 volt utility systems became increasingly common during 2012-16 and toward the end of this time period 1,500 volt systems were introduced in the U.S. market. These higher voltage systems use fewer balance of system components, require less installation time, reduce electricity losses, and lead to higher inverter efficiencies. This results in lower energy costs.[97]

Figure I-15
La Ola PV plant, a utility CSPV system on Lanai, Hawaii

Source: Photo courtesy of DOE/NREL, credit Jamie Keller; USITC Publication 4519, p. I-24.

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[95] Based on data from GTM and the August 2017 Utility PV tracker for 1,850 projects. KOPIA posthearing brief, exhibit 2, p. 2. The definition of utility systems, however, can vary by source of information.

[96] In their utility-scale report, LBNL uses alternating current for capacity rather than direct current. Bolinger, Mark and Joachim Seel, *Utility-Scale Solar 2015: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States*, LBNL-1006037, August 2016, report , pp. 5–6 and Data File, https://emp.lbl.gov/publications/utility-scale-solar-2015-empirical.

[97] One thousand volt systems are also used in some commercial installations. UL Website, http://www.ul.com/newsroom/featured/ul-provides-1500-volt-pv-module-certification/ (accessed July 10, 2017); Roselund, Christian, "1500-volt Systems to Account for 9% of Utility-scale PV Installations in 2016," *PV Magazine*, January 11, 2016, https://www.pv-magazine.com/2016/01/11/1500-volt-systems-to-account-for-9-of-utility-scale-pv-installations-in-2016_100022732/; Moskowitz, Scott, "The Next Opportunity for Utility PV Cost Reductions: 1,500 Volts DC," *Greentech Media*, May 14, 2015, https://www.greentechmedia.com/articles/read/The-Next-Opportunity-for-Utility-PV-Cost-Reductions-1500-Volts-DC; Morgenson, Jim, "Choose 1,000 Volts for Commercial PV Applications," *Solar Builder*, January 20, 2014, http://solarbuildermag.com/featured/1000-volts-inverters-sma-america/.

As noted above, there are a broad range of off-grid applications, such as power generation in remote locations, mobile power solutions, telecommunications power and lighting systems, and portable consumer goods (such as systems for recharging consumer electronics like tablets and phones). These systems often have additional balance of system components, such as a battery and charge controller, though inverters are not needed for all off-grid applications.

Marketing channels

Channels of distribution

U.S. producers' and importers' commercial U.S. shipments, by channels of distribution, are presented in table I-1. CSPV products are generally sold in the United States to distributors,[98] residential and commercial installers,[99] and utility/developers. Domestic producers sold CSPV products to all channels of distribution during the period of investigation, but sold a majority of their products to distributors (a majority of which were then sold to residential installers)[100] and a substantial amount to commercial installers. U.S. producers reported that a minor amount of their U.S. commercial shipments consist of CSPV cells to module assemblers.[101] Domestic producers reported that *** percent or less of their total commercial U.S. shipments were to utilities or developers during 2012-16. U.S. importers commercially shipped CSPV products to all channels of distribution during 2012-16, except for module assemblers. A majority of sales of imported products by U.S. importers were to utility/developers, with a substantial amount going to commercial and residential installers.

[98] Solar distributors typically sell CSPV products into the residential and nonresidential market, including to the installers that operate in these market segments. DiFrangia, Michelle, "How Distributors Do Solar," *Solar Power World*, April 30, 2014, https://www.solarpowerworldonline.com/2014/04/distributors-solar/.

[99] Installers are firms that are responsible for the CSPV system installation; however, they may subcontract some parts of the installation to other firms such as electrical contractors. Installers may sell the system themselves or be contracted by other system sellers, such as third-party owners, to install the system. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final)*, USITC Publication 4519, February 2015, p. II-3.

[100] A substantial portion of U.S. producers' total U.S. commercial shipments of modules were originally identified as shipments to distributors in their questionnaire responses (***). Domestic producers were subsequently asked to re-categorize the distributor data according to sales to the likely end user. The data presented in table I-1 reflect two of the responding domestic producers' re-assignment of the U.S. producers' U.S. commercial shipments of modules to distributors according to the most likely end user. ***. SolarWorld's posthearing brief, exhibit 1, p. 94; Suniva's posthearing brief, exhibit 1.

[101] CSPV cells are typically internally consumed to produce solar modules by U.S. producers, but may also be sold to companies that fabricate modules or panels. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final)*, USITC Publication 4519, February 2015, p. II-3.

Table I-1
CSPV products: U.S. producers' and importers' commercial U.S. shipments, by channels of distribution, 2012-16

* * * * * * *

Market segments

The largest grid-connected market segment in 2016 was the utility segment, with 10.6 GW in 2016 installations (including thin film products). This was followed by the residential sector with 2.6 GW and the nonresidential sector with 1.6 GW. The residential market exceeded the nonresidential market in size during 2014–16, but was smaller during 2012–13.[102] Public information on the size of the off-grid market was not readily available. The remainder of this section provides a brief description of each of the industries in these market segments, though in many cases the industries overlap. For example, many nonresidential installers also install residential CSPV systems.

There were several thousand residential solar installers in the United States in 2015 (latest available), most of which are relatively small firms.[103] According to one installer survey, the median volume installed by residential installers in 2016 was 500 kW.[104] However, there are also larger firms operating in multiple states, and the top three installers accounted for 48 percent of the market in the second quarter of 2016.[105] Many installers offer financing options to customers, and some installers also offer customers the option to lease or purchase the power from the system (known as third party ownership or TPO) rather than buy the system itself.[106] While TPO accounted for the majority of installations during 2012–16, the share of the market accounted for by TPO systems peaked in 2014.[107]

There were over 1,000 nonresidential installers in 2015, many of which also installed residential systems.[108] As with residential installers, the majority of nonresidential installers are

[102] GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, pp. 6, 10–11.

[103] Tracking the Sun Public Data File, The Open PV Project, National Renewable Energy Laboratory, https://openpv.nrel.gov/search (accessed July 11, 2017).

[104] EnergySage, *Solar Installer 2016 Survey Results*, January 2017, 2.

[105] The top ten installers combined accounted for 58 percent of the market. Allison Mond, "The Rise of the Regional Solar Installer," June 22, 2016, https://www.greentechmedia.com/articles/read/the-rise-of-the-regional-solar-installer; EnergySage, *Solar Installer 2016 Survey Results*, January 2017, 2.

[106] EnergySage, *Solar Installer 2016 Survey Results*, January 2017, 4–5; USITC, *Renewable Energy and Related Services: Recent Developments*, Investigation No. 332-534, USITC Publication 4421, August 2013, pp. 3-2–3, 3-8–9.

[107] Litvak, Nicole, "U.S. Residential Solar Financing 2016-2021," November 2016, Greentech Media, https://www.greentechmedia.com/research/report/us-residential-solar-financing-2016-2021.

[108] Tracking the Sun Public Data File, The Open PV Project, National Renewable Energy Laboratory, https://openpv.nrel.gov/search (accessed July 11, 2017).

small—the median installation volume in one installer survey was 285 kW.[109] The largest nonresidential installers account for a smaller share of the market than the largest residential installers. In 2015, the top three nonresidential installers accounted for about 26 percent of the market.[110] As with residential installers, many commercial installers offer financing and TPO options, though these account for a smaller share of nonresidential installations than residential.[111]

PV installations and other PV activities are the primary business lines for most residential and nonresidential solar installers, though the primary business lines for some firms that install PV systems are related activities such as electrical contracting, general contracting, and roofing.[112] Firms often compete with a large number of other installers, with 47 percent of firms reporting 20 or more competitors.[113]

The utility segment is the most concentrated in terms of the number of active project developers and engineering, procurement, and construction ("EPC") firms. [114] The top nine utility project developers in 2016 accounted for a combined 70 percent of the market in 2016, and the top nine EPC firms accounted for 69 percent of the market.[115] This is the largest market segment so many of these firms also installed a much larger volume of products in 2016 than firms in the other market segments.[116] The types of firms that develop utility projects are diverse and the industry is composed of (1) firms whose primary business is project development; (2) firms that are engaged in both producing equipment (e.g., modules) and developing projects; (3) unregulated entities related to major utility companies; (4) other

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[109] EnergySage, *Solar Installer 2016 Survey Results*, January 2017, 2.

[110] Cory Honeyman, "U.S. Solar Market Outlook: Market Drivers and Competitive Landscape Trends Shaping U.S. Solar Demand," GTM Research, July 2016, 18, http://sunspec.org/wp-content/uploads/2016/07/HoneymanGTMResearchSunSpecIntersolarPVFinance.pdf.

[111] USITC, *Renewable Energy and Related Services: Recent Developments*, Investigation No. 332-534, USITC Publication 4421, August 2013, pp. 3-2–3, 3-8–9; Barbose, Galen and Naïm Darghouth, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, Data file, Lawrence Berkeley National Laboratory, 2016, pp. 12–13, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price.

[112] EnergySage, *Solar Installer 2016 Survey Results*, January 2017, 2.

[113] EnergySage, *Solar Installer 2016 Survey Results*, January 2017, 8.

[114] USITC Publication 4519, pp. II-5–6; Solar Power World, "2016 Top Solar Utility Contractors, https://www.solarpowerworldonline.com/2016-top-solar-utility-contractors/ (accessed July 11, 2017); Energy Acuity, *2016 Solar Report: Utility Scale*, March 2017, pp. 7, 11, https://www.energyacuity.com/energy-acuity-reports.

[115] Excludes projects where First Solar, the largest global thin film producer, was listed as the developer or the EPC provider. However, the data likely still contain some thin film products. Energy Acuity, *2016 Solar Report: Utility Scale*, March 2017, pp. 7, 11, https://www.energyacuity.com/energy-acuity-reports; Finlay Colville, "Top-10 Solar Cell Producers in 2016," *PV Tech*, January 30, 2017, https://www.pv-tech.org/editors-blog/top-10-solar-cell-producers-in-2016.

[116] Solar Power World, "2016 Top Solar Utility Contractors," https://www.solarpowerworldonline.com/2016-top-solar-utility-contractors/ (accessed July 11, 2017).

independent power producers ("IPPs"); (5) utilities; and (6) other firms.[117] Project developers may perform EPC services, or large contractors often handle these services.[118]

The off-grid market segment is diverse, and within it there are a number of very different market segments. For example, some CSPV off-grid products, such as solar chargers and solar generators, are sold directly to consumers or through retail channels.[119] Other CSPV off-grid products—such as solar street lighting and off-grid power systems—are sold, either directly or through entities such as installers and contractors, to users such as industrial, commercial, and government entities.[120]

Discussion of specific products

There are a number of different CSPV cell and module technologies currently produced by CSPV manufacturers. This section will describe some of those technologies, as well as some of the companies producing these products globally. The extent to which each technology is used by U.S. producers and importers is discussed in *Part II* and *Part III*. During 2013–16, standard multicrystalline silicon and standard monocrystalline silicon accounted for most global production. Advanced process technologies increased their share of the market in 2016, primarily due to increasing production of passive emitter rear contact ("PERC") cells.[121]

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[117] An IPP is an entity that primarily produces electricity for sale on the wholesale market. It is not a utility, does not own electricity transmission, and does not have a designated service area. This is based on the Energy Information Administration definition as summarized in USITC Publication 4421. USITC, *Renewable Energy and Related Services: Recent Developments*, Investigation No. 332-534, USITC Publication 4421, August 2013, pp. 3-14–15.

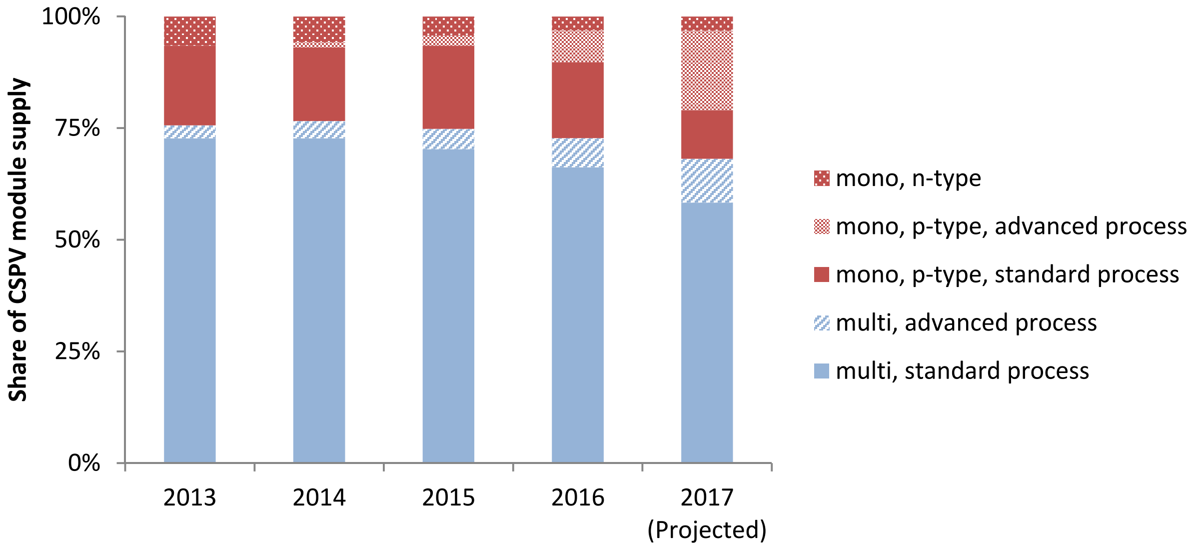
[118] USITC, *Renewable Energy and Related Services: Recent Developments*, Investigation No. 332-534, USITC Publication 4421, August 2013, pp. 3-15–16.

[119] Costco Website, https://www.costco.com/Goal-Zero-Sherpa-50-Solar-Kit--Power-on-the-Go.product.100145834.html (accessed July 9, 2017); Academy Sports and Outdoors Website, http://www.academy.com/shop/browse/hunting/wildlife-feed--feeders/feeder-accessories/solar-panel-chargers (accessed July 15, 2017); Goal Zero Website, http://www.goalzero.com/p/12/nomad-13-solar-panel (accessed July 15, 2017).

[120] Ameresco Solar Website, http://www.amerescosolar.com/about-ameresco-solar-what-we-do (accessed July 15, 2017); Solar Stik Website, http://www.solarstik.com/photo-gallery/ (accessed July 15, 2017); Sol Website, http://solarlighting.com/contractors/ (accessed July 16, 2017); EnGo Planet Website, https://www.engoplanet.com/projects (accessed July 15, 2017).

[121] Solar Media, "PV Module Supply in 2017: Leading Global Suppliers, Performance Benchmarks and Maximizing Investor Returns," August 30, 2017, p. 10; Colville, Finlay, "China and OEM cell production in 2016 delays shift to p-type mono," PV Tech and Solar Media, January 26, 2017, https://www.pv-tech.org/editors-blog/china-and-oem-cell-production-in-2016-delays-shift-to-p-type-mono.

Global CSPV module shipments by technology type



Source: Solar Media, "PV Module Supply in 2017: Leading Global Suppliers, Performance Benchmarks and Maximizing Investor Returns," August 30, 2017, p. 10; Colville, Finlay, "China and OEM Cell Production in 2016 Delays Shift to p-type Mono," PV Tech and Solar Media, January 26, 2017, https://www.pv-tech.org/editors-blog/china-and-oem-cell-production-in-2016-delays-shift-to-p-type-mono.

Notes: Advanced process in 2016 was primarily PERC cells. n-type mono includes all types of n-type production.

n-Type Mono

In the production of most types of monocrystalline CSPV wafers, the silicon is doped with boron (as described above) to create a positive electrical orientation. In the production of n-type mono wafers, the silicon is doped with phosphorous to create a negative electrical orientation. In the cell production process, a positive layer is added to create the p/n junction. n-type cells can be more expensive to produce, but have a number of benefits, such as higher conversion efficiencies, no light induced degradation, and they can be made using less pure wafers.[122]

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[122] American Chemical Society Website, https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/archive-2013-2014/how-a-solar-cell-works.html?cq_ck=1%E2%80%A6 (accessed August 24, 2017); Radovan Kopecek and Joris Libal, "Switch from p to n," PV Magazine, June 5, 2012, https://www.pv-magazine.com/magazine-archive/switch-from-p-to-n_10007072/; EnergyTrend, "Solar Manufacturers Vie for Control of Nascent N-type Mono Cell Market," October 27, 2014, http://pv.energytrend.com/price/20141027-7645.html; Roselund, Christian, "N-type Mono is Coming, but When?" *PV Magazine*, July 14, 2014, https://www.pv-magazine.com/2014/07/14/n-type-mono-is-coming-but-when_100015728/.

In 2016, n-type mono accounted for less than 5 percent of global CSPV cell production.[123] As of 2012, there were a relatively small number of producers of n-type mono products, including LG, Panasonic, SunPower, and Yingli. These companies remained among the leading suppliers of these products in 2016.[124]

Passive Emitter Rear Contact (PERC)

Passive Emitter Rear Contact (PERC)[125] cells incorporate an additional rear dielectric layer that reflects light that did not generate electricity as it initially passed through the CSPV cell back into the CSPV cell. There is, therefore, another opportunity for the CSPV cell to absorb this light. PERC cells have a higher efficiency, and improved performance in certain conditions, such as low light and high heat conditions. Existing CSPV cell production lines can be reconfigured to produce PERC cells with the addition of two steps. Therefore, the changeover to PERC technology is relatively straightforward, though there are some challenges with PERC technology such as the potential for more rapid cell degradation.[126]

PERC and related technologies accounted for more than 10 percent of the global market in 2016, and their production (particularly of monocrystalline PERC) is expected to significantly increase in the next few years, with one estimate projecting more than 15 GW of global PERC production in 2017.[127] SolarWorld was the first company to commercialize PERC production, with Sunrise Global, Hanwha QCells, and REC also starting commercial production relatively

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[123] Solar Media, "PV Module Supply in 2017: Leading Global Suppliers, Performance Benchmarks and Maximizing Investor Returns," August 30, 2017, p. 10.

[124] Radovan Kopecek and Joris Libal, "Switch from p to n," PV Magazine, June 5, 2012, https://www.pv-magazine.com/magazine-archive/switch-from-p-to-n_10007072/; LG Electronics, "LG Electronics Introduces High-Performance, Lightweight Mono-X Neon Solar Modules," News release, September 3, 2012, http://www.lg.com/us/business/about/press-release/lg-electronics-introduces-high-performance-lightweight-mono-x-neon-solar-modules; Colville, Finlay, "China and OEM Cell Production in 2016 Delays Shift to p-type Mono," PV Tech and Solar Media, January 26, 2017, https://www.pv-tech.org/editors-blog/china-and-oem-cell-production-in-2016-delays-shift-to-p-type-mono.

[125] This section will focus on PERC technology, but there are a range of related technologies such as Passivated Emitter Rear Totally Diffused ("PERT") and Passivated Emitter Rear Locally Diffused ("PERL"). Aleo website, http://www.aleo-solar.com/perc-cell-technology-explained/ (accessed June 9, 2017).

[126] Aleo website, http://www.aleo-solar.com/perc-cell-technology-explained/ (accessed June 9, 2017); Gustin, Gena, "What is PERC? Why Should you Care?" July 5, 2016, *Solar Power World*, June 9, 2017, http://www.solarpowerworldonline.com/2016/07/what-is-perc-why-should-you-care/; Schmid Group, "PERC Cells: Production Costs Down, Efficiency Up," News release, May 18, 2016, http://schmid-group.com/en/schmid-group/news-events/press-releases/perc-cells-production-costs-down-efficiency-up/.

[127] ITRPV, 2016 Results, March 2017, pp. 34-35, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a; Colville, Finlay, "PERC Solar Cell Production to Exceed 15GW in 2017," *PVTech*, July 27, 2017, https://www.pv-tech.org/editors-blog/perc-solar-cell-production-to-exceed-15gw-in-2017.

early.[128] Among module suppliers listed by Taiyang News, SolarWorld has the highest monocrystalline PERC production efficiency (at 21.6 percent), followed by Trina (21.12 percent) and Tainergy and Talesun (21.1 percent), though a number of suppliers have only slightly lower efficiencies.[129] Trina has the highest multicrystalline production efficiency among module suppliers listed by Taiyang News (19.86 percent), followed by HT-SAAE (19.8 percent), and Astronergy and Suntech (19.7 percent). REC Group, which is not listed by Taiyang, also reports production of high efficiency multicrystalline PERC cells.[130]

Heterojunction

Heterojunction cells, which include heterojunction with intrinsic thin layer (HIT), add thin layers of photosensitive semiconductor materials (typically amorphous silicon) on top of a monocrystalline wafer. These additional layers increase the absorption of sunlight, and the overall efficiencies of the CSPV cells. They also perform better in hot climates than typical monocrystalline cells. They are more expensive to produce and are difficult to scale up to commercial production, however, so only a few companies currently produce this technology.[131]

Panasonic was the first large-scale producer of heterojunction cells globally, and held many of the key patents related to heterojunction technology until they expired in 2010.[132] Other companies with production of heterojunction cells include BenQ Solar, Ecosolifer, Hevel, Kaneka, Sunpreme, and Tesla. Solartech Universal assembles modules from heterojunction

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[128] Chunduri, Shravan K. and Michael Schmela, *PERC Solar Cell Technology 2016: Background, Status and Outlook*, Taiyang News, 2016, pp. 21–22, http://taiyangnews.info/TaiyangNews%20PERC%20Report%202016%20FINAL.pdf; Chunduri, Shravan K. and Michael Schmela, "PERC Solar Cell Technology, 2017 Edition," 2017, http://taiyangnews.info/reports/, p. 41; Hearing transcript (Stein), p. 220.

[129] Two equipment suppliers, Meyer Burger and Centrotherm, report production efficiencies between SolarWorld and Trina. Chunduri, Shravan K. and Michael Schmela, "PERC Solar Cell Technology, 2017 Edition," 2017, http://taiyangnews.info/reports/, p. 39.

[130] Equipment supplier Meyer Burger lists a production efficiency of 20.5 percent. Clover, Ian, "REC achieves +20% efficiency for mass production of multicrystalline solar cells," *PV Magazine*, October 5, 2016, https://www.pv-magazine.com/2016/10/05/rec-achieves-20-efficiency-for-mass-production-of-multicrystalline-solar-cells_100026368/; Chunduri, Shravan K. and Michael Schmela, "PERC Solar Cell Technology, 2017 Edition," 2017, http://taiyangnews.info/reports/, p. 39.

[131] Roselund, Christian, "The Uncertain Future of Silicon Heterojunction Solar," *PV Magazine*, March 15, 2016, https://www.pv-magazine.com/magazine-archive/the-uncertain-future-of-silicon-heterojunction-solar_100023725/; Roselund, Christian, "The Best of the Best: Innovative High Efficiency PV Module Designs," *PV Magazine*, March 15, 2016, https://www.pv-magazine.com/magazine-archive/the-best-of-the-best-innovative-high-efficiency-pv-module-designs_100023720/.

[132] EU PVSEC Website, https://www.photovoltaic-conference.com/images/News/EU_PVSEC-2017-NewsNo5/eu_pvsec-2017-newsno5.html (accessed August 23, 2017).

cells. Meyer Burger also offers a turnkey production line for heterojunction cells.[133] Heterojunction cells account for less than 5 percent of the global market.[134]

Bifacial

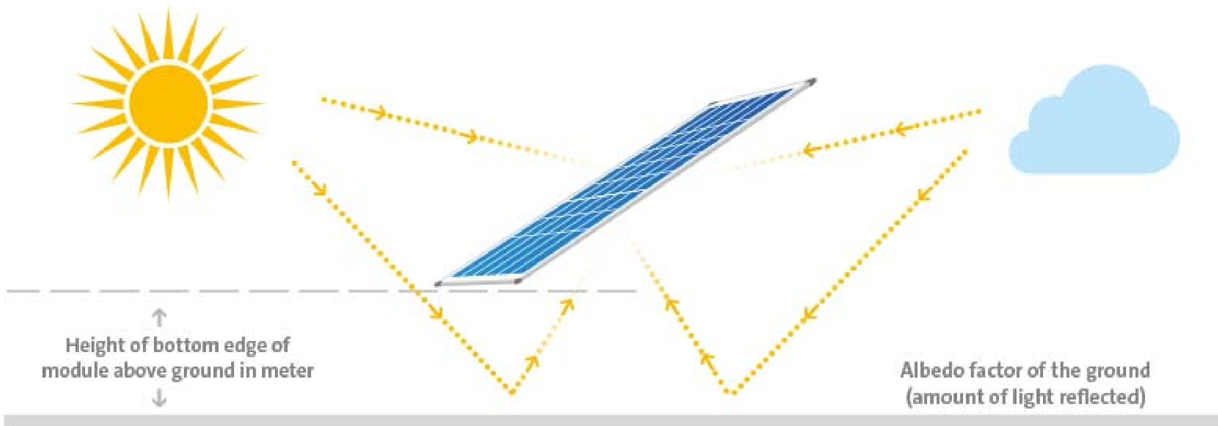
Bifacial cells convert light that hits both the front and back of the CSPV cell into electricity (figure I-16). Whereas most CSPV cells have a metalized back layer, bifacial cells allow light through to the back side of the CSPV cell. They often incorporate either the PERC or heterojunction technologies discussed above. When incorporated into modules, they use a transparent back sheet or rear glass layer to allow sunlight to pass through to the rear of the CSPV cell. Bifacial cells increase energy production, but are also more expensive to produce. The extent to which energy production increases depends in part on the characteristics of the surface below the installed modules.[135]

[133] Roselund, Christian, "The Uncertain Future of Silicon Heterojunction Solar," *PV Magazine*, March 15, 2016, https://www.pv-magazine.com/magazine-archive/the-uncertain-future-of-silicon-heterojunction-solar_100023725/; Sunpreme Website, http://sunpreme.com/symmetric-bifacial-architecture/ and http://sunpreme.com/about-us/ (accessed August 23, 2017). Veschetti, Y. "Cell Session Introduction," BIFIPV Workshop, September 2016, p. 9, http://bifipv-workshop.com/fileadmin/images/bifi/miyazaki/presentations/4_1_1_-_VESCHETTI_-bifacial_cells.pdf; Kaneka Website, http://www.kaneka-solar.jp/products/gransola.html (accessed August 23, 2017); Hevel Producing Heterojunction Solar Cells with Singulus Technology," March 29, 2017, https://www.pv-magazine.com/2017/03/29/hevel-producing-heterojunction-solar-cells-with-singulus-technology/.

[134] ITRPV, 2016 Results, March 2017, p. 35, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a; Solartech Universal Website, http://www.solartechuniversal.com/quantum-series.html (accessed August 23, 2017).

[135] Roselund, Christian, "Two Sides of the Same Coin," *PV Magazine*, February 6, 2017, https://www.pv-magazine.com/magazine-archive/two-sides-of-the-same-coin/; Brearley, David, "Bifacial PV Systems," *SolarPro*, March/April 2017, issue no. 10.2, https://solarprofessional.com/articles/design-installation/bifacial-pv-systems#.WTmljv7rsuZ.

Figure I-16
Bifacial PV modules absorb sunlight on both sides of the module



Source: SolarWorld AG Website, http://www.solarworld.de/en/products/products/solar-modules/sunmodule-bisun-protect/ (accessed July 15, 2017).

As of early 2017, bifacial modules were commercially available in the U.S. market from about eight companies, including LG, Lumos Solar, Mission Solar, Prism Solar, Silfab, SolarWorld, Sunpreme, and Yingli Solar.[136] Despite the relatively limited number of current suppliers, ***.[137] Globally, bifacial modules accounted for 1-2 percent of the global module market in 2015, but the market share is projected to grow in the next five years.[138]

Other

Some manufacturers have switched to modules with half-cut cells. These are standard cells that are cut in half, such that a standard 60 cell module would instead have 120 half cells. Half cut cells result in lower cell currents and, therefore, reduce power losses and increase cell efficiency and overall module output.[139] Half-cut cells accounted for 2 percent of the global market in 2016, though this share is forecast to increase.[140]

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[136] Brearley, David, "Bifacial PV Systems," SolarPro, March/April 2017, issue no. 10.2, pp. 24–25, https://solarprofessional.com/articles/design-installation/bifacial-pv-systems#.WTmljv7rsuZ.

[137] SEIA, Posthearing brief, Exhibit 13 (Bloomberg New Energy Finance, *3Q 2017 Global PV Market Outlook*, August 18, 2017, pp. 9–10).

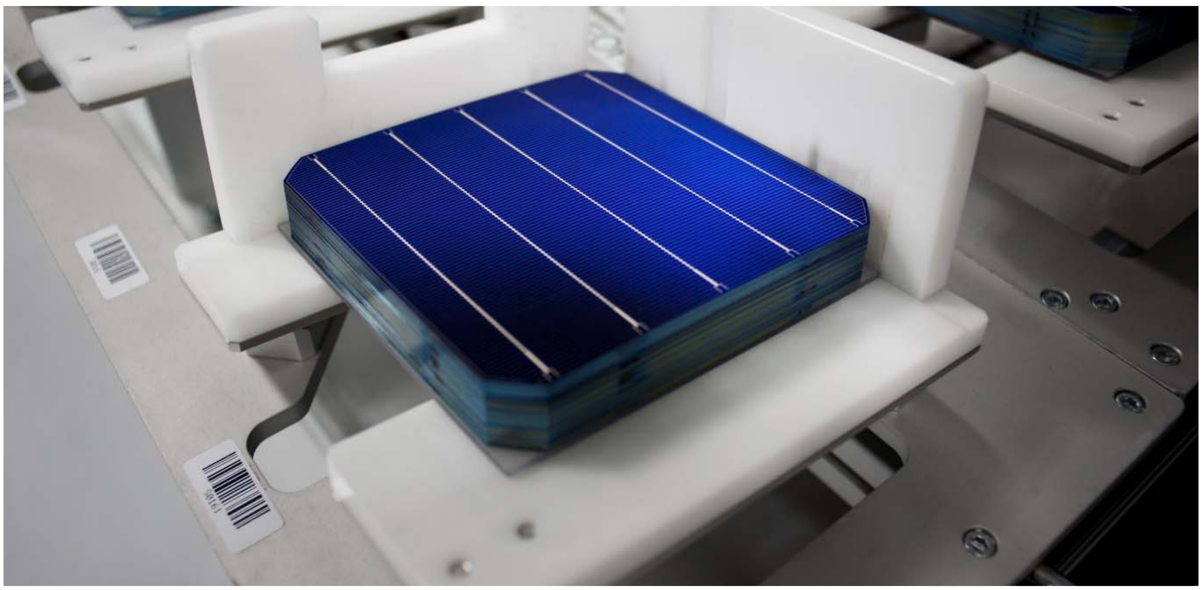
[138] Roselund, Christian, "Two Sides of the Same Coin," *PV Magazine*, February 6, 2017, https://www.pv-magazine.com/magazine-archive/two-sides-of-the-same-coin/; Brearley, David, "Bifacial PV Systems," *SolarPro*, March/April 2017, issue no. 10.2, https://solarprofessional.com/articles/design-installation/bifacial-pv-systems#.WTmljv7rsuZ.

[139] REC Solar, "The New REC TwinPeak Series," n.d., http://www.recgroup.com/sites/default/files/documents/whitepaper_twinpeak_technology.pdf (accessed July 15, 2017).

[140] ITRPV, 2016 Results, March 2017, pp. 36–37, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a.

Many manufacturers are increasing the number of busbars in PV cells,[141] which results in higher efficiency and greater power output (figure I-17). Three-busbar cells accounted for slightly more than half of the global market in 2016, down from more than 80 percent in 2014. Four or more busbar cells accounted for more than 40 percent of the market in 2016 and are forecast to account for close to 60 percent of the global market in 2017. Five busbar cells accounted for less than 10 percent of the global market in 2016, but are also forecast to gain market share in 2017. Some manufacturers have eliminated busbars, which can provide benefits such as reducing electrical losses and increasing the surface area of the cell that can absorb sunlight. Cells without busbars currently account for less than 5 percent of the global market.[142]

Figure I-17
CSPV 5 busbar cell



Source: SolarWorld Website, https://www.solarworld-usa.com/newsroom/media-downloads (accessed September 4, 2017).

[141] Electricity is carried from the thin metal strips on solar cells to wider metal strips known as busbars. These busbars are interconnected during the manufacturing process so that electricity is carried from the cell to the junction box. Ulbrich Website, https://www.pvribbon.com/press/glossary-of-pv-terms/ (accessed September 4, 2017).

[142] Pickerel, Kelly, "Busbars: A Solar Panel Necessity or Hindrance?" *Solar Power World*, May 9, 2016, https://www.solarpowerworldonline.com/2016/05/busbars-solar-panel-necessity-or-hindrance/; ITRPV, 2016 Results, March 2017, pp. 28–29, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a; ITRPV, 2014 Results, Revision 1, July 2015, p. 22, http://www.itrpv.net/Reports/Downloads/2015/.

Some manufacturers have also placed metal contacts onto the rear side of the cell, creating back (or rear contact) cells. This provides several advantages such as reduced shading, improved cell interconnection, and better aesthetics.[143]

Some PV modules do not use a frame, which reduces costs. These modules typically use a glass as the rear layer to ensure mechanical stability. Frameless modules account for less than 5 percent of the global market.[144]

U.S. tariff treatment

The imported articles are provided for in subheading 8541.40.60 (statistical reporting numbers 8541.40.6020 ("solar cells, assembled into modules or made up into panels") and 8541.40.6030 ("solar cells, other")) of the Harmonized Tariff Schedule of the United States ("HTS"), and have been free of duty under the general duty rate since at least 1987. These articles may also be imported as parts or subassemblies of goods provided for in subheadings 8501.31.80, 8501.61.00, and 8507.20.80. Inverters or batteries with CSPV cells attached are provided for under HTSUS subheadings 8501.61.00 and 8507.20.80, respectively. In addition, CSPV cells covered by the investigation may also be classifiable as DC generators of subheading 8501.31.80, when such generators are imported with CSPV cells attached. Goods classified in subheadings 8501.31.80 and 8501.61.00 have general duty rates of 2.5 percent, and goods classified in subheading 8507.20.80 have a general duty rate of 3.5 percent ad valorem. As stated in the Commission's notice of investigation, the HTS subheadings and reporting numbers are provided for convenience and the written description of the imported article is dispositive.[145] Decisions on the tariff classification and treatment of imported articles are within the authority of U.S. Customs and Border Protection.

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[143] SunPower, "SunPower Module Degradation Rate," n.d., pp.10– 11, https://us.sunpower.com/sites/sunpower/files/media-library/white-papers/wp-sunpower-module-degradation-rate.pdf (accessed August 24, 2017); PV Education Website, http://www.pveducation.org/pvcdrom/manufacturing/rear-contact (accessed August 24, 2017); M.K.Mat Desa et al, "Silicon Back Contact Solar Cell Configuration: A Pathway Towards Higher Efficiency," *Renewable and Sustainable Energy Reviews*, Volume 60, July 2016, Abstract, http://www.sciencedirect.com/science/article/pii/S1364032116002392.

[144] ITRPV, 2016 Results, March 2017, pp. 37–40, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a.

[145] *Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products): Institution and scheduling of safeguard investigation and determination that the investigation is extraordinarily complicated*, 82 FR 25331, June 1, 2017.

THE U.S. MARKET

U.S. producers[146]

The Commission sent U.S. producers' questionnaires to 188 firms identified by the Commission as possible U.S. producers or U.S. importers of CSPV cells and/or modules. The Commission received responses from 13 firms reporting domestic production since January 1, 2012.[147] During the previous *CSPV 2* investigations, three additional firms (Motech, Silicon Energy, and tenKsolar) that have since ceased CSPV operations supplied the Commission with information on their U.S. operations.[148] Where applicable, the aggregate U.S. industry data presented in this report also include the data provided to the Commission by these three domestic producers in the *CSPV 2* investigations. In total, these 16 firms are believed to have accounted for all known U.S. production of CSPV cells and 63.9 percent of U.S. production of CSPV modules during 2015.[149] Presented in table I-2 is a list of responding domestic producers

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[146] In the prior *CSPV 1* and *CSPV 2* investigations, the Commission found that U.S. module assemblers engaged in sufficient production-related activities to include them in the domestic industry as domestic producers of the domestic like product. Consequently, the Commission treated their resulting CSPV products as shipments by the domestic industry, even if those modules were assembled in the United States from inputs that were imported. No party in those prior investigations argued that module assemblers should not be included in the domestic industry. Based on her finding that CSPV cells and CSPV modules were separate domestic like products, however, Commissioner Broadbent defined two corresponding domestic industries. *Certain Crystalline Silicon Photovoltaic Cells and Modules from China and Taiwan*, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Publication 4519, February 2015, p. 16.

[147] One of the 12 firms providing responses to the U.S. producer questionnaire (***) provided responses to certain narrative questions in the U.S. producer questionnaire but did not provide any data concerning its production operations. The following companies reported that they have not produced CSPV products in the United States since January 1, 2012: ***.

[148] Another firm, Suntech, submitted data in the *CSPV 1* investigations but did not submit data in the *CSPV 2* investigations; Suntech, an opponent of the prior petitions, accounted for a small and declining share of domestic production, imported sizeable volumes from China and Taiwan, and closed its production facility in March 2013. The Commission determined that appropriate circumstances existed to exclude Suntech from the domestic industry as a related party. USITC Publication 4519 at 16-20; USITC Publication 4360 at 13-16; *Why a Chinese Firm's Factory in Arizona Failed*, (Sept. 18, 2014) available on Bloomberg.com.

[149] Based on a comparison of U.S. producers' reported production of CSPV modules of *** kW in 2015 with total 2015 U.S. production of modules of 864,985 kW as reported in EIA, Solar Photovoltaic Cell/Module Shipments Report, September 2016, table 6. EIA data also include thin film products that are not within the scope of this investigation. Since EIA's estimate of total U.S. production of modules includes thin film products and is likely somewhat overstated for purposes of a coverage calculation for U.S. module production in this investigation, the questionnaire responses received from U.S. module producers likely account for a higher percentage of U.S. CSPV module production.

and each company's position on the petition, production locations, and share of reported production of CSPV products during 2012-16.

Table I-2
CSPV products: U.S. producers, their position on the petition, location of production, and share of reported production, January 2012 through December 2016

Firm	Position on petition	Production location	Share of CSPV cell production (percent)	Share of module assembly (percent)
Itek	***	Bellingham WA	***	***
Kyocera	***	San Diego, CA	***	***
Mission Solar	***	San Antonio, TX	***	***
Motech Americas	([1])	New Castle, DE	***	***
SBM	***	Concord, NC	***	***
Seraphim	***	Jackson, MS	***	***
Sharp	***	Memphis, TN	***	***
Silicon Energy	([1])	Marysville, WA Mountain Iron, MN	***	***
Solaria	***	Fremont, CA	***	***
Solartech	***	Riviera Beach, FL	***	***
SolarWorld	***	Hillsboro, OR	***	***
Suniva	***	Norcross, GA Saginaw, MI	***	***
SunStream	***	Westminster, CO Gilbert, AZ	***	***
tenKsolar	([1])	Bloomington, MN	***	***
Tesla	***	Fremont, CA Buffalo, NY	***	***
Wanxiang	***	Rockford, IL	***	***
Total			100.0	100.0

[1] Did not provide a response to the Commission's questionnaire in this proceeding. Motech closed in late 2013, Silicon Energy shut down in 2017 but had been operating at diminished capacity since 2014, and tenKsolar announced in May 2017 that it had discontinued its operations. In the prior *CSPV 2* investigations, ***.

Note.--Shares shown as "0.0" represent values greater than zero but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires; "Newark solar facility has closed, official says," Delaware Online, The News Journal, September 8, 2014, http://www.delawareonline.com/story/money/business/2014/09/08/newark-solar-facility-closed-official-says/15290473/, accessed July 18, 2017; Myers, John, "Mountain Iron solar company among last in Minnesota," Prairie Business, Forum News Service, June 12, 2017, http://www.prairiebusinessmagazine.com/energy/4281984-mountain-iron-solar-company-among-last-minnesota, accessed July 18, 2017; Hughlett, Mike, "Ten K Solar 'discontinuing' current operation," Star Tribune, May 10, 2017, http://www.startribune.com/ten-k-solar-discontinuing-current-operation/421917033/, accessed July 18, 2017.

U.S. importers

The Commission sent U.S. importers' questionnaires to 188 firms identified by the Commission as possible U.S. producers or U.S. importers of CSPV cells and/or modules.[150] Questionnaire responses containing usable data were received from 56 firms and are believed to have accounted for approximately 83 percent of U.S. imports of CSPV products from all sources during 2016.[151] Although separate U.S. import data were requested in the Commission's questionnaires for U.S. imports from Australia, Brazil, Colombia, Israel, Jordan, Mexico, Panama, Peru, and the Dominican Republic-Central America Free Trade Agreement ("CAFTA-DR") countries (i.e., Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua),[152] no U.S. import data were reported by U.S. importers in their questionnaire responses for these countries for 2012-16.

Table I-3 lists all responding U.S. importers of CSPV products, their U.S. locations, and their share of the quantity of total U.S. imports from January 2012 to December 2016.

[150] The following firms reported that they have not imported CSPV products since January 1, 2012: ***.

[151] Based on a comparison of the total value of 2016 U.S. imports of CSPV cells and modules from all countries reported in the responses to the Commission's U.S. importer questionnaire ($7.06 billion) with total landed-duty paid value ($8.5 billion) of 2016 U.S. imports of cells and modules as reported by official Commerce import statistics (HTS 8541.40.6030 and 8541.40.6020). Questionnaire data coverage presented may be imprecise because the official Commerce statistics may include other products not within the scope of this investigation, such as thin film solar products.

[152] Data were requested separately for the listed countries consistent with statutory provisions regarding separate findings for imports from these countries.

Table I-3
CSPV products: U.S. importers, their headquarters, and share of total U.S. imports, January 2012 through December 2016

Firm	Headquarters	Share of total U.S. imports (percent)
Academy, Ltd.	Katy, TX	***
Ameresco	Framingham, MA	***
Astro Solartech	Irwindale, CA	***
AUO Green Energy America	Milpitas, CA	***
Boviet Solar USA	San Jose, CA	***
BYD America	Los Angeles, CA	***
Canadian Solar (USA)	Walnut Creek, CA	***
Carmanah Technologies	Victoria, BC	***
Celestica	Merrimack, NH	***
Centrosolar America	Scottsdale, AZ	***
DMEGC USA	Torrance, CA	***
First Solar	Tempe, AZ	***
Goal Zero	Bluffdale, UT	***
Grape Solar	Eugene, OR	***
Hanwha International	Teaneck, NJ	***
Hanwha Q Cells America	Irvine, CA	***
Hanwha Q Cells USA.	Irvine, CA	***
Hareon Solar USA	San Jose, CA	***
Heliene	Sault Ste. Marie, ON	***
IES Residential	Stafford, TX	***
Itek Energy	Bellingham, WA	***
JA Solar USA	San Jose, CA	***
Jiawei	Hayward, CA	***
JinkoSolar (U.S.)	San Francisco, CA	***
Kyocera International	San Diego, CA	***

Table continued on following page.

Table I-3--Continued
CSPV products: U.S. importers, their headquarters, and share of total U.S. imports, January 2012 through December 2016

Firm	Headquarters	Share of total U.S. imports (percent)
Lerri Solar	San Ramon, CA	***
LG Electronics USA	Englewood Cliffs, NJ	***
Mission Solar Energy	San Antonio, TX	***
NextEra Energy Resources	Juno Beach, FL	***
Panasonic Eco Solutions	Newark, NJ	***
Pitsco	Pittsburg, KS	***
Posco-Daewoo America	Teaneck, NJ	***
Prism Solar Technologies	Highland, NY	***
REC Americas	San Mateo, CA	***
SBM Solar	Concord,, NC	***
Seraphim Solar USA	Sugar Land, TX	***
Sharp (constructed from CNIF)	Memphis, TN	***
Silfab Solar	Mississauga, ON	***
Solarland USA	Ontario, CA	***
Solartech Power	Ontario, CA	***
SolarTech Universal	Riviera Beach, FL	***
SolarWorld Americas	Hillsboro, OR	***
Solatube International	Vista, CA	***
Sumec North America	Chatsworth, CA	***
Suniva	Norcross, GA	***
SunPower	San Jose, CA	***
SunPower Corporation Systems	Richmond, CA	***
SunPower North America	San Jose, CA	***
Sunpreme	Sunnyvale, CA	***
SunStream Technology	Westminster, CO	***
Tesla	Palo Alto, CA	***
The Chamberlain Group	Oak Brook, IL	***
The Solaria Corp.	Fremont, CA	***
Trina Solar (U.S.)	San Jose, CA	***
Upsolar America	San Francisco, CA	***
Wanziang (constructed from CNIF)	Rockford, IL	***
Winaico Delaware	Southampton, PA	***
Yingli Green Energy Americas	San Francisco, CA	***
Total		***

[1] BYD America ***.

Note.—Shares shown as "0.0" represent values greater than zero but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. purchasers

The Commission sent U.S. purchasers' questionnaires to 65 firms identified as possible U.S. purchasers of CSPV products and received 106 usable questionnaire responses from firms that purchased CSPV products during January 2012-December 2016.[153] Fifty-eight responding purchasers are commercial installers, 39 are residential installers, 38 are utility companies or developers, 19 are module distributors, 8 are module assemblers, 7 are distributors of off-grid portable consumer goods, 4 are utility scale EPC contractors, 2 are retailers, 1 is an original equipment manufacturer ("OEM"), and 1 is a community solar provider.

Ten firms reported their purchase quantities of CSPV cells during 2012-16. The largest purchasers of CSPV cells were ***, which accounted for 99 percent of total reported purchases of CSPV cells. Ninety-six purchasers reported their purchase quantities of CSPV modules during 2012-16. The largest purchasers of CSPV modules were ***; these six purchasers accounted for 58 percent of total reported purchases of CSPV modules during 2012-16.

[153] The Commission sent U.S. purchaser questionnaires to the industry's largest purchasers. However, due to the large number of firms that purchase CSPV products in the U.S. market and the industry's awareness of the investigation, the Commission received additional U.S. purchaser questionnaire responses from firms that had purchased CSPV products during the period of investigation and volunteered their participation in the ongoing investigation.

THIRD-COUNTRY MARKET IMPORT RESTRAINTS

Several countries have imposed antidumping and/or countervailing duties on imports of CSPV products from one or more sources. Such restraints are discussed in detail in the sections that follow, organized by the specific country that has undertaken such measures. A summary of import restraint measures taken by third countries is presented in table I-4.

Table I-4
CSPV products: Third country market import restraints in effect[1]

Importing country	Product	Measure	Date	Exporting country
European Union	CSPV cells and modules	Provisional antidumping duties (37.3% – 67.9%)	June 2013	China
		Price Undertaking Agreement	August 2013	
		Final antidumping and anti-subsidy determination (4.7% – 64.9%) applies to companies in China that are not part of the Price Undertaking Agreement	December 2013	
		Final affirmative circumvention finding – duties in force for China extended to modules manufactured in Malaysia and Taiwan from cells produced in China	February 2016	Malaysia Taiwan
		18-month extension of measures	March 2017	China Malaysia Taiwan
Canada	CSPV modules	Antidumping duties (124.4%) Subsidy rate (6.2%)	July 2015	China
China	Solar-grade polysilicon	Provisional antidumping duties (up to 57%) and subsidy rate (2.1%)	January 2014	United States Korea
		Final antidumping duties (42%) and subsidy rate (1.2%)	May 2014	European Union
Turkey	CSPV modules	Antidumping duties (27%)	February 2017	China

[1] Investigations conducted by India during 2012-14 on CSPV cells and modules originating in China, Taiwan, Malaysia, and the United States and investigations conducted by Australia during 2014-16 on CSPV cells and modules originating in China did not result in antidumping duties or subsidy rates. However, India is currently conducting an antidumping investigation initiated in July 2017 on imports of "Solar Cells whether or not assembled partially or fully in Modules or Panels or on glass or some other suitable substrates" originating in or exported from China, Malaysia, and Taiwan.

Source: Cited public articles in sections that follow.

The European Union

In July 2012, EU ProSun filed an antidumping duty petition with the European Commission ("EC") regarding imports of CSPV cells and modules from China, and on September 6, 2012, the EC announced its initiation of an antidumping duty investigation on these imports.[154] In response to a countervailing duty complaint filed on September 26, 2012 by EU ProSun, on November 8, 2012 the EC announced its initiation of an antisubsidy investigation concerning imports of crystalline silicon photovoltaic modules and key components (i.e., cells and wafers) originating in China.[155]

In June 2013, the EC announced the imposition of provisional antidumping duties ranging from 37.3 percent to 67.9 percent.[156] Thereafter, the EC and a group of Chinese solar manufacturers, which represented approximately 70 percent of total Chinese exports to the EU, entered into a "price undertaking" agreement, which went into effect in August 2013.[157] Certain named CSPV product manufacturers agreed to volume quotas and minimum prices pursuant to the undertaking, and in return for selling at or above the Minimum Import Price ("MIP"), the antidumping and anti-subsidy duties do not apply to imports of their products into the EU. The EC reports that it constantly monitors the implementation of the price undertaking and occasionally adjusts the MIP to account for market price developments. All imports into the EU from China that are above the quota, as well as those imports of solar cells and solar panels from Chinese producers that are not named in the undertaking, are subject to the final

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[154] *Notice of initiation of an antidumping duty proceeding concerning imports of crystalline silicon photovoltaic modules and key components (i.e. cells and wafers) originating in the People's Republic of China*, Official Journal of the European Union, C/269/5, September 6, 2012.

[155] *Notice of initiation of an anti-subsidy proceeding concerning imports of crystalline silicon photovoltaic modules and key components (i.e. cells and wafers) originating in the People's Republic of China*, Official Journal of the European Union, C/340/6, November 8, 2012.

[156] *Imposing a provisional anti-dumping duty on imports of crystalline silicon photovoltaic modules and key components (i.e. cells and wafers) originating in or consigned from the People's Republic of China and amending Regulation (EU) No 18212013 making these imports originating in or consigned from the People's Republic of China subject to registration*, Commission Regulation (EU) No 513/2013, (June 4, 2013).

[157] European Commission Directorate-General for Trade, *EU imposes definitive measures on Chinese solar panels, confirms undertaking with Chinese solar panel exporters*, Press Release (December 2, 2013).

antidumping and countervailing duty rates that the EC imposed on December 5, 2013 ranging from 47.7 percent to 64.9 percent.[158]

On May 29, 2015, the EC initiated investigations into claims that the duties in force concerning imports from China were being circumvented by shipments through Taiwan and Malaysia. On February 11, 2016, the EC determined that circumvention had occurred and extended the duties in force against China to solar panels and solar cells consigned from Taiwan and Malaysia. However, the EC's circumvention finding (and the extended duties) do not apply to approximately twenty companies in Taiwan and five companies in Malaysia that the EC found were "genuine producers" that had not engaged in any circumvention activities.[159]

On March 3, 2017, the EU published an 18-month extension of antidumping and anti-subsidy duties on CSPV products from China, and notified its intention to conduct a partial interim review of the gradual mitigation of the measures over the next 18 months. The EC expected to complete its interim review within six to nine months. In its review, the EC intends to examine if the measures are still applicable and of relevance in light of the fact that several manufacturers in China have withdrawn from the MIP undertaking or have been excluded by the EC for various violations. Antidumping duty margins, which range from 27.3 percent to 64.9 percent, and anti-subsidy duties, which range from 3.5 percent to 11.5 percent, apply to those companies that were excluded or withdrew from the MIP undertaking. The duties apply to imports of CSPV modules and CSPV cells manufactured in China and to modules assembled in third countries from CSPV cells produced in China.[160]

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[158] *Certain Crystalline Silicon Photovoltaic Cells and Modules from China and Taiwan*, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Publication 4519, February 2015, p. VII-29; *Council Implementing Regulation (EU) No 1239/2013 of 2 December 2013 imposing a definitive countervailing duty on imports of crystalline silicon photovoltaic modules and key components (i.e. cells) originating in or consigned from the People's Republic of China*, Official Journal of the European Union, December 5, 2013; *Council Implementing Regulation (EU) No 1238/2013 of 2 December 2013 imposing a definitive anti-dumping duty and collecting definitively the provisional duty imposed on imports of crystalline silicon photovoltaic modules and key components (i.e. cells) originating in or consigned from the People's Republic of China*, Official Journal of the European Union, December 5, 2013.

[159] *Commission Implementing Regulation (EU) 2016/184 of 11 February 2016 extending the definitive countervailing duty imposed by Council Implementing Regulation (EU) No 1239/2013 on imports of crystalline silicon photovoltaic modules and key components (i.e. cells) originating in or consigned from the People's Republic of China to imports of crystalline silicon photovoltaic modules and key components (i.e. cells) consigned from Malaysia and Taiwan, whether declared as originating in Malaysia and in Taiwan or not*, Official Journal of the European Union, February 11, 2016.

[160] *Notice of initiation of a partial interim review of the anti-dumping and countervailing measures applicable to imports of crystalline silicon photovoltaic modules and key components (i.e. cells) originating in or consigned from the People's Republic of China (2017/C 67/10)*, Official Journal of the European Union, March 3, 2017; "Extension of EU duties on Chinese solar products is now official," *PV Magazine*, March 3, 2017, https://www.pv-magazine.com/2017/03/03/extension-of-eu-duties-on-chinese-solar-products-is-now-official/, accessed on July 9, 2017.

India

In October 2012, solar manufacturers in India filed a complaint alleging that solar cells and modules from China, Taiwan, Malaysia, and the United States are being sold at LTFV and unfairly subsidized by the respective governments. On November 23, 2012, India initiated its investigation. After extending the duration of the investigation, in May 2014, the Indian Directorate General of Anti-Dumping and Allied Duties ("DGAD") recommended imposing duties ranging from $0.11 to $0.81 per watt on solar cells imported from the United States, China, Malaysia and Taiwan. However, the Indian Ministry of Commerce announced in September 2014 that the government would not impose the duties and had let the recommendation lapse.[161]

In June 2017, an antidumping petition concerning solar cells and modules imported into India from China, Malaysia, and Taiwan was filed by the Indian Solar Manufacturers Association (on behalf of Indosolar Ltd., Jupitar Solar Power Ltd., Jupitar International Ltd., and Websol Energy Systems Ltd.). DGAD issued notification on July 21, 2017 of the initiation of an antidumping investigation on imports of "Solar Cells whether or not assembled partially or fully in Modules or Panels or on glass or some other suitable substrates" originating in or exported from China, Malaysia, and Taiwan. The scope of the product under investigation covers cells, modules, and thin films. While it investigates the antidumping allegations, which can take 12-18 months, India is also reportedly considering in the context of a possible safeguard investigation whether or not there has been a sudden surge in imports of solar cells and modules from China and certain other countries that may be causing harm to manufacturers in India.[162]

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[161] *"India Not to Impose Anti-Dumping Duty on Solar Panels: Nirmala,"* Outlook India, September 10, 2014, http://www.outlookindia.com/news/article/India-Not-to-Impose-AntiDumping-Duty-on-Solar-Panels-Nirmala/859279 accessed July 9, 2017; *Certain Crystalline Silicon Photovoltaic Cells and Modules from China and Taiwan*, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Publication 4519, February 2015, p. VII-30.

[162] Kenning, Tom, "*India mulling safeguard duties on solar imports with China in sights*," PV-Tech, July 21, 2017, https://www.pv-tech.org/news/india-considers-safeguard-duties-on-solar-imports-with-dumping-investigatio, accessed July 23, 2017; *Initiation Notification, Case No. OI-33/2017*, F. No. 6/30/2017-DGAD, Government of India, Department of Commerce, Ministry of Commerce & Industry, Directorate General of Anti-Dumping & Allied Duties, July 21, 2017.

Australia

On May 14, 2014, the Government of Australia initiated an antidumping duty investigation on CSPV modules or panels from China. The proposed dumping margins ranged from 21.6 percent to 60.3 percent.[163] On October 17, 2016, the Government of Australia terminated the investigation on the grounds that any injury to the Australian industry that had been or may be caused by the exports of dumped CSPV panels from China was "negligible."[164]

Canada

On December 8, 2014, the Canadian International Trade Tribunal ("CITT") initiated antidumping and countervailing duty investigations on CSPV products from China.[165] On July 3, 2015, the CITT determined that the dumping and subsidizing of the CSPV products from China did not cause injury, but threatened to cause injury to the Canadian industry. The Canada Border Services Agency ("CBSA") determined that 100 percent of the subject goods imported into Canada from China had been dumped at a weighted average margin of 124.4 percent, when expressed as a percentage of the export price. The CBSA also determined that 100 percent of the subject goods imported into Canada from China had been subsidized at a

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[163] The investigation excluded CSPV cells and wafers. Antidumping Commission, Government of Australia, http://www.adcommission.gov.au/cases/documents/031-ADN-201438-Initiationofaninvestigationintoallegeddumping.pdf; http://www.adcommission.gov.au/cases/documents/094-Notice-Anti-DumpingNotice2014-06ExtentionoftimetoissueSEF.pdf .

[164] *Certain crystalline silicon photovoltaic modules or panels exported from the People's Republic of China: Termination of Investigation*, Anti-Dumping Notice No. 2016/110, Antidumping Commission, Government of Australia, October 17, 2016, http://www.adcommission.gov.au/cases/EPR%20193%20%20250/EPR%20239%20-%20archived%2013%20December%202016/182%20-%20Notice%20-%20ADN%202016-110%20-%20Termination%20of%20Investigation.pdf, accessed on July 9, 2017.

[165] *Notice of Commencement of Preliminary Injury Inquiry, Certain Photovoltaic Modules and Laminates*, Canadian International Trade Tribunal, Inquiry No. PI-2014-003. Canadian solar producers, Eclipsall Energy Corp., Heliene, Inc., Silfab Ontario Inc., and Solgate, Inc. filed the petition on October 1, 2014. The investigation covered photovoltaic modules and laminates consisting of crystalline silicon photovoltaic cells, including laminates shipped or packaged with other components of photovoltaic modules, and thin film photovoltaic products produced from amorphous silicon (a-Si), cadmium telluride (CdTe), or copper indium gallium selenide (CIGS), originating in or exported from China, excluding modules, laminates or thin film products with a power output not exceeding 100 W, and also excluding modules, laminates or thin film products incorporated into electrical goods where the function of the electrical goods is other than power generation and these electrical goods consume the electricity generated by the photovoltaic product. Excluded are 195 W monocrystalline photovoltaic modules made of 72 monocrystalline cells, each cell being no more than 5 inches in width and height.

weighted average amount of subsidy of 6.2 percent, when expressed as a percentage of the export price.[166]

China

On July 20, 2012, the Government of China announced the commencement of an antidumping and countervailing duty investigation of "solar-grade polysilicon," a raw material used in the manufacturing of solar panels, from the United States and Korea.[167] In January 2014, China imposed provisional antidumping duties on U.S. and Korean polysilicon as high as 57 percent and provisional countervailing duties of 2.1 percent. On January 20, 2014, the Government of China imposed definitive antidumping duties that ranged from 53.3 to 57 percent on imports from the United States and 2.4 to 48.7 percent for imports from Korea; on the same date, the Government of China announced that it found zero or *de minimis* subsidy rates on imports from U.S. firms REC Solar Grade Silicon LLC, REC Advanced Silicon Materials LLC, and MEMC Pasadena, Inc., but that it was imposing a countervailing duty rate of 2.1 percent on imports from Hemlock Semiconductor Corp., AE Polysilicon Corp., and all other U.S. exporters.

Separately, the Government of China launched an antidumping and subsidy investigation on solar-grade polysilicon originating in the European Union in November 2012.[168] Following the investigation, in May 2014, the Government of China confirmed final antidumping duties of 42 percent and anti-subsidy duties of 1.2 percent on imports of solar-grade polysilicon from the EU.[169]

Turkey

The Government of Turkey completed an antidumping investigation of imported modules from China in February 2017, in which it found a dumping rate of 27 percent. On April 1, 2017, the Government of Turkey published a list of China-based CSPV manufacturers that are the subject of antidumping duty fees.[170]

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[166] *Photovoltaic Modules and Laminates, Inquiry No. NQ-2014-003*, Canadian International Trade Tribunal, July 3, 2015, http://www.citt.gc.ca/en/node/7411#_Toc426546520, accessed on July 10, 2017.

[167] Ministry of Commerce, People's Republic of China website: http://english.mofcom.gov.cn/aarticle/newsrelease/significantnews/201207/20120708245225.html accessed August 30, 2012.

[168] "China moves forward with duties on EU polysilicon," International Centre for Trade and Sustainable Development, May 8, 2014, https://www.ictsd.org/bridges-news/biores/news/china-moves-forward-with-duties-on-eu-polysilicon, accessed on July 20, 2017.

[169] "China hits EU with final duties on polysilicon," REUTERS, 30 April 2014, https://www.ajot.com/news/china-hits-eu-with-final-duties-on-polysilicon, accessed on July 10, 2017.

[170] "Turkey publishes antidumping fee and list for China-based PV manufacturers," PV Magazine, April 3, 2017, https://www.pv-magazine.com/2017/04/03/turkey-publishes-antidumping-fee-and-list-for-china-based-pv-manufacturers/, accessed on July 10, 2017.

PART II: INFORMATION RELATING TO INCREASED IMPORTS

U.S. IMPORTS

The import data presented in this part of the report are compiled from data submitted in response to Commission questionnaires. Import data compiled from official U.S. import statistics using HTS statistical reporting numbers 8541.40.6020 and 8541.40.6030 are presented in appendix C, table C-4.[1]

Country-of-origin based on cell manufacture location

Total U.S. imports of certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products ("CSPV products"),[2] were more than five times higher in 2016 than reported in 2012 based on quantity (kW) (table II-1 and figure II-1).[3] A similar upward trend is observed for U.S. imports based on value. However, the average unit value of U.S. imports of CSPV products declined from a high of $881 per kW in 2012 to a low of $551 per kW in 2016. The largest increases in U.S. imports of CSPV products were observed for Malaysia (*** kW higher in 2016 than in 2012), China (2.4 million kW higher in 2016 than in 2012), and Korea (*** kW higher in 2016 than in 2012). The leading suppliers of foreign CSPV products to the United States during 2012 were Taiwan, China, and the Philippines, representing 49.3 percent, 15.1 percent, and *** percent of all imports by quantity, respectively. In 2016, Malaysia, China, and Korea were the leading suppliers of foreign CSPV products to the United States, representing *** percent, 21.2 percent, and *** percent of all imports by quantity, respectively.

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[1] Official U.S. import statistics may be overstated by certain items that are outside the scope of this investigation, such as thin film photovoltaic products. In addition, only import value data are presented in table C-4 because quantity data are not collected on the basis of kW.

[2] See the section entitled "The Imported Articles Described in this Investigation" in *Part I* of this report for a complete description of the merchandise subject to this investigation.

[3] The data presented in table II-1 and figure II-1 represent CSPV cells and modules with a country-of-origin based on cell manufacture location.

Table II-1

CSPV products: U.S. imports (country-of-origin based on cell manufacture location), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
U.S. imports from.-- Canada	***	***	***	***	***
China	326,846	82,264	1,263,270	3,311,513	2,720,193
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	1,065,160	2,113,220	2,090,974	852,758	1,118,967
Thailand	***	***	***	***	***
Vietnam	---	---	---	161,195	472,682
All other sources	***	***	***	***	***
All import sources	2,162,388	3,101,412	4,582,898	8,430,393	12,813,568
	Value (1,000 dollars)				
U.S. imports from.-- Canada	***	***	***	***	***
China	291,878	69,976	747,148	1,680,733	1,258,864
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	743,337	1,349,271	1,274,305	467,820	606,449
Thailand	***	***	***	***	***
Vietnam	---	---	---	96,336	240,625
All other sources	***	***	***	***	***
All import sources	1,904,664	2,214,457	3,014,861	4,967,865	7,060,489

Table continued on following page.

Table II-1--Continued

CSPV products: U.S. imports (country-of-origin based on cell manufacture location), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Unit value (dollars per kW)				
U.S. imports from.-- Canada	***	***	***	***	***
China	893	851	591	508	463
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	698	638	609	549	542
Thailand	***	***	***	***	***
Vietnam	---	---	---	598	509
All other sources	***	***	***	***	***
All import sources	881	714	658	589	551
	Ratio to U.S. production (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	***	***	***	***	***

Table continued on following page.

Table II-1--Continued

CSPV products: U.S. imports (country-of-origin based on cell manufacture location), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Share of quantity (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	15.1	2.7	27.6	39.3	21.2
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	49.3	68.1	45.6	10.1	8.7
Thailand	***	***	***	***	***
Vietnam	---	---	---	1.9	3.7
All other sources	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Rank based on quantity				
U.S. imports from.-- 1st largest source	Taiwan	Taiwan	Taiwan	China	Malaysia
2nd largest source	China	Malaysia	China	Malaysia	China
3rd largest source	Philippines	Philippines	Malaysia	Taiwan	Korea
4th largest source	Malaysia	Korea	Philippines	Singapore	Taiwan
5th largest source	Japan	China	Singapore	Japan	Thailand
6th largest source	Korea	Japan	Korea	Korea	Vietnam
7th largest source	Singapore	Singapore	Germany	Philippines	Singapore
8th largest source	Germany	Germany	Japan	Germany	Germany
9th largest source	---	---	---	Vietnam	Philippines
10th largest source	---	---	---	Thailand	Japan

Table continued on following page.

Table II-1--Continued

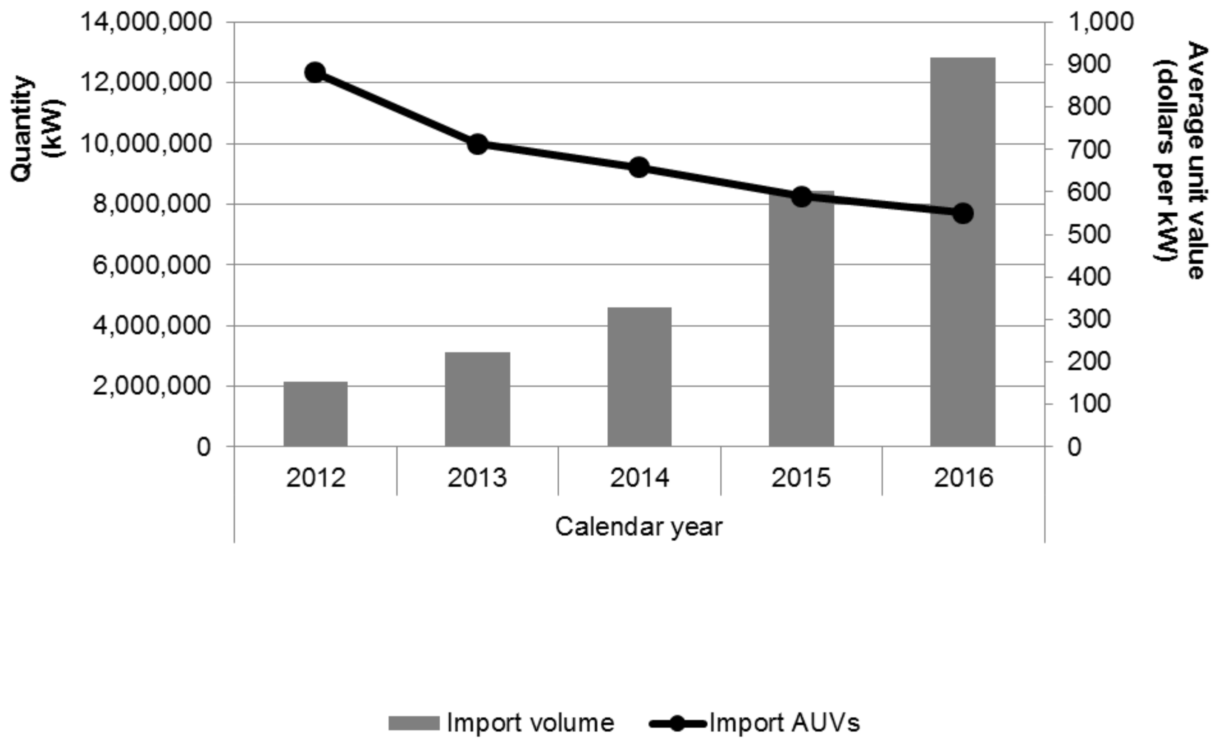
CSPV products: U.S. imports (country-of-origin based on cell manufacture location), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Share of value (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	15.3	3.2	24.8	33.8	17.8
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	39.0	60.9	42.3	9.4	8.6
Thailand	***	***	***	***	***
Vietnam	---	---	---	1.9	3.4
All other sources	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Rank based on value				
U.S. imports from.-- 1st largest source	Taiwan	Taiwan	Taiwan	China	Malaysia
2nd largest source	Philippines	Malaysia	China	Malaysia	Korea
3rd largest source	China	Philippines	Malaysia	Taiwan	China
4th largest source	Malaysia	Japan	Philippines	Singapore	Taiwan
5th largest source	Japan	China	Korea	Japan	Philippines
6th largest source	Korea	Korea	Singapore	Philippines	Thailand
7th largest source	Singapore	Singapore	Germany	Korea	Singapore
8th largest source	Germany	Germany	Japan	Germany	Vietnam
9th largest source	---	---	---	Vietnam	Japan
10th largest source	---	---	---	Thailand	Germany

Note.--Shares and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure II-1
CSPV products: U.S. import volumes and average unit values, 2012-16



Source: Compiled from data submitted in response to Commission questionnaires.

Country-of-origin based on cell manufacture location except for NAFTA countries

Total U.S. imports of CSPV products with a country-of-origin for NAFTA countries based on module manufacture location and a country-of-origin for all other sources based on the cell manufacture location are presented in table II-2.

Table II-2
CSPV products: Alternative U.S. imports (country-of-origin based on cell manufacture location, except for NAFTA countries), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	2,163,073	3,100,220	4,583,141	8,415,542	12,815,100
	Value (1,000 dollars)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	1,907,405	2,212,042	3,015,041	4,955,829	7,061,435

Table continued on following page.

Table II-2--Continued

CSPV products: Alternative U.S. imports (country-of-origin based on cell manufacture location, except for NAFTA countries), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Unit value (dollars per kW)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	882	714	658	589	551
	Ratio to U.S. production (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	733.9	948.4	1,141.0	1,593.5	2,276.2

Table continued on following page.

Table II-2--Continued

CSPV products: Alternative U.S. imports (country-of-origin based on cell manufacture location, except for NAFTA countries), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Share of quantity (percent)				
U.S. imports from.--					
Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Rank based on quantity				
U.S. imports from.--					
1st largest source	Taiwan	Taiwan	Taiwan	China	Malaysia
2nd largest source	China	Mexico	China	Malaysia	China
3rd largest source	Mexico	Malaysia	Mexico	Mexico	Korea
4th largest source	Philippines	Korea	Malaysia	Singapore	Mexico
5th largest source	Malaysia	China	Singapore	Taiwan	Taiwan
6th largest source	Korea	Singapore	Korea	Korea	Thailand
7th largest source	Singapore	Philippines	Germany	Canada	Vietnam
8th largest source	Japan	Germany	Philippines	Japan	Singapore
9th largest source	Germany	Japan	Canada	Germany	Germany
10th largest source	Canada	Canada	Japan	Vietnam	Canada

Table continued on following page.

Table II-2--Continued

CSPV products: Alternative U.S. imports (country-of-origin based on cell manufacture location, except for NAFTA countries), by source, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Share of value (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
All other sources	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Rank based on value				
U.S. imports from.-- 1st largest source	Taiwan	Taiwan	Taiwan	China	Malaysia
2nd largest source	Mexico	Mexico	China	Malaysia	Korea
3rd largest source	China	Malaysia	Mexico	Mexico	China
4th largest source	Philippines	China	Malaysia	Singapore	Mexico
5th largest source	Malaysia	Korea	Korea	Taiwan	Taiwan
6th largest source	Korea	Singapore	Singapore	Korea	Thailand
7th largest source	Singapore	Philippines	Germany	Canada	Singapore
8th largest source	Japan	Germany	Philippines	Japan	Vietnam
9th largest source	Germany	Japan	Canada	Germany	Germany
10th largest source	Canada	Canada	Japan	Vietnam	Canada

Note.--Shares and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent. The adjustments made to reclassify the country-of-origin for modules assembled in Canada or Mexico resulted in small immaterial differences in the total import values (never exceeding a margin of 0.2 percent difference). Data for Canada do not include U.S.-origin cells assembled into modules or laminates in Canada.

Source: Compiled from data submitted in response to Commission questionnaires.

According to these data, U.S. imports of CSPV modules from Canada increased from *** kW ($***) in 2012 to *** kW ($***) in 2016. However, the average unit value of U.S. imports of modules from Canada declined from a high of $*** per kW in 2012 to a low of $*** per kW in 2015, before increasing to $*** per kW in 2016. The share of the total quantity of U.S. imports held by Canadian imports increased from *** percent of total U.S. imports in 2012 to *** percent in 2015, before declining to *** percent in 2016. Canada was the tenth largest source of U.S. imports of CSPV products during 2012, 2013, and 2016. It was the ninth largest source during 2014 and the seventh largest source during 2015.

The quantity of U.S. imports of CSPV modules from Mexico were *** higher in 2016 than reported in 2012, increasing from *** kW in 2012 to *** kW in 2016. However, the average unit value of U.S. imports of modules from Mexico declined from a high of $*** per kW in 2012 to a low of $*** per kW in 2016. The share of the total quantity of U.S. imports held by Mexican imports increased from *** percent of total U.S. imports in 2012 to *** percent in 2013, before declining to *** percent in 2016. Based on quantity, Mexico was the second largest source of U.S. imports of CSPV products during 2013, the third largest source during 2012, 2014, and 2015, and the fourth largest source during 2016. Based on value, the share of total U.S. imports held by Mexican imports increased from *** percent of total U.S. imports in 2012 to *** percent in 2013, before declining to *** percent in 2016. Based on value, Mexico was the second leading source of U.S. imports of CSPV products during 2012-13, the third leading source during 2014-15, and the fourth leading source in 2016.

U.S. imports from China

The Commission requested that importing firms also separately report their U.S. imports of CSPV products from China using the assembly location of the modules to determine the country of origin (table II-3).[4] According to these data, U.S. imports of CSPV products from China fluctuated upward from 1.7 million kW ($518.9 million) in 2012 to 2.4 million kW ($1.2 billion) in 2016. The average unit value of these U.S. imports of CSPV products from China increased from $299 per kW in 2012 to $659 per kW in 2013, before falling overall to $521 per kW in 2016. The share of the total quantity of U.S. imports held by Chinese imports based on country-of-origin of module manufacture fell from 80.3 percent of total U.S. imports in 2012 to 18.4 percent in 2016. Based on value, the share of total U.S. imports held by these Chinese imports increased from 27.2 percent of total U.S. imports in 2012 to 44.7 percent in 2013, before declining to 17.4 percent in 2016.

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[4] Import data for Canada and Mexico for country-of-origin based on assembly location of the modules are incorporated into table II-2. Antidumping and countervailing duty orders associated with the *CSPV 1* investigations concerning China became effective December 7, 2012. In the *CSPV 1* investigations, Commerce determined that the country of origin of CSPV modules was the country of manufacture of the CSPV cells. Antidumping and countervailing duty orders associated with the *CSPV 2* investigations concerning China became effective February 18, 2015. In its final *CSPV 2* determinations, Commerce defined the subject merchandise from China to include U.S. imports of CSPV modules assembled in China from CSPV cells made in other countries.

Table II-3
CSPV products: Alternative U.S. imports from China (country-of-origin based on module manufacture location), 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
U.S. imports from China.-- Quantity (kW)	1,735,955	1,501,817	2,178,727	1,993,901	2,360,823
Value (1,000 dollars)	518,856	989,576	1,292,582	1,007,159	1,230,110
Unit value (dollars per kW)	299	659	593	505	521
Share of quantity of total imports (percent)	80.3	48.4	47.5	23.7	18.4
Share of value of total imports (percent)	27.2	44.7	42.9	20.3	17.4
Ratio to U.S. production (percent)	***	***	***	***	***

Note.-- Antidumping and countervailing duty orders associated with the *CSPV 1* investigations concerning China became effective December 7, 2012. Antidumping and countervailing duty orders associated with the *CSPV 2* investigations concerning China became effective February 18, 2015. Shares and ratios shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Forms of imported CSPV products

The Commission collected U.S. import data for CSPV products by the following forms in which they entered the United States: cell form, laminate form, off-grid portable consumer goods, module/panel form, and integrated building materials form. During 2012, *** percent of U.S. imports of CSPV products entered the United States as modules/panels, whereas *** percent were in cell form, *** percent were off-grid portable consumer goods, and *** percent were in laminate form (table II-4). By 2016, *** percent of U.S. imports of CSPV products entered the United States as modules/panels and *** percent were in cell form. Imports of off-grid portable consumer goods and laminate forms remained at *** percent during 2016. *** U.S. imports for CSPV products in building integrated forms were reported during the period of investigation.

All categories/types of CSPV imports were higher in 2016 than in 2012, except for U.S. imports of laminates, which declined by *** percent from 2012 to 2016. U.S. imports of CSPV cells declined from 2012 to 2014, before increasing in 2016 to a level that was *** percent higher than reported in 2012. U.S. imports of module/panel forms were *** higher in 2016 than in 2012 and off-grid portable consumer goods were *** percent higher. The largest absolute quantity increase in forms of U.S. imports of CSPV products was observed for module/panel forms at *** kW higher in 2016 than in 2012. The average unit values of all forms of CSPV imports declined from 2012 to 2016. The average unit values of module/panel forms fell by $*** per kW from a high of $*** per kW in 2012 to a low of $*** per kW in 2016.

Table II-4
CSPV products: U.S. imports, by form, 2012-16

Item	Calendar year				
	2012	**2013**	**2014**	**2015**	**2016**
	Quantity (kW)				
U.S. imports in.-- Cell form	***	***	***	***	***
Laminate form	***	***	***	***	***
Off-grid portable consumer goods	***	***	***	***	***
Module / panel form	***	***	***	***	***
Integrated building materials form	***	***	***	***	***
All forms	2,162,388	3,101,412	4,582,898	8,430,393	12,813,568
	Value (1,000 dollars)				
U.S. imports in.-- Cell form	***	***	***	***	***
Laminate form	***	***	***	***	***
Off-grid portable consumer goods	***	***	***	***	***
Module / panel form	***	***	***	***	***
Integrated building materials form	***	***	***	***	***
All forms	1,904,664	2,214,457	3,014,861	4,967,865	7,060,489
	Unit value (dollars per kW)				
U.S. imports in.-- Cell form	***	***	***	***	***
Laminate form	***	***	***	***	***
Off-grid portable consumer goods	***	***	***	***	***
Module / panel form	***	***	***	***	***
Integrated building materials form	***	***	***	***	***
All forms	881	714	658	589	551
	Share of quantity (percent)				
U.S. imports in.-- Cell form	***	***	***	***	***
Laminate form	***	***	***	***	***
Off-grid portable consumer goods	***	***	***	***	***
Module / panel form	***	***	***	***	***
Integrated building materials form	***	***	***	***	***
All forms	100.0	100.0	100.0	100.0	100.0

Source: Compiled from data submitted in response to Commission questionnaires.

Importers' CSPV technology

A majority of the 56 responding U.S. importers reported imports of CSPV products containing multicrystalline cells (40 out of 56) and monocrystalline cells (36 out of 56) since January 1, 2012, whereas slightly more than one-fourth of responding U.S. importers (15 out of 56) reported imports of CSPV products containing PERC cells (table II-5). A minority of U.S. importers reported imports of CSPV products containing bifacial cells (7 out of 56), hybrid cells (5 out of 56), and HIT cells (2 out of 56).

The largest importing firms are ***, which together accounted for *** of reported total U.S. CSPV imports during the period of investigation (see table I-3).[5] ***, which accounted for ***, reported imports of monocrystalline and multicrystalline cells. ***, which accounted for *** percent of total U.S. CSPV product imports, also reported imports of mono and multi cells, as well as hybrid cells. ***, which accounted for *** percent of total U.S. CSPV product imports, reported imports of mono and multi cells, as well as PERC cells.

Table II-5
CSPV products: U.S. importers' reported ability to supply specific technologies, 2012-16

Firm	Type of technology firm reported					
	Mono cells	Multi cells	PERC cells	HIT cells	Bifacial cells	Hybrid cells
Academy	***	***	***	***	***	***
Ameresco	***	***	***	***	***	***
Astro Solartech	***	***	***	***	***	***
AUO Green Energy America	***	***	***	***	***	***
Boviet Solar	***	***	***	***	***	***
BYD America	***	***	***	***	***	***
Canadian Solar	***	***	***	***	***	***
Carmanah Technologies	***	***	***	***	***	***
Celestica	***	***	***	***	***	***
Centrosolar America	***	***	***	***	***	***
DMEGC USA	***	***	***	***	***	***
First Solar	***	***	***	***	***	***
Goal Zero	***	***	***	***	***	***
Grape Solar	***	***	***	***	***	***
Hanwha International	***	***	***	***	***	***
Hanwha Q Cells America	***	***	***	***	***	***
Hanwha Q Cells USA	***	***	***	***	***	***
Hareon Solar USA	***	***	***	***	***	***
Heliene	***	***	***	***	***	***
IES Residential	***	***	***	***	***	***
Itek Energy	***	***	***	***	***	***

Table continued on following page.

[5] *** reported CSPV imports from ***. *** reported imports from ***. *** reported imports from ***. *** reported imports from ***. *** reported imports from ***.

Table II-5--Continued
CSPV products: U.S. importers' reported ability to supply specific technologies, 2012-16

Firm	Type of technology firm reported					
	Mono cells	Multi cells	PERC cells	HIT cells	Bifacial cells	Hybrid cells
JA Solar USA	***	***	***	***	***	***
Jiawei	***	***	***	***	***	***
JinkoSolar (U.S.)	***	***	***	***	***	***
Kyocera International	***	***	***	***	***	***
Lerri Solar	***	***	***	***	***	***
LG Electronics USA	***	***	***	***	***	***
Mission Solar Energy	***	***	***	***	***	***
NextEra Energy Resources	***	***	***	***	***	***
Panasonic Eco Solutions	***	***	***	***	***	***
Pitsco	***	***	***	***	***	***
Posco-Daewoo America	***	***	***	***	***	***
Prism Solar Technologies	***	***	***	***	***	***
REC Americas	***	***	***	***	***	***
SBM Solar	***	***	***	***	***	***
Seraphim Solar USA	***	***	***	***	***	***
Silfab Solar	***	***	***	***	***	***
Solarland USA	***	***	***	***	***	***
Solartech Power	***	***	***	***	***	***
SolarTech Universal	***	***	***	***	***	***
SolarWorld Americas	***	***	***	***	***	***
Solatube International	***	***	***	***	***	***
Sumec North America	***	***	***	***	***	***
Suniva	***	***	***	***	***	***
SunPower	***	***	***	***	***	***
SunPower Corp., Systems	***	***	***	***	***	***
SunPower North America	***	***	***	***	***	***
Sunpreme	***	***	***	***	***	***
SunStream Technology	***	***	***	***	***	***
Tesla	***	***	***	***	***	***
The Chamberlain Group	***	***	***	***	***	***
The Solaria Corp.	***	***	***	***	***	***
Trina Solar (U.S.)	***	***	***	***	***	***
Upsolar America	***	***	***	***	***	***
Winaico Delaware	***	***	***	***	***	***
Yingli Green Energy	***	***	***	***	***	***
Total	36	40	15	2	7	5

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. IMPORTERS' IMPORTS SUBSEQUENT TO DECEMBER 31, 2016

The Commission requested importers to indicate whether they had imported or arranged for the importation of CSPV products for delivery after December 31, 2016. The quarterly data reported for 2017 by responding importers are presented in table II-6.[6] The leading suppliers of arranged foreign CSPV products to the United States during 2017 are Malaysia, Korea, the Philippines, and Vietnam, representing *** percent, *** percent, *** percent, and 10.0 percent of all imports by quantity, respectively. The total quantity of 10.2 million kW of arranged U.S. imports for calendar year 2017 is 20.7 percent lower than the annual import level of 12.8 million kW reported for calendar year 2016, but 20.5 percent higher than the annual import level of 8.4 million kW reported during calendar year 2015 (compare table II-1 and table II-6).

Table II-6

CSPV products: Arranged U.S. imports (country-of-origin based on cell manufacture location), by source, 2017

Item	Jan-Mar 2017	Apr-Jun 2017	Jul-Sep 2017	Oct-Dec 2017	Calendar year 2017
	Quantity (kW)				
Arranged U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	58,532
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	654,495
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	1,012,546
All other sources	***	***	***	***	***
All import sources	1,653,143	2,665,989	3,500,081	2,336,559	10,155,772

Table continued on following page.

[6] These data were reported as of June 29, 2017.

Table II-6--Continued

CSPV products: Arranged U.S. imports (country-of-origin based on cell manufacture location), by source, 2017

Item	Jan-Mar 2017	Apr-Jun 2017	Jul-Sep 2017	Oct-Dec 2017	Calendar year 2017
	Share of quantity (percent)				
Arranged U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	0.6
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	6.4
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	10.0
All other sources	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

IMPORTS BY U.S. PRODUCERS AND RELATED FIRMS

Thirteen U.S. producers of CSPV products reported direct imports since January 1, 2012. Eight of the 13 reported direct imports of exclusively CSPV cells, one reported direct imports of CSPV laminates, and four reported direct imports of a combination of CSPV cells, modules, and off-grid portable consumer goods. The most common reasons cited for imports by U.S. producers include the following: ***. Table II-7 presents data on individual U.S. producers' U.S. production and U.S imports of CSPV products and the reasons each cited for such imports.

Table II-7

CSPV products: U.S. producers' U.S. production, imports, import ratios to U.S. production, and reasons for importing, 2012-16

* * * * * * *

The *** domestic producer *** reported that its ratio of U.S. imports to U.S. production increased from *** percent in 2012 to *** percent in 2016. *** of ***'s U.S. imports in 2012 were CSPV products in module form. However, *** began importing increasing amounts of ***. By 2016, *** percent of ***'s direct imports of CSPV products were in cell form, *** percent were in module form, and ***.

The *** domestic producer *** reported that its ratio of U.S. imports to U.S. production was *** percent in 2012, *** percent in 2013, and *** percent in 2014. *** reported that its direct imports of CSPV products during 2012-14 were from Taiwan and were in laminate form. The producer did not import CSPV products during 2015 and 2016.

U.S. IMPORTS RELATIVE TO PRODUCTION

The ratio of U.S. imports to U.S. production increased from a low of *** percent in 2012 to a high of *** percent in 2016 (table II-1). The largest increases in U.S. imports relative to U.S. production were reported for Malaysia, Korea, and China. U.S. imports remained greater than U.S. production during the period of investigation.

PART III: SERIOUS INJURY OR THREAT OF SERIOUS INJURY

OVERVIEW

The term “domestic industry” is defined in section 202(c)(6)(A)(i) of the Trade Act as “the domestic producers as a whole of the like or directly competitive article or those producers whose collective production of the like or directly competitive article constitutes a major proportion of the total domestic production of such article.”[1] The list of firms that reported domestic production of certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products (“CSPV products”)[2] in response to the Commission’s U.S. producer questionnaire in this proceeding is presented in *Part I* of this report at table I-2. Also presented in table I-2 are each company’s position on the petition, production locations, and share of reported production of CSPV products during 2012-16.

U.S. producers’ ownership and related or affiliated firms

The Commission asked firms responding to the U.S. producer questionnaire to identify their owners and any related or affiliated firms involved in the production or import of CSPV products. Responses to the Commission’s request for information are presented in table III-1. Information on U.S. imports of CSPV products by U.S. producers and their affiliates are discussed in *Part II* of the report and summarized in table II-7.

Table III-1
CSPV products: U.S. producers' ownership, related and/or affiliated firms

* * * * * * *

[1] 19 U.S.C. § 2252(c)(6)(A)(i).
[2] See the section entitled “The Imported Articles Described in the Petition” in *Part I* of this report for a complete description of the merchandise subject to this investigation.

Reported changes experienced and anticipated by the industry

In the U.S. producers' questionnaire, firms were asked to indicate whether they had experienced any plant openings, relocations, expansions, acquisitions, consolidations, closures, or prolonged shutdowns because of strikes or equipment failure; curtailment of production because of shortages of materials or other reasons, including revision of labor agreements; or any other change in the character of their operations or organization relating to the production of CSPV products since January 1, 2012. Fourteen firms providing responses to the U.S. producers' questionnaire in this proceeding indicated that they had experienced such changes in the character of their operations; their responses are presented in table III-2.

Table III-2
CSPV products: Changes in the character of U.S. operations since January 1, 2012

* * * * * * *

As previously noted in table III-2, numerous firms providing a U.S. producers' questionnaire response in this safeguard investigation reported events that affected total U.S. capacity and production. Table III-3 shows a time line of when U.S. producers of CSPV cells or modules either entered or exited the U.S. market during the period of investigation.

Table III-3

CSPV products: Listing of U.S. firms with CSPV production facilities opening and/or closing, 2012-17

Company	State	Product	Status, January 1, 2012	Status, December 31, 2016	Status, July 2017	Opening/closing date: Prior 2012	2012	2013	2014	2015	2016	2017 YTD
1Soltech	TX	Modules	Open	Closed	Closed	🟢			🔴			
Advanced Solar Photonics	FL	Modules	Open	Closed	Closed	🟢		🔴				
Alternative Energies Kentucky	KY	Modules	Open	Closed	Closed	🟢		🔴				
Amerisolar	CA	Modules	Not available	Open	Open	*Opening date not available*						
Auxin Solar	CA	Modules	Open	Open	Open	🟢						
CBS Solar	MI	Modules		Open	Open			🟢				
Colored Solar	CA	Modules	Open	Open	Open	🟢						
Flextronics/SunPower	CA	Modules	Open	Closed	Closed	🟢					🔴	
Heliene	MN	Modules		Open	Open					🟢		
Helios	WI	Modules	Open	Closed	Closed	🟢		🔴				
Isofoton	OH	Modules		Closed	Closed		🟢	🔴				
Itek Energy	MN	Modules		Open	Open				🟢			
	WA	Modules	Open	Open	Open	🟢						
Kyocera	CA	Modules	Open	Closed	Closed	🟢		🔴				
Lumos Solar	CO	Modules		Open	Open						🟢	
Mage Solar	GA	Modules	Open	Closed	Closed	🟢				🔴		
Mission Solar	TX	Cells		Closed	Closed				🟢		🔴	
	TX	Modules		Open	Open				🟢			
Motech	DE	Modules	Open	Closed	Closed	🟢		🔴				
MX Solar	NJ	Modules	Open	Closed	Closed	🟢	🔴					
Navajo Universal	AZ	Modules		Not available	Closed			🟢				🔴
Nu-Cell	LA	Modules	Open	Open	Open	🟢						
NuSun	IN	Modules		Closed	Closed		🟢		🔴			
Prism Solar	NY	Modules	Open	Open	Open	🟢						
SBM Solar	NC	Modules	Open	Open	Open	🟢						
Schott Solar	NJ	Modules	Open	Closed	Closed	🟢	🔴					
Seraphim Solar	MS	Modules		Open	Open						🟢	
Sharp	TN	Modules	Open	Closed	Closed	🟢			🔴			
Silicon Energy	MN	Modules	Open	Open	Closed	🟢						🔴
	WA	Modules	Open	Closed	Closed	🟢					🔴	
Solar Power Industries	PA	Cells	Open	Closed	Closed	🟢	🔴					
	PA	Modules	Open	Closed	Closed	🟢	🔴					
Solaria	CA	Cells	Not available	Not available	Open	*Opening date not available*						
	CA	Modules	Open	Open	Open	🟢						
Solartec Energia	TX	Modules		Open	Open				🟢			
Solartech Renewables	NY	Modules	Open	Closed	Closed	🟢			🔴			
SolarTech Universal	FL	Modules		Open	Open					🟢		
SolarWorld	CA	Modules	Open	Closed	Closed	🟢	🔴					
	WA	Cells	Open	Open	Open	🟢						
	WA	Modules	Open	Open	Open	🟢						
Sunergy America	CA	Modules			Announced							
Suniva	GA	Cells	Open	Open	Closed	🟢						🔴
	GA	Modules	Open	Closed	Closed	🟢				🔴		
	MI	Modules		Open	Closed				🟢			🔴
SunPower	CA	Cells			Open							🟢
SunSpark Technology	CA	Modules		Open	Open					🟢		
Suntech	AZ	Modules	Open	Closed	Closed	🟢		🔴				
tenKsolar	MN	Modules	Open	Open	Closed	🟢						🔴
Tesla	CA	Cells		Open	Open					🟢		
	CA	Modules		Open	Open					🟢		
	NY	Cells			Announced							
	NY	Modules			Announced							
Transform Solar	ID	Cells	Open	Closed	Closed	🟢	🔴					
Twin Creeks Technologies	MS	Cells	Open	Closed	Closed	🟢	🔴					
Wanxiang New Energy	IL	Cells	Open	Open	Open	🟢						

Legend	
🟢	Plant opening
🔴	Plant closing

Notes continued on following page.

Notes.—This table is based on publicly available information. Information on producers of off-grid products such as consumer electronic products or solar generators is not included. In addition, it does not include changes in production capacity at existing plants. 2017 YTD is to July 18, 2017.

Three companies, CertainTeed, German Solar USA, and Upsolar indicate that their products are made in the United States, but they are not included in the table above since a U.S. production location for these products could not be identified. In addition, Perlight previously indicated that some of its modules were made in Texas, but this is not currently listed on their website as a manufacturing location.

Beamreach had a pilot PV production line in California, with equipment from 2014-2015, but it is not clear whether it had any commercial production as it initially sourced modules from another company.

BP Solar closed its Maryland location between the end of 2011 and early 2012, but had stopped manufacturing at this location prior to this time.

Heliene initially started production at a plant owned by SimpleRay in Minnesota, with this production lasting less than one year. From mid-2016, Silicon Energy produced modules for Heliene at its Minnesota plant. Following the closure of Silicon Energy's plant in 2017, Heliene took over the lease and began manufacturing its modules in Minnesota.

The exact date that the Mage Solar plant closed is not readily available, but as of the first quarter of 2015 the firm was reportedly no longer producing modules.

Siliken filed for bankruptcy in 2013, but moved its manufacturing to Mexico in 2011 and is therefore not included in this table.

Navajo Solar was closed as of February 2017, but information on whether it was in operation in 2016 is not readily available.

For Solartec, opening is based on the announcement date. The date on which it began production is not readily available.

SunPower partnered with contract manufacturer Flextronics to produce modules. SunPower purchased the equipment, while Flextronics manufactured the modules. The exact date when this manufacturing ended is not available, but it was no longer listed among SunPower's manufacturing locations in its financial report for the year ending January 1, 2017. SunPower started production of cells in California in 2017. Although SunPower testified at the Commission’s hearing and submitted briefs in this proceeding, it did not submit a response to the Commission’s U.S. producer questionnaire.

Sunpreme is considering building a solar cell and module manufacturing facility in Nevada.

Source: Compiled from publicly available information, and USITC Publications 4519 and 4360.

U.S. PRODUCTION, CAPACITY, AND CAPACITY UTILIZATION

CSPV cells

Four firms that reported U.S. production of CSPV cells in response to the Commission's U.S. producer questionnaire are profiled below, inclusive of their module assembly operations, as applicable.

U.S. producer profiles[3]

Mission Solar Energy

Mission Solar Energy ("Mission Solar") is headquartered in San Antonio, Texas and is a fully-owned subsidiary of OCI Solar Power.[4] Mission Solar produced n-type monocrystalline (including bifacial) CSPV solar cells *** and assembled modules with mono and mono-PERC cells in both 60-cell and 72-cell formats for residential, commercial, and utility markets ***.

The company opened its manufacturing plant in San Antonio, Texas in 2014 with cell and module capacity of 100 MW and doubled capacity to 200 MW in 2015.[5] In September 2016, however, Mission Solar closed its n-type mono PV cell production lines and then ***. Mission Solar stated that it closed its cell line because "***." Other reports noted that Mission Solar faced technical challenges producing n-type cells, and had difficulty ramping up production.[6] Following the closure of cell production, Mission Solar has continued module assembly with PV

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[3] SunPower Corporation ("SunPower"), headquartered in San Jose, California, did not respond to the Commission's producer questionnaire. However, the firm reported investing approximately $25 million in a San Jose, California facility to produce its Signature™ Black solar panels. The facility started production around May 2017 and will ultimately produce CSPV cells and panels for residential and commercial applications. By yearend 2018, SunPower expects this facility to produce 5-7 MW of volume. SunPower is also a partner with Flextronics in the production of CSPV modules in Milpitas, California. CSPV module output at this facility during 2012-16 totaled ***, with output *** SunPower moved module production from the Milpitas, California facility to its other manufacturing facilities, stating that the shift of production occurred because the plant was not adequately scaled. SunPower's posthearing brief, August 22, 2017.

[4] OCI Solar Power is a subsidiary of OCI Enterprises, the North American subsidiary of OCI Company, Ltd. (Korea). Mission Solar was formerly known as Nexolon America when it was a joint venture of OCI Solar Power and Texas-based CPS Energy. Osborne, Mark, "Mission Solar closing N-type mono cell line with 87 job losses – reports," PV Tech, July 18, 2017, https://www.pv-tech.org/news/mission-solar-closing-n-type-mono-cell-line-with-87-job-losses-reports.

[5] Osborne, Mark, "Mission Solar closing N-type mono cell line with 87 job losses – reports," PV Tech, July 18, 2017, https://www.pv-tech.org/news/mission-solar-closing-n-type-mono-cell-line-with-87-job-losses-reports.

[6] Osborne, Mark, "Mission Solar closing N-type mono cell line with 87 job losses – reports," PV Tech, July 18, 2017, https://www.pv-tech.org/news/mission-solar-closing-n-type-mono-cell-line-with-87-job-losses-reports.

cells imported from Asia (***).[7] Mission Solar projects its calendar year 2017 production of modules to reach ***.[8] These modules incorporate newer technology, including ***. Its current business model "***," and its 200 MW cell manufacturing lines are currently offered for sale.[9]

SolarWorld Americas Inc.

SolarWorld Americas Inc. ("SolarWorld"), headquartered in Hillsboro, Oregon, produced *** CSPV cells and CSPV modules during 2012-16.[10] SolarWorld has stated that it was the first producer of mono-PERC products and that it considers its ***.[11]

SolarWorld started production in the United States via its acquisition of Camarillo, California-based Shell Solar, a CSPV module producer with output of 80 MW, in 2006.[12] In October 2011, module production ceased at this facility and the work was transferred to its Hillsboro location.[13] SolarWorld *** (see table III-2).

SolarWorld's Hillsboro, Oregon plant opened in 2008 with operations dedicated to growing crystals and producing wafers and CSPV cells. In 2010, SolarWorld added 350 MW of module production to become the first fully integrated monocrystalline plant in the Americas.[14] In addition to the transfer of its Camarillo, California work in 2011, SolarWorld ***, and

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[7] Osborne, Mark, "Mission Solar closing N-type mono cell line with 87 job losses – reports," PV Tech, July 18, 2017, https://www.pv-tech.org/news/mission-solar-closing-n-type-mono-cell-line-with-87-job-losses-reports; Mission's U.S. producer questionnaire response, II-16.

[8] Email to Commission staff from Mission Solar, August 29, 2017.

[9] Silicon Valley Disposition, Negotiated Sale (Buy Now), State of the Art 200 MW Solar PV Cell Manufacturing Lines, http://www.svdisposition.com/?r=site/auction-detail&id=149 (accessed August 22, 2017).

[10] SolarWorld AG, parent of SolarWorld Americas, Inc., is headquartered in Bonn, Germany. SolarWorld AG and its German subsidiaries are currently undertaking insolvency proceedings in Germany. SolarWorld, "SolarWorld Americas Inc. Maintainers Full Operations Amid Parent's Insolvency," May 13, 2017, http://www.solarworld-usa.com/newsroom/news-releases/news/2017/solarworld-americas-maintains-full-operations; SolarWorld U.S. producer questionnaire response, II-6.

[11] SolarWorld posthearing brief, August 22, 2017, p. 10; SolarWorld U.S. producer questionnaire response, II-4.

[12] "SolarWorld Acquires Shell's Solar Business," February 2, 2006, Reneweable Energy World, http://www.renewableenergyworld.com/articles/2006/02/solarworld-acquires-shells-solar-business-42840.html

[13] Read, Richard, "SolarWorld, its California Plant Gone Dark, Prepares in Oregon for Industry Shakeout While Battling China," The Oregonian, November 19, 2011, http://www.oregonlive.com/business/index.ssf/2011/11/solarworld_its_california_plan.html.

[14] An additional 150 MW of module capacity was in place at its Camarillo plant, for a total of 500 MW. SolarWorld, "SolarWorld to add module assembly in Hillsboro," October 4, 2009, http://www.solarworld-usa.com/newsroom/news-releases/news/2009/solarworld-to-add-module-assembly-in-hillsboro.

expanded cell capacity to 435 MW and module assembly to 530 MW in 2014.[15] In 2016, SolarWorld added a 150 MW assembly line to produce 72-cell format modules to supply the utility market.[16] The firm reported that production at this line *** (see table III-2).

SolarWorld has stated that it "has maintained all production-related plant and equipment, and could easily and quickly return to a production rate closer to the nameplate capacities if safeguard relief is granted."[17] SolarWorld reported nameplate production capacity of *** for modules and *** for cells.[18] However, SolarWorld projects cell production of *** and module production of *** in 2017.[19] Although SolarWorld ***, SolarWorld has noted that *** (see table III-2). As part of its parent SolarWorld AG's bankruptcy proceedings, a buyer is currently being sought for SolarWorld and other SolarWorld AG subsidiaries. Because SolarWorld is a subsidiary of the bankrupt SolarWorld AG, it is under the jurisdiction of the insolvency administrator. SolarWorld is reportedly the "key outstanding asset up for grabs" in this process in part because of its PERC cell technology.[20]

Suniva

Suniva, headquartered in Norcross, Georgia, produced *** CSPV cells and CSPV modules during 2012-16. Suniva was founded in 2007 as a producer of CSPV cells based on the work of the Georgia Institute of Technology's University Center of Excellence in Photovoltaics. In 2015, Shungfeng International Clean Energy acquired approximately 63 percent of Suniva.[21]

Suniva started CSPV cell production in Norcross, Georgia, in November 2008 with capacity of 32 MW. An additional 64 MW line was added in 2009. In July 2010, Suniva further expanded capacity to 170 MW by adding a third cell line.[22]

In July 2011, Suniva announced its expansion of CSPV module R&D and assembly capabilities by September 2011, with an initial capacity of 25-30 MW at the Georgia plant.[23]

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[15] SolarWorld, "SolarWorld Announces Expansions of Solar Panel and Advanced Cell Production in Oregon," October 30, 2014, http://www.solarworld-usa.com/newsroom/news-releases/news/2014/solarworld-announces-expansions-in-oregon.

[16] SolarWorld posthearing brief, August 22, 2017, p. 10; Roselund , Christian,"SolarWorld ramps 72-cell module production in Oregon," PV Magazine, June 14, 2016, https://www.pv-magazine.com/2016/06/14/solarworld-ramps-72-cell-module-production-in-oregon_100024984/.

[17] SolarWorld posthearing brief, August 22, 2017, p. 83.

[18] SolarWorld posthearing brief, August 22, 2017, p. 83.

[19] SolarWorld posthearing brief, August 22, 2017, p. 94.

[20] Osborne, Mark, "SolarWorld AG's Insolvency Administrator Starts Sale Process for SolarWorld Americas," August 16, 2017, https://www.pv-tech.org/news/solarworld-ags-insolvency-administrator-starts-sale-process-for-solarworld; Roselund, Christian, "SolarWorld Americas is Up for Sale," August 17, 2017, https://pv-magazine-usa.com/2017/08/17/solarworld-america-is-up-for-sale/.

[21] Suniva, "Suniva to Increase U.S. Manufacturing Capacity to Over 400MW," August 13, 2015, http://www.suniva.com/documents/Suniva%20Expands%20Manufacturing%20final.pdf. Shungfeng also owns CSPV cell and module producer Wuxi Suntech.

[22] Suniva, "Suniva Increases Manufacturing Capacity to 170 Megawatts," July 7, 2010, http://www.suniva.com/documents/Expanded%20Capacity_070310Final2.pdf.

Suniva further expanded module assembly capacity in 2013 to produce Buy American Act compliant modules.[24] In 2014, Suniva expanded production by 240 MW with the opening of a second module assembly facility in Saginaw, Michigan.[25]

In July 2016, Suniva expanded production for cells and modules with power ratings up to 300W (60-cell format) and 350W (72-cell format) at its Norcross facility.[26] Suniva completed an additional expansion in December 2016 to bring the Norcross, Georgia plant capacity for cells and modules up to 450 MW.[27]

Suniva ***, citing *** that "***." Suniva has indicated that it has no ability to supply any CSPV cells or modules for the remainder of 2017 as it has ceased operations under Chapter 11 bankruptcy reorganization. Suniva states that, going forward, it would have the capacity to produce a total of *** of modules made with U.S.-manufactured cells, with *** of modules supplied from its own operations and an additional *** supplied through contract manufacturing. Suniva indicates that its cell manufacturing capacity would total ***. Suniva believes that its cell manufacturing could be brought back up in a few months.[28] Suniva shut down its operations in a way that would facilitate rapid restart of output and has maintained a maintenance staff during its bankruptcy.[29] Suniva also reports contact with several potential clients and prior suppliers who are interested in working with Suniva when it restarts its U.S. operations.[30]

Tesla

Tesla is a U.S. producer of electric vehicles and alternative energy solutions, such as solar modules and battery-powered back-up storage units. Tesla is currently in the process of opening a manufacturing facility in Buffalo, New York to produce ***. Tesla has a build-to-suit

(…*continued*)

[23] Suniva, "Suniva Expands U.S. Module Assembly and Research Facility," July 12, 2011, http://www.suniva.com/documents/Module%20Assembly%207%208%2011.pdf.

[24] Suniva, "Suniva Announces Manufacturing Capacity Expansion and New Jobs at Norcross HQ" May 9, 2013, http://www.suniva.com/documents/Suniva%20Expansion%20Release%202013%2005%2009%20Final.pdf.

[25] Suniva, "Suniva Begins Construction on Second Solar Facility," August 12, 2014, http://www.suniva.com/documents/Suniva%20Begins%20Construction%20on%20Second%20Solar%20Facility%202014%2008%2012.pdf.

[26] Suniva, "Suniva Celebrates Nine Years as America's Leading Solar Manufacturer," July 12, 2016, http://suniva.com/documents/Suniva%20Celebrates%20Nine%20Years%202016%2007%2012%20Final.pdf.

[27] "Suniva Announces Expansion Completion at U.S. Manufacturing Headquarters," December 15, 2016, http://www.suniva.com/documents/Suniva%20Announces%20Expansion%20Completion%20at%20Headquarters%202016%2012%2015.pdf.

[28] Suniva posthearing brief, August 22, 2017, exhibit no. 9, p. 3.

[29] Suniva posthearing brief, August 22, 2017, exhibit no. 9, p. 3.

[30] Suniva posthearing brief, August 22, 2017, exhibit no. 9, p. 3.

lease arrangement with the Research Foundation for the State University of New York (Foundation).[31] As part of this arrangement, the Foundation constructed the solar cell and panel manufacturing facility and will own the facility and any manufacturing equipment purchased by the Foundation. Tesla will lease the manufacturing facility and equipment for an initial 10-year period, with an option to renew.[32] Tesla also has a Fremont, California facility, which opened in 2014, where PV cell and module R&D and pilot production are performed.

In December 2016, Tesla entered into an agreement with Panasonic to manufacture custom CSPV cells and modules at the Buffalo, New York plant while Tesla manages factory operations and produces solar roof tiles.[33] Tesla has reported that it will purchase certain quantities of PV cells and modules from Panasonic during the 10-year term of the agreement, with the intent to produce approximately 1 GW of CSPV cells and modules annually beginning in 2019.[34]

Initial production will reportedly focus on solar modules to be used in residential rooftop applications by Tesla's SolarCity business.[35] Tesla also plans to manufacture its solar roof tiles at the Buffalo plant by yearend 2017, following pilot production at its Fremont plant in second quarter 2017.[36] Tesla's solar roof production at its Fremont, California plant ***.[37] Tesla expects to produce ***; Panasonic intends to ***. [38] Cell production at Fremont totaled ***. Although cell production ***.[39] Tesla's production capacity in 2016 was reported as *** each for cells and modules. Production of cells *** and modules *** in 2016 was solely for ***.

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[31] As part of this arrangement Tesla is required to meet certain operational milestones during the 10-year lease period, including meeting employment level requirements and spending or incurring $5 billion in capital, operational expenses, and other costs in New York State. Failure to meet these requirements would lead to a $41.2 million "program payment" to the Foundation for each year that Tesla failed to meet the specified milestones. Tesla 10-Q Quarterly Report, August 4, 2017, p. 24, http://ir.tesla.com/sec.cfm?view=all.

[32] Tesla will pay the Foundation $2.00 annually plus utilities for the lease of the plant. Tesla 10-Q Quarterly Report, August 4, 2017, p. 24, http://ir.tesla.com/sec.cfm?view=all.

[33] Robinson, David, "Column: Panasonic will play big role at Buffalo's SolarCity factory," Buffalo News, March 8, 2017, http://buffalonews.com/2017/03/07/robinson-panasonics-role-reflects-deep-changes-solarcitys-buffalo-factory/; Geuss, Megan, "Panasonic will spend $256 million on Tesla solar panel factory in Buffalo, NY," Ars Technica, December 27, 2016, https://arstechnica.com/information-technology/2016/12/panasonic-will-spend-256-million-on-tesla-solar-panel-factory-in-buffalo-ny/.

[34] Tesla 10-Q Quarterly Report, August 4, 2017, p. 4, http://ir.tesla.com/sec.cfm?view=all.

[35] SolarCity, which was acquired by Tesla in 2016, had previously purchased PV cell manufacturer Silevo in 2014. Cunningham, Bill, "Tesla, SolarCity, And The Silevo Acquisition, " Seeking Alpha, April 10, 2017, https://seekingalpha.com/article/4061589-tesla-solarcity-silevo-acquisition.

[36] Tesla 10-Q Quarterly Report, August 4, 2017, p. 30, http://ir.tesla.com/sec.cfm?view=all.

[37] Email to Commission staff from Tesla, August 24, 2017.

[38] Emails to Commission staff from Tesla, August 24, 2017 and August 29, 2017.

[39] Emails to Commission staff from Tesla, August 24, 2017 and August 29, 2017.

U.S. CSPV cell production

Reported data[40] show that, from 2012 to 2016, total U.S. production of CSPV cells increased by *** percent from *** kW to *** kW, with *** largely driving the trend (table III-4 and figure III-1). Total U.S. capacity, which was *** percent higher in 2016 than in 2012, increased by *** percent from *** kW in 2012 to *** kW in 2013, but fell to *** kW in 2014 as ***. Total domestic CSPV cell capacity then increased by *** percent from *** kW in 2014 to *** kW in 2016 as Mission Solar ***, as SolarWorld ***, as Suniva ***, and as Tesla/SolarCity ***. Average capacity utilization of domestic CSPV cell producers increased from *** percent in 2012 to *** percent in 2015, before declining to *** percent in 2016.

Table III-4
CSPV cells: U.S. producers' production, capacity, and capacity utilization, 2012-16

* * * * * * *

Figure III-1
CSPV cells: U.S. producers' production, capacity, and capacity utilization, 2012-16

* * * * * * *

U.S. cell producers' 2017 quarterly production

The Commission requested the four responding U.S. producers of CSPV cells to provide quarterly production data for their cell and module operations for the first two quarters of 2017 and projections for the final two quarters of 2017 (table III-5).[41] Aggregate quarterly data reflect an expected decline in CSPV cell and module production throughout 2017 as Suniva closed its facilities as part of a Chapter 11 bankruptcy filing[42] and as SolarWorld reduced its production levels commensurate with mass employment reductions in 2017 in response to "an overwhelming surge of global imports into the United States, and with it, the collapse in prices."[43] Mission Solar reported *** cell production during 2017 with the shutdown of its cell operations in ***, and it projected that the production levels of CSPV modules at its facility are expected to *** throughout 2017. It noted in its questionnaire response that its "***."

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[40] Four U.S. firms reported capacity and production data for CSPV cells.

[41] SunPower did not submit a response to the U.S. producer questionnaire in this proceeding and, in its importer questionnaire response dated July 13, 2017, SunPower indicated that it "***." However, SunPower testified at the hearing that it began cell production in the United States "within the last 6 months." Hearing transcript, p. 409 (Werner). In its posthearing brief, the firm indicated that it began production of CSPV panels in the United States in May 2017 and will ultimately produce domestic CSPV cells and panels for residential and commercial applications. By yearend 2018, SunPower expects to produce 5-7 MW of volume in the United States. SunPower's posthearing brief, August 22, 2017, appendix, p. i.

[42] Hearing transcript, p. 80 (Brightbill).

[43] Hearing transcript, pp. 89, 92-93, and 236-237 (Stein).

Table III-5
CSPV products: Quarterly U.S. production, 2017

* * * * * * *

CSPV cell technology

The *** domestic CSPV cell producers are SolarWorld and Suniva, which together accounted for *** percent of U.S. CSPV cell production by kW in 2016. The largest U.S. CSPV cell producer, ***, which accounted for *** percent of U.S. CSPV cell production in 2016, reported that since January 1, 2012, it has produced *** (table III-6). It also noted that over the past five years it has transitioned from *** and has developed the capability to produce ***. The second largest U.S. CSPV cell producer, ***, which accounted for *** percent of U.S. CSPV cell production in 2016, reported that since January 1, 2012, it produced ***, but indicated that it completed *** and began producing ***. ***, which accounted for *** percent of U.S. CSPV cell production during 2016, reported that since January 1, 2012, it produced *** and that it conducts ongoing research and development on ***. ***, which accounted for *** percent of U.S. production during 2016, reported that it produces ***.

Table III-6
CSPV products: U.S. producers' reported ability to produce specific technology, 2012-16

* * * * * * *

CSPV modules

Reported data show that, from 2012 to 2016, total U.S. assembly of CSPV modules fell from 538,633 kW in 2012 to 440,259 kW in 2014, but increased to 669,089 kW in 2016 to a level that was 24.2 percent higher than that reported in 2012 (table III-7 and figure III-2). Domestic producers' capacity to assemble modules in the United States also declined from 929,827 kW in 2012 to 716,900 kW in 2014, but increased to 1.2 million kW in 2016 to a level that was 34.0 percent higher than that reported in 2012. Average capacity utilization of domestic CSPV module assembly declined from 57.9 percent in 2012 to 48.9 percent in 2013, increased to 63.4 percent in 2016, but declined again to 53.7 percent in 2016. These data are based on the responses of 15 firms[44] for their U.S. production, capacity, and capacity utilization for CSPV modules. The largest U.S. assemblers of CSPV modules are ***, accounting for ***, ***, and *** percent of U.S. module assembly, respectively, during 2012-16.

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[44] Twelve U.S. firms reported capacity and production data for CSPV modules in this proceeding. An additional firm, ***, provided a response to the Commission's producer questionnaire, but did not provide any requested data. Also, certain information supplied by three additional firms (Motech, Silicon Energy, and tenKsolar) that responded to the Commission's producer questionnaire during the previous *CSPV 2* investigations, but have since ceased CSPV operations, is included in select presentations in this report.

Table III-7
CSPV modules: U.S. producers' production, capacity, and capacity utilization, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Capacity (kW)				
Itek	***	***	***	***	***
Kyocera	***	***	***	***	***
Mission Solar	***	***	***	***	***
Motech	***	***	***	***	***
SBM	***	***	***	***	***
Seraphim	***	***	***	***	***
Sharp	***	***	***	***	***
Silicon	***	***	***	***	***
Solaria	***	***	***	***	***
Solartech	***	***	***	***	***
SolarWorld	***	***	***	***	***
Suniva	***	***	***	***	***
SunStream	***	***	***	***	***
TenKsolar	***	***	***	***	***
Tesla	***	***	***	***	***
Wanxiang	***	***	***	***	***
Total capacity for modules	929,827	913,452	716,900	871,603	1,245,807
	Production (kW)				
Itek	***	***	***	***	***
Kyocera	***	***	***	***	***
Mission Solar	***	***	***	***	***
Motech	***	***	***	***	***
SBM	***	***	***	***	***
Seraphim	***	***	***	***	***
Sharp	***	***	***	***	***
Silicon	***	***	***	***	***
Solaria	***	***	***	***	***
Solartech	***	***	***	***	***
SolarWorld	***	***	***	***	***
Suniva	***	***	***	***	***
SunStream	***	***	***	***	***
TenKsolar	***	***	***	***	***
Tesla	***	***	***	***	***
Wanxiang	***	***	***	***	***
Total module assembly	538,633	447,129	440,259	552,968	669,089

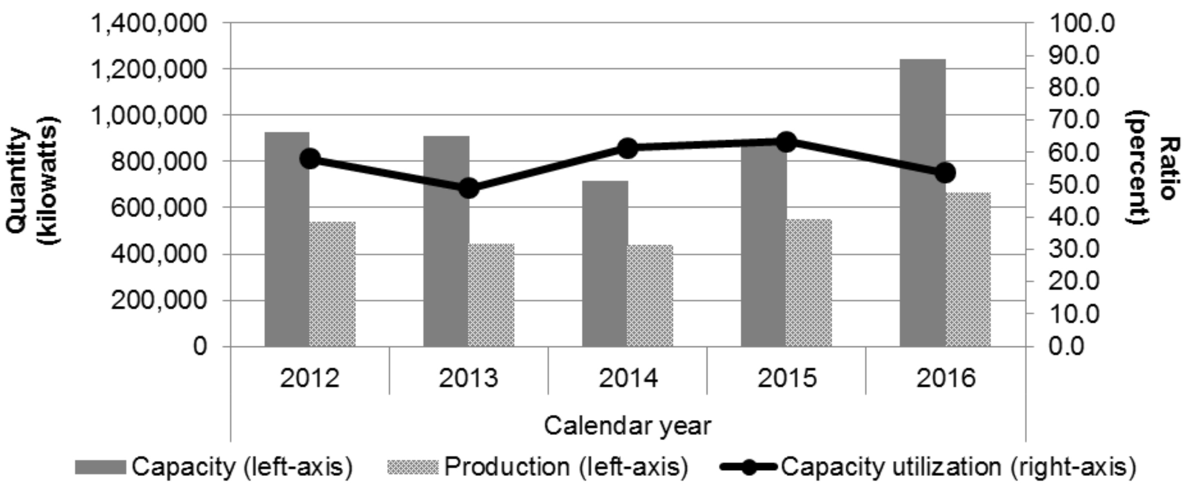
Table continued on following page.

Table III-7--Continued
CSPV modules: U.S. producers' production, capacity, and capacity utilization, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Capacity utilization (percent)				
Itek	***	***	***	***	***
Kyocera	***	***	***	***	***
Mission Solar	***	***	***	***	***
Motech	***	***	***	***	***
SBM	***	***	***	***	***
Seraphim	***	***	***	***	***
Sharp	***	***	***	***	***
Silicon	***	***	***	***	***
Solaria	***	***	***	***	***
Solartech	***	***	***	***	***
SolarWorld	***	***	***	***	***
Suniva	***	***	***	***	***
SunStream	***	***	***	***	***
TenKsolar	***	***	***	***	***
Tesla	***	***	***	***	***
Wanxiang	***	***	***	***	***
Average capacity utilization for CSPV modules	57.9	48.9	61.4	63.4	53.7

Source: Compiled from data submitted in response to Commission questionnaires.

Figure III-2
CSPV modules: U.S. producers' production, capacity, and capacity utilization, 2012-16



Source: Compiled from data submitted in response to Commission questionnaires.

The Commission requested that domestic CSPV module producers provide data concerning the source of the CSPV cells from which their modules were produced. These data show that during the period of investigation, the domestic cell content for U.S.-produced modules increased from *** percent in 2012 to *** percent in 2015, but declined to *** percent in 2016 (table III-8).

Table III-8
CSPV products: U.S. producers' module assembly by source of CSPV cell, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Production (kW)				
U.S. producers' module assembly using.-- U.S.-origin cells	***	***	***	***	***
of which petitioners	***	***	***	***	***
of which other firms	***	***	***	***	***
Foreign-origin cells	***	***	***	***	***
of which petitioners	***	***	***	***	***
of which other firms	***	***	***	***	***
Total	538,633	447,129	440,260	552,968	669,090
	Share of quantity (percent)				
U.S. producers' module assembly using.-- U.S.-origin cells	***	***	***	***	***
of which petitioners	***	***	***	***	***
of which other firms	***	***	***	***	***
Foreign-origin cells	***	***	***	***	***
of which petitioners	***	***	***	***	***
of which other firms	***	***	***	***	***
Total	100.0	100.0	100.0	100.0	100.0

Note—The total for U.S. module assembly reported here matches data reported in table III-7 but for differences due to rounding.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. PRODUCERS' SHIPMENTS

CSPV cells

The quantity and value of U.S. producers' total CSPV cell shipments increased overall by *** percent and *** percent from 2012 to 2016, respectively (table III-9). The unit value of total U.S. shipments fluctuated downward from a high of $*** per kW reported in 2012 to a low of $*** per kW reported in 2016, a net decline of *** percent. Most (*** percent in 2016) of the U.S. producers' shipments of CSPV cells are internally consumed in the United States, with the majority of the balance (*** percent in 2016) being consumed by related firms outside the United States. Relatively few CSPV cells produced in the United States are sold commercially. In fact, during 2016, *** percent of U.S. producers' total shipments were commercially shipped in the United States and *** percent were exported to unrelated firms.

Table III-9
CSPV cells: U.S. producers' U.S. shipments, exports shipments, and total shipments, 2012-16

* * * * * * *

CSPV modules

The total shipment quantity of CSPV modules assembled in the United States declined from 598,155 kW in 2012 to 442,960 kW in 2013, but increased each year thereafter, reaching 633,504 kW in 2016, a level that was 5.9 percent higher than that reported in 2012 (table III-10). The value of total module shipments declined from 620,486 kW in 2012 to 380,035 kW in 2013, but increased thereafter to 513,266 kW during 2016, a level that was 17.3 percent lower than that reported in 2012. The average unit value of total shipments fluctuated downward from a high of $1,037 per kW reported in 2012 to a low of $810 per kW reported in 2016, representing a 21.9 percent decline in average unit values. Most U.S. producers' shipments (*** percent in 2016) of CSPV modules are commercially shipped in the United States, with a relatively minor amount that are internally consumed in other products or exported outside the United States. Transfers to related firms in the United States, which accounted for *** percent of aggregate total shipments in 2016, largely represented ***.

Table III-10
CSPV modules: U.S. producers' U.S. shipments, exports shipments, and total shipments, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	598,155	442,960	472,367	528,599	633,504
	Value (1,000 dollars)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	620,486	380,035	420,560	477,422	513,266
	Unit value (dollars per kW)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	1,037	858	890	903	810
	Share of quantity (percent)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	100.0	100.0	100.0	100.0	100.0

Note.—Includes imported CSPV cells assembled in the United States into modules. Share shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. commercial shipments, by form of CSPV product

Reported data show that *** (i.e., *** percent in 2016) commercial U.S. shipments of CSPV products made by U.S. producers are in module or panel form, whereas *** commercial shipments of CSPV products are in cell and laminate forms (table III-11). There were *** U.S. commercial shipments reported by U.S. producers of CSPV products in the forms of off-grid portable consumer goods or integrated building materials.

Table III-11
CSPV products: U.S. producers' commercial U.S. shipments, by form, 2012-16

*   *   *   *   *   *   *

U.S.-origin U.S. shipments for apparent consumption

Apparent U.S. consumption of CSPV products increased by *** percent from *** kW in 2012 to *** kW in 2016 (see *Part IV*, table IV-1). Apparent U.S. consumption consists of the sum of U.S. producers' U.S. shipments of CSPV products and U.S. imports of CSPV products. As shown in table III-12, the U.S. shipments component of apparent U.S. consumption by quantity (in kW) reflects U.S. producers' U.S. shipments of (1) modules that contain U.S.-produced CSPV cells, (2) U.S.-produced CSPV cells that are otherwise not reported by module assemblers, and (3) re-imports of U.S.-origin CSPV cells. This quantity measure excludes any CSPV modules produced in the United States from imported CSPV cells, as those are reported for the purposes of apparent U.S. consumption as imports. However, the U.S. component for value does include the incremental value added in the United States for the module assembly of foreign-origin CSPV cells. The apparent U.S. consumption data that incorporate this U.S. component are presented separately in *Part IV* of this report.

Table III-12
CSPV products: U.S.-origin U.S. shipments for apparent consumption, 2012-16

*   *   *   *   *   *   *

INVENTORIES MAINTAINED BY U.S. PRODUCERS AND U.S. IMPORTERS

U.S. producers' inventories

CSPV cells

Three of the four firms that reported production of CSPV cells indicated in their questionnaire responses that they maintained inventories at yearend; the ratio of these inventories to shipment and production levels declined from 2012 to 2016, equaling *** percent of production, *** percent of U.S. shipments, and *** percent of total shipments in 2016 (table III-13).[45]

Table III-13
CSPV cells: U.S. producers' inventories, 2012-16

*   *   *   *   *   *   *

CSPV modules

All but one firm that reported assembly of CSPV modules in the United States indicated in their questionnaire responses that they maintained inventories during at least part of the period from 2012 to 2016; the ratios of inventories to shipment and production amounts declined from 2012 to 2014 but increased in 2015 and 2016. The ratio of inventories to U.S. assembly operations equaled *** percent in 2016 (table III-14).[46]

Table III-14
CSPV modules: U.S. producers' inventories, 2012-16

*   *   *   *   *   *   *

U.S. importers' inventories

More than one-half of the responding U.S. importers of CSPV products indicated in their questionnaire responses that they maintained inventories at some point during 2012-16 (table III-15).[47] Inventories held by U.S. importers in the aggregate increased by 308.2 percent from 2012 to 2016, but declined overall as a ratio of imports and shipments.

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[45] End-of-period inventories of CSPV cells held by U.S. producers of CSPV cells and ratios of these inventories to U.S. producers' production, U.S. shipments, and total shipments.
[46] End-of-period inventories of CSPV modules held by U.S. producers of CSPV modules and the ratios of these inventories to U.S. producers' production, U.S. shipments, and total shipments.
[47] End-of-period inventories of CSPV products held by U.S. importers and the ratios of these inventories to U.S. imports, U.S. shipments of imports, and total shipments of imports.

Table III-15
CSPV products: U.S. importers' inventories, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
U.S. importers' end-of-period inventories	303,409	327,638	560,211	1,107,536	1,238,641
	Ratio (percent)				
Ratio of inventories to.-- U.S. imports	14.0	10.6	12.2	13.1	9.7
U.S. shipments of imports	13.3	10.2	12.2	13.9	9.6
Total shipments of imports	13.0	9.7	12.1	13.8	9.6

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. EMPLOYMENT, HOURS, AND WAGES

CSPV cells

The overall number of production and related workers ("PRWs") employed by firms reporting CSPV cell operations in Commission producer questionnaire responses declined from *** PRWs in 2012 to *** PRWs in 2014, but increased thereafter to *** PRWs in 2016, which was *** percent higher than the level reported in 2012 (table III-16). Although the general increases in employment during the period of investigation are consistent with the *** percent increase in U.S. production of CSPV cells from 2012 to 2016, the increase in certain employment indicators during 2016 is primarily explained by *** in 2016. Similar to the level of PRWs employed by the domestic industry producing CSPV cells, the total number of hours worked and wages paid declined from 2012 to 2014, but increased thereafter. Hourly wages, unit labor costs, and productivity were higher during 2016 than reported in 2012 by *** percent, *** percent, and *** percent, respectively, whereas the numbers of hours worked per employee was lower by *** percent.

Table III-16
CSPV cells: Average number of production and related workers, hours worked, wages paid to such employees, hourly wages, productivity, and unit labor costs, 2012-16

* * * * * * *

CSPV modules

The employment-related indicators for U.S. producers of modules fluctuated during the period of investigation. The overall number of PRWs employed by domestic CSPV module producers as reported in Commission questionnaire responses declined from 1,293 in 2012 to 956 in 2014, but increased thereafter to 1,253 in 2016, a level that was 3.1 percent lower than that reported in 2012 (table III-17). The number of hours worked and wages paid followed the same general trend, declining from 3,041 to 1,781 and $*** to $***, respectively, during 2012 to 2014, and increasing to 2,364 and $*** in 2016, respectively. Hourly wages fluctuated upward throughout the period examined, while unit labor costs fluctuated downward. Productivity continually increased from *** watts per hour in 2012 to *** watts per hour in 2016.

Table III-17
CSPV modules: Average number of production and related workers, hours worked, wages paid to such employees, hourly wages, productivity, and unit labor costs, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
PRWs (number)	1,293	1,080	956	1,038	1,253
Total hours worked (1,000 hours)	3,041	2,335	1,781	2,095	2,364
Hours worked per PRW (hours)	2,352	2,162	1,863	2,018	1,887
Wages paid ($1,000)	***	***	***	***	***
Hourly wages (dollars per hour)	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***
Unit labor costs (dollars per kW)	***	***	***	***	***

Source: Compiled from data submitted in response to Commission questionnaires. Also included in this table are the data for three firms that provided questionnaire responses in *CSPV 2.* For more information, see “The U.S. Market” in *Part I* of this report.

FINANCIAL CONDITION OF THE U.S. INDUSTRY

Background

CSPV products financial results, as presented in this section of the report, are divided into two primary categories: CSPV cell operations and CSPV module operations. The financial results on U.S.-produced cell operations, which include only commercial sales and transfers, reflect ***.[48] The financial results on U.S.-produced module operations reflect ***.[49] [50]

As described earlier in this report, several U.S. producers effectively began their cell and module operations during the period examined, while several others exited and/or substantially modified their operations. During the period Suniva *** and SolarWorld ***, as discussed in table III-2.

Operations on CSPV products

Table III-18 and table III-19, respectively, present income-and-loss data for cell operations (commercial sales and transfers) and corresponding changes in average cell per kilowatt values. Table III-20 presents a separate variance analysis of cell financial results.[51]

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[48] *** did not have commercial sales or transfers of cells during the period examined: *** used all of its internally-produced cells in the production of modules and *** cell production reflects R&D activity (see also footnote 49). The majority of cells produced by *** are internally consumed in the production of modules and are therefore reflected as part of module cost of goods sold (COGS); e.g., ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions.

[49] ***. USITC auditor notes. ***. July 13, 2017 e-mail from counsel on behalf of *** to USITC auditor. ***. USITC auditor notes.

The financial results of *** are included in this report based on information reported to the Commission in the most recently completed CSPV investigations. *Certain Crystalline Silicon Photovoltaic Cells and Modules from China and Taiwan*, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Pub. 4519, February 2015. The period covered in those investigations was 2011 through first half 2014.

[50] The majority of U.S. producers reported their financial results for calendar year periods and on the basis of U.S. generally accepted accounting principles. The exceptions were ***, which both reported financial results for fiscal years ending March 31, and SolarWorld, which reported its financial results according to International Financial Reporting Standards (IFRS).

[51] The Commission's variance analysis is calculated in three parts: sales variance, COGS variance, and SG&A expenses variance. Each part consists of a price variance (in the case of the sales variance) or a cost or expense variance (in the case of the COGS and SG&A expenses variance), and a volume variance. The sales or cost/expense variance is calculated as the change in unit price or per-unit cost/expense times the new volume, while the volume variance is calculated as the change in volume times the old unit price or per-unit cost/expense. As summarized at the bottom of table III-20 and III-23, the price variance is from sales, the cost/expense variance is the sum of those items from the COGS and SG&A variances, respectively, and the volume variance is the sum of the volume components of the net sales, COGS, and SG&A expenses variances. In general, the utility of the Commission's variance analysis is enhanced when product mix remains the same throughout the period.

Table III-18
CSPV products: U.S. producers' financial results on cells (commercial sales and transfers), 2012-16

* * * * * * *

Table III-19
CSPV products: Changes in average cell per kilowatt values, between fiscal years, 2012-16

* * * * * * *

Table III-20
CSPV products: Variance analysis of U.S. producers' financial results on cells (commercial sales and transfers), 2012-16

* * * * * * *

Income-and-loss data for module operations are presented in table III-19. Table III-22 presents corresponding changes in module average per kilowatt values. Table III-23 presents a separate variance analysis of module financial results. Appendix E presents company-specific financial results for cells and modules in table E-2 and table E-3, respectively.

Net sales

Total commercial sales and transfer volume of cells fluctuated during the period with the highest level achieved in 2013 (see table III-18). Following declines in 2014 and 2015, sales volume of cells increased in 2016 to its second highest level of the period. While both *** reported higher cell sales volume in 2016, the higher absolute level is attributable primarily to ***.[52]

Module sales volume, as reported in table III-21, reflects a somewhat different pattern compared to cells. Total module sales volume, which primarily reflects a mix of commercial sales and transfers, declined to its lowest level in 2013 and then subsequently increased in each year and reached its highest level in 2016.[53] While the absolute volume of module sales increased during 2014-16, the net amount includes the reduction and/or exit of module operations by several U.S. producers.[54] As shown in table E-3, various U.S. producers contributed to the pattern of higher module sales volume; e.g., most notably *** in 2014, *** in 2015, and *** in 2016.

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[52] ***.

[53] While internal consumption was reported by several U.S. producers, it was determined that the activity represented costs supporting module operations. Accordingly, U.S. producer module internal consumption is generally excluded from the financial results presented in this report. USITC auditor notes. The small amount of module internal consumption presented in table III-21 was reported by ***, which exited the market in 2014.

***. July 7, 2017 e-mail with attachment from *** to USITC auditor.

[54] ***. July 7, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

***. July 6, 2017 e-mail with attachment from *** to USITC auditor.

Table III-21
CSPV products: U.S. producers' financial results on modules, 2012-16

Item	Fiscal year				
	2012	2013	2014	2015	2016
	Quantity (kilowatts)				
Commercial sales	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	581,762	464,771	472,355	527,683	623,846
	Value (1,000 dollars)				
Commercial sales	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	607,615	410,608	420,661	476,920	484,359
Cost of goods sold.-- Raw materials	499,847	318,171	334,276	379,190	414,603
Direct labor	41,444	34,098	16,441	27,196	33,991
Other factory costs	317,456	193,579	71,857	26,538	39,983
Total COGS	858,747	545,848	422,574	432,924	488,577
Gross profit or (loss)	(251,132)	(135,240)	(1,913)	43,996	(4,218)
SG&A expense	125,946	68,803	56,642	54,526	210,773
Operating income or (loss)	(377,078)	(204,043)	(58,555)	(10,530)	(214,991)
Interest expense	14,773	10,539	10,738	12,767	9,774
All other expenses	175,984	13,308	2,336	1,825	2,247
All other income	16,665	10,755	17,126	4,051	2,139
Net income or (loss)	(551,170)	(217,135)	(54,503)	(21,071)	(224,873)
Depreciation/amortization	172,017	13,823	18,652	23,555	21,260
Cash flow	(379,153)	(203,312)	(35,851)	2,484	(203,613)
	Ratio to net sales (percent)				
Cost of goods sold.-- Raw materials	82.3	77.5	79.5	79.5	85.6
Direct labor	6.8	8.3	3.9	5.7	7.0
Other factory costs	52.2	47.1	17.1	5.6	8.3
Average COGS	141.3	132.9	100.5	90.8	100.9
Gross profit or (loss)	(41.3)	(32.9)	(0.5)	9.2	(0.9)
SG&A expense	20.7	16.8	13.5	11.4	43.5
Operating income or (loss)	(62.1)	(49.7)	(13.9)	(2.2)	(44.4)
Net income or (loss)	(90.7)	(52.9)	(13.0)	(4.4)	(46.4)

Table continued on next page.

Table III-21--Continued
CSPV products: U.S. producers' financial results on modules, 2012-16

Item	Fiscal year				
	2012	2013	2014	2015	2016
	Ratio to total COGS (percent)				
Cost of goods sold.-- Raw materials	58.2	58.3	79.1	87.6	84.9
Direct labor	4.8	6.2	3.9	6.3	7.0
Other factory costs	37.0	35.5	17.0	6.1	8.2
Average COGS	100.0	100.0	100.0	100.0	100.0
	Unit value (dollars per kilowatt)				
Commercial sales	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	1,044	883	891	904	776
Cost of goods sold.-- Raw materials	859	685	708	719	665
Direct labor	71	73	35	52	54
Other factory costs	546	417	152	50	64
Average COGS	1,476	1,174	895	820	783
Gross profit or (loss)	(432)	(291)	(4)	83	(7)
SG&A expense	216	148	120	103	338
Operating income or (loss)	(648)	(439)	(124)	(20)	(345)
Net income or (loss)	(947)	(467)	(115)	(40)	(360)
	Number of firms reporting				
Operating losses	8	9	10	4	7
Net losses	8	10	9	4	6
Data	11	12	11	7	8

Source: Compiled from data submitted in response to Commission questionnaires.

Table III-22
CSPV products: Changes in average module per kilowatt values, between fiscal years, 2012-16

Item	Between fiscal years				
	2012-16	2012-13	2013-14	2014-15	2015-16
Total net sales	(268)	(161)	7	13	(127)
Cost of goods sold.-- Raw materials	(195)	(175)	23	11	(54)
Direct labor	(17)	2	(39)	17	3
Other factory costs	(482)	(129)	(264)	(102)	14
Average COGS	(693)	(302)	(280)	(74)	(37)
Gross profit	425	141	287	87	(90)
SG&A expense	121	(68)	(28)	(17)	235
Operating income or (loss)	304	209	315	104	(325)
Net income or (loss)	587	480	352	75	(321)

Source: Compiled from data submitted in response to Commission questionnaires.

Table III-23
CSPV products: Variance analysis of U.S. producers' financial results on modules, 2012-16

Item	Between fiscal years				
	2012-16	2012-13	2013-14	2014-15	2015-16
Net sales: Price variance	(167,210)	(74,817)	3,353	6,986	(79,473)
Volume variance	43,954	(122,190)	6,700	49,273	86,912
Net sales variance	(123,256)	(197,007)	10,053	56,259	7,439
COGS: Cost variance	432,291	140,207	132,181	39,147	23,241
Volume variance	(62,121)	172,692	(8,907)	(49,497)	(78,894)
COGS variance	370,170	312,899	123,274	(10,350)	(55,653)
Gross profit variance	246,914	115,892	133,327	45,909	(48,214)
SG&A expenses: Cost/expense variance	(75,716)	31,816	13,284	8,751	(146,310)
Volume variance	(9,111)	25,327	(1,123)	(6,635)	(9,937)
Total SG&A expense variance	(84,827)	57,143	12,161	2,116	(156,247)
Operating income variance	162,087	173,035	145,488	48,025	(204,461)
Summarized as: Price variance	(167,210)	(74,817)	3,353	6,986	(79,473)
Net cost/expense variance	356,575	172,023	145,465	47,898	(123,069)
Net volume variance	(27,277)	75,830	(3,330)	(6,859)	(1,919)

Source: Compiled from data submitted in response to Commission questionnaires.

The average sales value of cells declined in 2013, increased in 2014, and then declined during 2015-16 (see table III-18). With regard to the increase in cell average sales value in 2014, *** contributed to this pattern (see table E-2).

On an overall basis and as compared to cells, average module sales value followed a somewhat different pattern: declining in 2013, increasing in 2014 and 2015, and then declining in 2016. For U.S. module operations as a whole, the pattern of marginally higher average module sales values in 2014 and 2015 is primarily attributable to higher company-specific average sales values reported by *** in 2014 and *** in 2015; i.e., most U.S. producers reported lower average module sales values in 2013 and 2014 (see table E-3). In 2015, the directional pattern of module average sales value was mixed. In 2016, most U.S. producers reported lower average module sales values.[55]

Cost of goods sold and gross profit

For both cells and modules, total raw material cost is the most substantial component of total COGS. For cells total raw material cost reflects a combination of polysilicon, wafers, and all other raw material costs.[56] As shown in table III-18, ***.[57] Total cell raw material costs

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[55] In 2016, *** reported the only increase in average module sales value. The company's large increase appears to reflect *** (see footnote 54). Table E-3 shows that U.S. module producers reported a range of average sales values. ***. July 8, 2017 e-mail with attachments from *** to USITC auditor.

[56] The share of total COGS accounted for by cell all other raw material costs declined in 2014, in conjunction with higher average wafer costs, and then increased in 2015-16, in conjunction with lower
(*continued...*)

reported for commercial sales and transfer of cells increased from *** percent of total COGS in 2012 to *** percent in 2016. To the extent that average raw material costs declined during the period, the increasing share of COGS accounted for by raw material costs is generally attributable to declines in corresponding cell conversion costs (direct labor and other factory costs).[58]

Total raw material costs for modules reflect internally-produced cells, cells purchased from related and unrelated firms, and all other raw material costs.[59] Company-specific module cost structures varied with the following producers reporting consumption of internally-produced cells: ***.[60] Notwithstanding internal cell production, these companies also purchased cells during the period.[61] The remaining companies produce modules using purchased finished cells from related and/or unrelated suppliers. Similar to the pattern reported for commercial sales and transfers of cells, the overall share of total module COGS accounted for by module raw material costs increased from 58.2 percent in 2012 to 84.9 percent in 2016.[62] Module conversion costs declined on an average basis and as a share of total module COGS.

With respect to cell and module COGS, *** U.S. producer to include non-recurring items identified as ***. In addition to changes in underlying operations, impairments recognized by *** at the beginning of the period also impacted COGS, specifically conversion costs, by reducing subsequent levels of depreciation included in cell and module other factory costs.[63] As noted below, *** impairments were recognized in other expenses, as opposed to COGS.

Gross profit was generated on cell operations in 2014 and 2015 and on module operations in 2015. For both cells and modules the positive spread between average sales

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(…*continued*)
average wafer cost. ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions. ***. July 11, 2017 e-mail from counsel on behalf of *** to USITC auditor.

[57] ***. *** U.S. producer questionnaire, response to III-9d. ***. August 28, 2017 e-mail with from counsel on behalf of *** to USITC auditor. ***. July 10, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[58] ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions.

[59] ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions. ***. July 11, 2017 e-mail from counsel on behalf of *** to USITC auditor.

[60] ***. July 7, 2017 e-mail with attachment from *** to USITC auditor.

[61] The cost of internally-produced cells as a share of total module raw material costs was marginally lower in 2016 (*** percent) compared to 2012 (*** percent) while the share accounted for by purchased cells was marginally higher in 2016 (*** percent) compared to 2012 (*** percent). (Note: These percentages reflect revised information submitted by ***. July 21, 2017 e-mail with attachment from *** to USITC auditor.) USITC auditor notes. ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions.

[62] With regard to module COGS, costs associated with internally produced cells and purchased cells were classified as part of total raw material cost and increased from *** percent of module COGS in 2012 to *** percent in 2016. USITC auditor notes.

[63] In part, the pattern of the U.S. industry's declining average conversion costs reflects the exit of several U.S. producers from the market. With regard to U.S. producers with module operations throughout the period, *** reported the most notable decline in average module conversion costs. ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions.

values and COGS was at its highest level in 2015 and subsequently declined to negative spread in 2016. During the period, U.S. module producers reported a wide range of negative and positive gross profit ratios (see table E-3).

SG&A expenses and operating income or loss

With the exception of 2016, SG&A expense ratios (total SG&A expenses divided by total revenue) calculated for cell operations were higher compared to module operations. The higher level of SG&A expenses for cell operations reflects, in part, non-recurring items reported by ***. *** also reported higher absolute SG&A expenses compared to *** throughout the period (see table E-2).[64]

Total SG&A expenses assigned to module operations, as well as corresponding SG&A expense ratios, declined in 2013 through 2015 and then increased notably in 2016 (see table III-21). The 2016 increase in total module SG&A expenses primarily reflects impairments reported by ***.[65] [66] On a company-specific basis, module SG&A ratios cover a relatively wide range (see table E-3). What appear to be unusually high SG&A expense ratios reflect, in part, operations which were in an entry, transition, or exit phase.[67]

With regard to cell operations and in conjunction with gross losses in 2012, 2013, and 2016 and relatively low gross profit ratios in 2014 and 2015, the U.S. industry reported cell operating losses of varying magnitude throughout the period. Company-specific operating income on cell operations was *** (see table E-2).

The pattern of overall module gross losses in 2012, 2013, 2014, and 2016 and relatively low gross profit, when generated, in 2015 yielded module operating losses of varying magnitudes throughout the period. The majority of U.S. module producers reported operating losses throughout all or most of the period for which they had operations (see table E-3). *** U.S. module producer in terms of reported sales volume, reported operating income on its module operations in 2015 only.[68] *** reported operating losses of varying amounts throughout the period.[69] ***, an exception to the general pattern of persistent operating losses, reported operating income throughout the period.[70]

Interest expense, other expenses, and net income or loss

Interest expense was reported for cell and module operations throughout the period. For cell operations, interest expense declined irregularly during 2012-15 and then increased

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[64] ***. *** U.S. producer questionnaire, III-10. ***. July 10, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[65] ***. July 7, 2017 e-mail with attachment from *** to USITC auditor.

[66] In its 2016 annual financial results, Suniva's parent company, Shunfeng, recognized an impairment of its investment in Suniva. Shunfeng 2016 Annual Report, p. 55. ***. July 10, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[67] ***. July 7, 2017 e-mail with attachments from *** to USITC auditor.

[68] ***. July 10, 2017 e-mail with attachments from *** in response to USITC staff follow-up questions.

[69] ***. July 10, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[70] ***.

notably in 2016. For module operations, interest expense also fluctuated and ended the period somewhat lower.[71] In 2012, *** reported asset impairments related to its cell and module operations which account for the majority of total other expenses reported in that year for cell and module operations.[72] Other expenses did not have a notable impact on net results after 2012. Other income, which reached its highest level in 2014, primarily reflects amounts reported by ***.[73]

The U.S. industry's net losses were consistently greater than corresponding operating losses throughout the period due to the inclusion of interest expense and other expenses. The more pronounced difference between net losses and operating losses in 2012 reflects the impairments noted above.

Capital expenditures, research and development expenses, and investment in productive facilities

Table III-24 presents total capital expenditures, research and development (R&D) expenses, and total investment in productive facilities related to U.S. cell and module operations.[74]

Capital expenditures

The level of overall capital expenditures assigned to cell operations fluctuated and increased to its highest level in 2015 (see table III-24), which primarily reflects amounts reported by *** (see table E-4).[75] *** accounted for the largest share of the period's total capital expenditures assigned to cell operations (*** percent), followed by *** (*** percent), *** (***) percent, and *** (*** percent).[76]

Table III-24
CSPV products: U.S. producers' capital expenditures, research and development (R&D) expenses, and investment in productive assets related to cells and modules, 2012-16

* * * * * * *

[71] ***.

[72] ***. USITC auditor notes. ***. July 7, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[73] ***. USITC auditor notes.

[74] For the reasons described in footnote 49, *** are not included in the cell and module financial results presented in table III-18 and table III-21, respectively. However, financial information reported by *** related to cell and module capital expenditures, R&D expenses, and total assets are included in table III-24 and table E-4.

[75] ***. *** U.S. producer questionnaire, response to III-13 (note 1). ***. July 24, 2017 e-mail from counsel on behalf of *** to USITC auditor.

[76] ***. *** U.S. producer questionnaire, response to III-13 (note 1).

Capital expenditures assigned to module operations fluctuated and were at their highest level in 2016. ***, which began production in 2014, accounted for the largest share of the period's total module capital expenditures (*** percent), followed by *** (*** percent), *** (*** percent), and *** (*** percent).[77 78] The remaining module producers reporting capital expenditures accounted for shares ranging from *** percent (***) to *** percent (***).[79]

R&D expenses

The level of R&D expenses assigned to cell operations declined throughout the period. *** accounted for the largest share (*** percent), followed by *** (*** percent) and *** (*** percent).[80] *** did not report cell-related R&D expenses.

R&D expenses assigned to module operations declined from 2013 through 2015 and then increased in 2016, largely due to ***.[81] *** accounted for the largest share (*** percent), followed by ***, which exited the market in 2014, (*** percent), *** (*** percent), and *** (*** percent). The remaining U.S. producers reporting R&D expenses accounted for shares ranging from *** percent (***) to *** percent (***).[82]

Investment in productive facilities

Total assets assigned to cell operations increased throughout most of the period with the large increase in 2015 due to ***.[83] As noted previously, the decline in *** assets in 2016 reflects asset impairments in that year.

Total assets assigned to module operations declined in 2013 and then increased during the rest of the period. While most U.S. module producers reported lower total asset values in 2016, the U.S. industry's total module assets increased due to *** (see table E-4).

Capital and investment

The Commission requested the U.S. producers of cells and modules to describe any actual or potential negative effects on their return on investment or their growth, investment, ability to raise capital, existing development and production efforts (including efforts to develop a derivative or more advanced version of the product), or the scale of capital

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[77] ***. *** U.S. producer questionnaire, response to III-13 (note 3).

[78] ***. July 7, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[79] *** did not report capital expenditures.

[80] ***. *** U.S. producer questionnaire, response to III-13 (note 2).

***. July 10, 2017 e-mail with attachment from counsel on behalf of *** to USITC auditor.

[81] ***. *** U.S. producer questionnaire, response to III-13 (note 4).

[82] *** did not report R&D expenses.

[83] With respect to a company's overall operations, staff notes that a total asset value (i.e., the bottom line value on the asset side of a company's balance sheet) reflects an aggregation of a number of assets which, in some instances, are not product specific. With respect to U.S. producers that have multiple operations, allocation was presumably necessary to report a total asset amount specific to cell and/or module operations.

investments as a result of imports of cells (whether or not partially or fully assembled into other products). Table III-25 tabulates the responses of U.S. producers regarding actual negative effects on investment, growth and development, as well as anticipated negative effects of imports of CSPV products.[84] U.S. producers' narrative responses regarding actual and anticipated negative effects on investment, growth and development are presented in table E-1 in Appendix E.

Table III-25
CSPV products: Actual and anticipated negative effects of imports on investment and growth and development

Item	No	Yes
Negative effects on investment	3	10
Cancellation, postponement, or rejection of expansion projects		5
Denial or rejection of investment proposal		2
Reduction in the size of capital investments		4
Return on specific investments negatively impacted		4
Ability to generate capital for modernization efforts		4
Ability to maintain existing expenditures		4
Other		3
Negative effects on investments differ by category	10	2
Negative effects on growth and development	3	9
Rejection of bank loans		4
Lowering of credit rating		3
Problem related to the issue of stocks or bonds		2
Ability to service debt		3
Harmed bankability		4
Other		6
Effects of imports on growth differ by category	10	2
Anticipated negative effects of imports	3	8
Anticipated effects differ by category	8	3

Source: Compiled from data submitted in response to Commission questionnaires.

[84] *** are not included in the U.S. industry's financial results on cells or modules (see footnote 49). However and to the extent reported, their responses regarding actual and anticipated negative effects of imports are included in table III-25 and table E-1. *** are included in the module financial results based on information reported in the most recently completed Solar investigation (see footnote 49). These companies, which are no longer in operation, are not reflected in table III-25 or table E-1.

PART IV: U.S. MARKET AND FOREIGN INDUSTRIES

This part of the report provides information from questionnaires and public sources on the U.S. market and foreign industries for CSPV products.

APPARENT U.S. CONSUMPTION AND MARKET SHARES

Country-of-origin based on cell manufacture location

Apparent U.S. consumption of certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products ("CSPV products"),[1] by quantity, increased by *** percent from *** kW in 2012 to *** kW in 2016 (table IV-1). By value, apparent U.S. consumption of CSPV products increased by *** percent from $*** in 2012 to $*** in 2016. The U.S. producers' component of apparent U.S. consumption increased overall by *** percent from *** kW in 2012 to *** kW in 2016. The U.S. import component of apparent U.S. consumption increased by 492.6 percent from 2.2 million kW in 2012 to 12.8 million kW in 2016.

[1] See the section entitled "The Imported Articles Described in this Investigation" in *Part I* of this report for a complete description of the merchandise subject to this investigation.

Table IV-1
CSPV products: U.S. shipments of domestic product, U.S. imports, and apparent U.S. consumption (country-of-origin based on cell manufacture location), 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	326,846	82,264	1,263,270	3,311,513	2,720,193
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	1,065,160	2,113,220	2,090,974	852,758	1,118,967
Thailand	***	***	***	***	***
Vietnam	---	---	---	161,195	472,682
All other sources	***	***	***	***	***
All import sources	2,162,388	3,101,412	4,582,898	8,430,393	12,813,568
Apparent U.S. consumption	***	***	***	***	***
	Value (1,000 dollars)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	291,878	69,976	747,148	1,680,733	1,258,864
Germany	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	743,337	1,349,271	1,274,305	467,820	606,449
Thailand	***	***	***	***	***
Vietnam	---	---	---	96,336	240,625
All other sources	***	***	***	***	***
All import sources	1,904,664	2,214,457	3,014,861	4,967,865	7,060,489
Apparent U.S. consumption	***	***	***	***	***

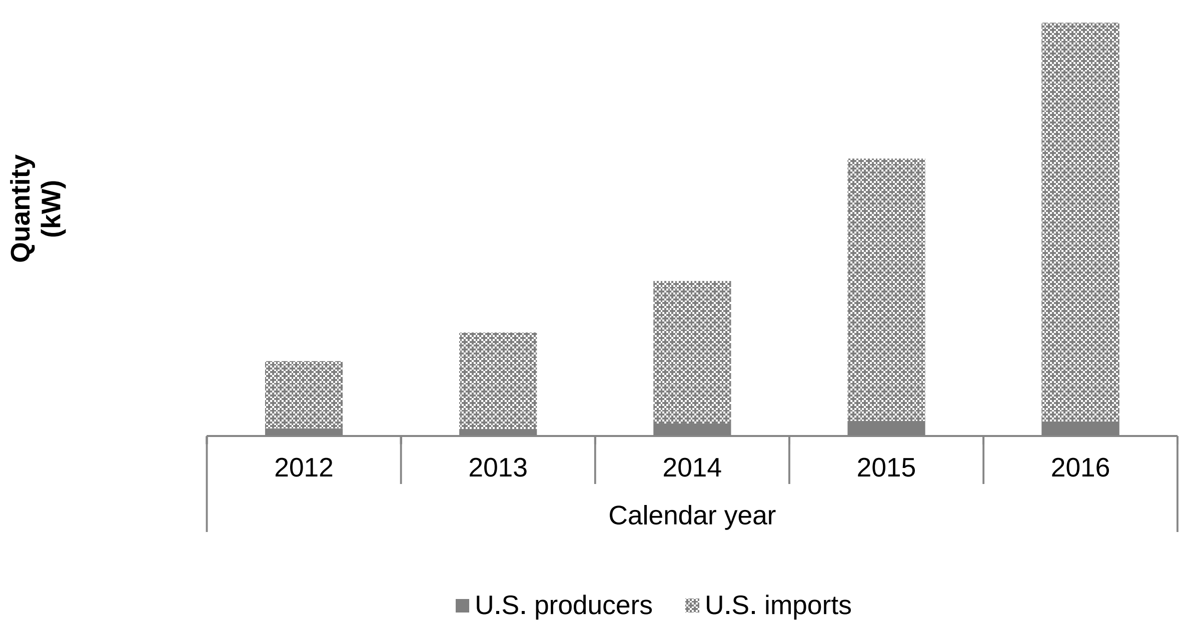
Source: Compiled from data submitted in response to Commission questionnaires.

The U.S. producers accounted for a relatively small and declining share of the U.S. market for CSPV products during the period of investigation (table IV-2 and figure IV-1). During 2012, the U.S. producers accounted for *** percent of total apparent U.S. consumption by quantity and *** percent by value. By 2016, however, the share of apparent U.S. consumption held by domestic producers fell to *** percent by quantity and *** percent by value. Even as U.S. demand for CSPV products increased from 2012 to 2016, foreign suppliers, primarily Malaysia, China, and Korea, captured a larger share of the U.S. market. The market share held by Malaysian imports, on the basis of quantity, increased by *** percentage points from *** percent in 2012 to *** percent in 2016; whereas that held by Chinese imports (for which there are currently two sets of antidumping and countervailing duty orders in place, as indicated in *Part I* of the report) increased by *** percentage points from *** percent in 2012 to *** percent in 2016, and that held by Korean imports increased by *** percentage points from *** percent in 2012 to *** percent in 2016. On the other hand, the market share held by Taiwan (for which there is currently an antidumping duty order in place) declined by *** percentage points from *** percent of the U.S. market in 2012 to *** percent in 2016.

Table IV-2
CSPV products: U.S. market shares (country-of-origin based on cell manufacture location), 2012-16

* * * * * * *

Figure IV-1
CSPV products: U.S. market shares, 2012-16



Source: Compiled from data submitted in response to Commission questionnaires.

Alternative NAFTA country presentation

The alternative calculations for apparent U.S. consumption of CSPV products in this section consider the country-of-origin for Canada and Mexico to be the location of the module manufacture and the country-of-origin for all other sources to be the location of the cell manufacture (table IV-3). Therefore, the U.S. component and total import source component (as well as total apparent consumption) remain largely unchanged from the earlier presentations in tables IV-1 and IV-2.[2] Based on this alternative calculation, U.S. imports from Canada increased from *** kW ($***) in 2012 to *** kW ($***) in 2015, before declining to *** kW ($***) in 2016. Reported U.S. imports of CSPV modules assembled in Canada included cells believed to be manufactured in the following countries: ***. U.S. imports from Mexico increased from *** kW ($***) in 2012 to *** kW ($***) in 2016. Reported U.S. imports of CSPV modules assembled in Mexico included cells believed to be manufactured in the following countries: ***. The market share held by Canadian imports, on the basis of quantity, increased from *** percent in 2012 to *** percent in 2015, before declining to *** percent in 2016 (table IV-4). The share of the U.S. market held by U.S. imports from Mexico, on the basis of quantity, increased from *** percent in 2012 to *** percent in 2013, before declining to *** percent in 2016.

Table IV-3
CSPV products: U.S. shipments of domestic product, U.S. imports, and apparent U.S. consumption (country-of-origin for NAFTA countries based on module manufacture location and all other based on cell manufacture location), 2012-16

* * * * * * *

Table IV-4
CSPV products: U.S. market shares (country-of-origin for NAFTA countries based on module manufacture location and all other sources based on cell manufacture location), 2012-16

* * * * * * *

[2] The adjustments made to reclassify the country-of-origin for modules assembled in Canada or Mexico resulted in small immaterial differences in the total import values (never exceeding a margin of 0.2 percent difference). Data for Canada do not include U.S.-origin cells assembled into modules or laminates in Canada (those data are counted as part of U.S. producers' U.S. shipments).

FOREIGN INDUSTRIES

Global installations and production

Global installations

Global PV system installations (including thin film) increased from 29 GW in 2012 to about 75 GW in 2016 (figure IV-2).[3] In 2016, installations were highest in the second quarter, primarily due to the deadline to complete projects in China to receive the higher feed-in tariff (FIT) rate (discussed below).[4] The leading global markets have changed over time. Germany was the largest market in 2012 (accounting for 26 percent of installations), followed by Italy (13 percent), China (12 percent), and the United States (11 percent).[5] The largest markets in 2016 were China (34.5 GW, 46 percent of installations), the United States (14.7 GW, 20 percent), Japan (8.6 GW, 11 percent), and India (4 GW, 5 percent).[6]

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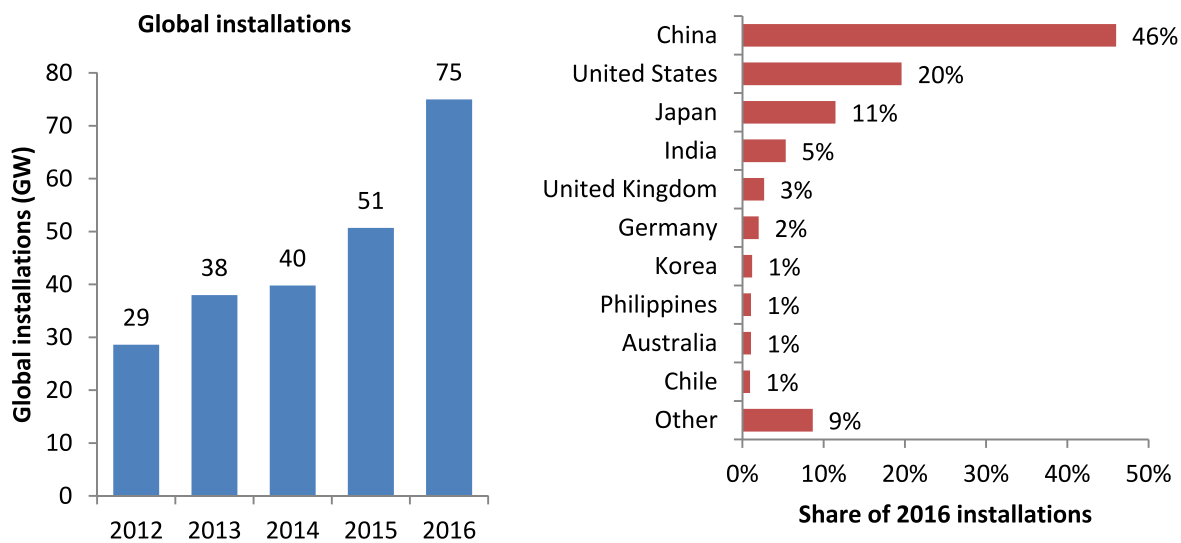
[3] International Energy Agency (IEA) Photovoltaic Power Systems Programme (PVPS), *2016 Snapshot of Global Photovoltaic Markets*, Report IEA PVPS T1-31:2017, 2017, 4, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf; IEA PVPS, *Trends 2013 in Photovoltaic Power Applications*, Report IEA-PVPS T1-23:2013, 2013, p. 11, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/FINAL_TRENDS_v1.02.pdf.

[4] Global installations totaled 18.4 GW in the first quarter of 2016, 24.1 GW in the second quarter, 15.9 GW in the third quarter, and 19.5 GW in the fourth quarter. These installation estimates are based on GTM data, and the annual total is slightly higher than the estimate from the IEA. GTM Research, Global Solar Demand Monitor, Q1 2017 Market Trends Update, March 2017, p. 4, http://www.ourenergypolicy.org/wp-content/uploads/2017/06/Global_Solar_Demand_Monitor_Q1_2017_Executive_Summary.pdf.

[5] IEA PVPS, *Trends 2013 in Photovoltaic Power Applications*, Report IEA-PVPS T1-23:2013, 2013, p. 12, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/FINAL_TRENDS_v1.02.pdf.

[6] IEA, PVPS, *2016 Snapshot of Global Photovoltaic Markets*, Report IEA PVPS T1-31:2017, 2017, 4, 10, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf.

Figure IV-2
Global PV (including thin film) installations, 2012-16 and share of 2016, by country

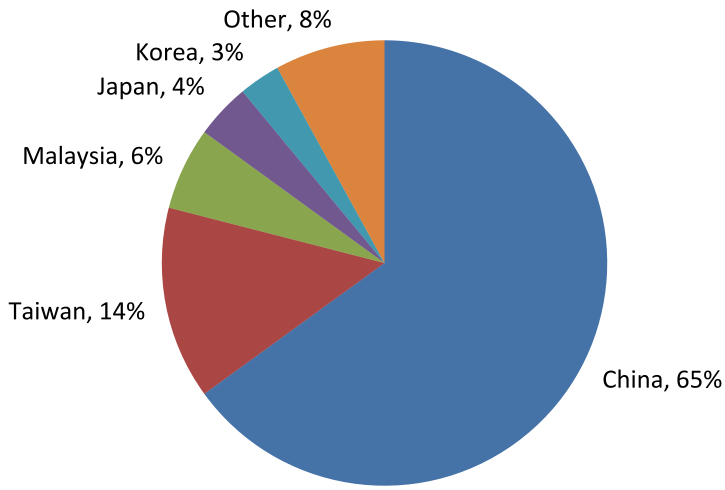


Source: IEA PVPS, Trends 2013 in Photovoltaic Power Applications, Report IEA PVPS T1-30:2016, 2016, 48; : IEA PVPS, Trends 2015 in Photovoltaic Power Applications, Report IEA-PVPS T1-27:2015, 2015, p. 8; : IEA PVPS, Trends 2016 in Photovoltaic Power Applications, Report IEA PVPS T1-30:2016, 2016, 8; IEA, PVPS, 2016 Snapshot of Global Photovoltaic Markets, Report IEA PVPS T1-31:2017, 2017, 4, 10; All reports available from http://www.iea-pvps.org.

Global cell production and capacity

Global PV cell (including thin film) production in 2015, according to public data sources, was estimated at approximately 63 GW.[7] The leading global PV (including thin film) cell manufacturing country in 2015 was China (65 percent of global production), followed by Taiwan (14 percent), Malaysia (6 percent), Japan (4 percent), and Korea (3 percent) (figure IV-3).[8] Global CSPV cell production capacity *** from *** in 2012 to *** GW in 2016, according to GTM Research. Of the *** in 2016, *** was ramped capacity ("a discount of total capacity, accounting for capacity ramp time, plant downtimes, and plant suspensions").[9]

Figure IV-3
Global PV (including thin film) cell production by country, 2015



Note: According to IEA data, the United States accounted for 2 percent of cell production. Total production was about 63 GW.

Source: IEA PVPS, Trends 2016 in Photovoltaic Power Applications, Report IEA PVPS T1-30:2016, 2016, 48, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf.

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[7] IEA PVPS, *Trends 2016 in Photovoltaic Power Applications*, Report IEA PVPS T1-30:2016, 2016, 47, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf.

[8] IEA PVPS, *Trends 2016 in Photovoltaic Power Applications*, Report IEA PVPS T1-30:2016, 2016, 48, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf.

[9] SolarWorld prehearing brief, exhibit 12 (GTM Research PV Pulse, July 2017); Jones, Jade, "Will There Be a PV Module Supply Shortage by the End of 2015?" GTM Research, June 25, 2015, https://www.greentechmedia.com/articles/read/will-there-be-a-pv-module-supply-shortage-by-the-end-of-2015.

The distribution of CSPV cell production based on data collected via the Commission's questionnaires is largely consistent with public data sources (table IV-5). The industry in China was the largest producer of CSPV cells, accounting for 57.9 percent of production in 2016, followed by the industries in Taiwan (15.9 percent), ***.

Table IV-5
CSPV products: Cell production by country, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
Production of cells in.-- China	11,124,972	14,027,686	18,537,642	22,720,444	27,779,992
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Netherlands	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	3,806,669	5,165,941	6,313,934	7,544,196	7,638,180
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
Total cell production	18,401,207	23,968,755	31,231,437	37,959,187	47,958,366
	Share of quantity (percent)				
Production of cells in.-- China	60.5	58.5	59.4	59.9	57.9
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Netherlands	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	20.7	21.6	20.2	19.9	15.9
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
Total cell production	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

The leading CSPV cell manufacturing companies in 2016, in order from largest to smallest, were Hanwha Q-Cells (headquartered in Korea), JA Solar (China), Trina Solar (China), Jinko Solar (China), Motech (Taiwan), Tongwei Solar (China), Yingli (China), Canadian Solar (China), and Shunfeng (China). These firms all have production in China, though most also have production in other locations as well.[10] The top ten PV cell (including thin film) suppliers in 2016 accounted for less than 40 percent of global production.[11]

Global module production and capacity

Global PV module (including thin film) production in 2015 was estimated at approximately 63 GW.[12] The leading global PV (including thin film) module manufacturing country in 2015 was China (69 percent of production), followed by Malaysia (6 percent), Korea and Japan (5 percent each), and Germany (4 percent) (figure IV-4).[13] Global CSPV module production capacity *** from *** in 2012 to *** in 2016. Of the *** in PV capacity at the end of 2016 (including thin film products), *** was ramped production capacity.[14]

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[10] Colville, Finlay, "Top-10 Solar Cell Producers in 2016,"PV tech, January 30, 2017, https://www.pv-tech.org/editors-blog/top-10-solar-cell-producers-in-2016.

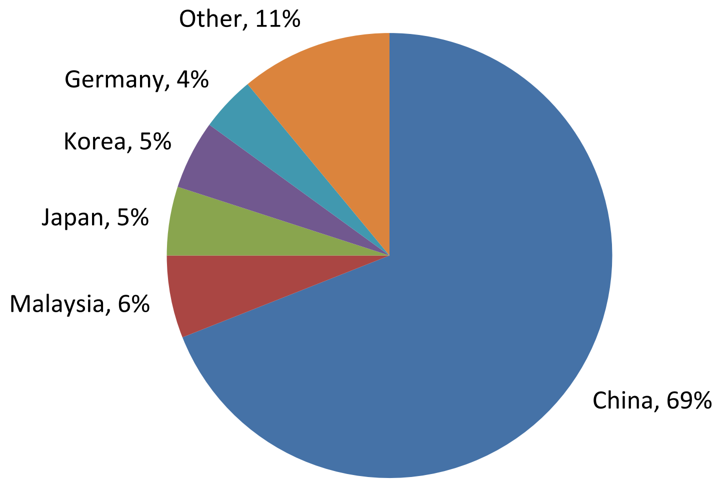
[11] Colville, Finlay, "Top-10 Solar Cell Producers in 2016,"PV tech, January 30, 2017, https://www.pv-tech.org/editors-blog/top-10-solar-cell-producers-in-2016.

[12] IEA PVPS, *Trends 2016 in Photovoltaic Power Applications*, Report IEA PVPS T1-30:2016, 2016, 48, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf.

[13] IEA PVPS, *Trends 2016 in Photovoltaic Power Applications*, Report IEA PVPS T1-30:2016, 2016, 48, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf.

[14] SolarWorld prehearing brief, exhibit 12 (GTM Research PV Pulse, July 2017).

Figure IV-4
Global PV (including thin film) module production by country, 2015



Note: According to IEA data, the United States accounted for 2 percent of module production. 2015 production was approximately 63 GW.

Source: IEA PVPS, Trends 2016 in Photovoltaic Power Applications, Report IEA PVPS T1-30:2016, 2016, 48, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf.

Data provided in response to the Commission's questionnaire also show that the industry in China was the largest global producer of CSPV modules, accounting for 69.0 percent of global module assembly in 2016 (table IV-6). The industry in *** was the second largest producer of modules, accounting for *** of module assembly, followed by the industries in ***.

Table IV-6
CSPV products: Module assembly by country, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
Assembly of modules in.-- Brazil	***	***	***	***	***
Canada	296,019	423,493	648,114	725,151	517,719
China	12,462,092	16,326,264	22,071,981	28,792,042	35,470,622
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	210,415	370,057	663,285	831,700	597,078
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
Total module assembly	15,789,716	20,848,784	28,619,986	38,441,620	51,430,556
	Share of quantity (percent)				
Assembly of modules in.-- Brazil	***	***	***	***	***
Canada	1.9	2.0	2.3	1.9	1.0
China	78.9	78.3	77.1	74.9	69.0
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	1.3	1.8	2.3	2.2	1.2
Thailand	***	***	***	***	***
Vietnam	***	***	***	***	***
Total module assembly	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

The leading CSPV module suppliers in 2016, in order from largest to smallest, were Jinko Solar (headquartered in China), Trina Solar (China), Canadian Solar (China), JA Solar (China), Hanwha Q-Cells (Korea), GCL (China), Longi Solar (China), Yingli (China), and Shunfeng (China). The leading suppliers to markets outside of China in 2016 were Trina, Hanwha, Canadian Solar, Jinko, JA Solar, SunPower (United States), SolarWorld (Germany), REC Solar (Singapore), and Shunfeng.[15]

The industries in North America

Canada

Overview

The Commission issued foreign producer questionnaires to 12 firms believed to produce CSPV products in Canada. Four CSPV module producers in Canada responded to the Commission's questionnaire with useable information, accounting for approximately 89 percent of 2016 module capacity in Canada.[16] The four responding Canadian producers reported that they are currently the only known producers of CSPV products in Canada.

Table IV-7 lists the Canadian producers of CSPV modules that responded to the Commission's questionnaire and certain summary data for the period January 2012 through December 2016 reported in those responses.

[15] Colville, Finlay, "100GW of PV Modules to Ship During 2018, but is Quality Matching Quantity? (Part 2)," PV Tech, August 17, 2017, https://www.pv-tech.org/editors-blog/100gw-of-pv-modules-to-ship-during-2018-but-is-quality-matching-quanti.

[16] A fifth firm in Canada (***) provided a questionnaire response ***. There was no reported Canadian production of CSPV cells during the period of investigation. Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017; Poissant, Y. and P. Bateman, "National Survey Report of PV Power Applications in Canada," IEA PVPS, p, 20, http://www.iea-pvps.org/?id=93.

Table IV-7
CSPV cells: Summary data on responding firms in Canada, January 2012 through December 2016

Firm	Production (kW)	Share of reported production (percent)	Exports to the United States (kW)	Share of reported exports to the United States (percent)	Total shipments (kW)	Share of firm's total shipments exported to the United States (percent)
CSPV modules:						
Canadian Solar	***	***	***	***	***	***
Celestica	***	***	***	***	***	***
Heliene	***	***	***	***	***	***
Silfab	***	***	***	***	***	***
Total	2,610,496	100.0	***	100.0	2,584,951	***

Note.--Foreign producer data on module assembly does not necessarily equate to the country-of-origin classification used for U.S. import statistics. ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Changes in operations

All four responding producers in Canada reported operational and organizational changes since January 1, 2012. Details concerning the changes reported are presented in table IV-8.

Table IV-8
CSPV products: Reported changes in operations by producers in Canada, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Canadian producers were asked whether they anticipated changes in the character of their operations relating to CSPV products in the future. Two producers in Canada (***) reported that they do not anticipate any changes in the character of their CSPV operations, whereas two firms reported the following details presented in table IV-9 concerning the anticipated changes.

Table IV-9
CSPV products: Canadian producers’ anticipated changes in operations

* * * * * * *

Operations on CSPV cells

There was no reported production of CSPV cells in Canada.

Operations on CSPV modules

Canadian capacity, production, and total shipments for CSPV module operations generally increased from 2012 to 2016 (table IV-10). Capacity and production increased by 69.1 and 74.9 percent, respectively, from 2012 to 2016, and the capacity utilization for firms producing CSPV modules in Canada ranged from 53.5 to 82.9 percent during 2012-16. Firm projections indicate that capacity, production, and capacity utilization in Canada are expected to decline from 2016 to 2018. Inventories of CSPV modules declined during 2012-16 and a further decline is projected during 2017-18. Home market shipments, which accounted for *** percent of total shipments by the Canadian producers in 2016, increased during 2012-14, but declined in 2015 and 2016 to a level that was *** percent below that reported in 2012. Firms' projections indicate that home market shipments are expected to decline further in 2017 and 2018. Conversely, exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the Canadian producers in 2016, fluctuated upward from 2012 to *** kW in 2016, higher than reported in 2012. Firms project that exports to the United States in 2017 and 2018 will decline. Export markets other than the United States for CSPV modules produced in Canada accounted for *** percent of the responding Canadian producers' total shipments in 2016. Other major export markets identified by producers in Canada for CSPV modules include ***.

Home market

All four responding module producers in Canada indicated that they compete with imports in the home market and noted that the trend in home market competition with imports has either fluctuated or increased since January 1, 2012. Explanations for the trend in home market competition with imports include the following:

*   *   *   *   *   *   *

Export markets

Producers of CSPV modules in Canada were asked to identify export markets other than the United States that they have developed or where they have increased sales since January 1, 2012. These other major export markets include the following: ***. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in Canada.[17] Export data compiled by the Global Trade Atlas ("GTA") for Canada are not presented in this report because data specific to PV products are not available.

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[17] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Table IV-10
CSPV modules: Data on the industry in Canada, 2012-16 and projected 2017-18

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	553,000	707,000	851,000	875,000	935,000	744,000	744,000
Production	296,019	423,493	648,114	725,151	517,719	254,000	280,250
End-of-period inventories	***	***	***	***	***	***	***
Shipments: Home market shipments: Internal consumption/ Transfers	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Total home market Shipments	***	***	***	***	***	***	***
Export shipments to: United States	***	***	***	***	***	***	***
European Union[1]	***	***	***	***	***	***	***
All other markets[2]	***	***	***	***	***	***	***
Total exports	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***
	Ratios and shares (percent)						
Capacity utilization	53.5	59.9	76.2	82.9	55.4	34.1	37.7
Inventories/production	***	***	***	***	***	***	***
Inventories/total shipments	***	***	***	***	***	***	***
Share of shipments: Home market shipments: Internal consumption/ Transfers	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Total home market shipments	***	***	***	***	***	***	***
Export shipments to: United States	***	***	***	***	***	***	***
European Union[1]	***	***	***	***	***	***	***
All other markets[2]	***	***	***	***	***	***	***
Total exports	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

[1] European Union country markets include ***.

[2] Other markets include ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Global relationships

Canadian CSPV module manufacturers maintain corporate and other arms-length supply chain relationships in several other countries (table IV-11). Although there is no CSPV cell manufacturing conducted in Canada, according to data collected in this investigation, *** percent of total global CSPV cell production was conducted by firms that share a corporate or arms-length supplier relationship with the Canadian module assemblers in 2016. In addition, *** percent of total global CSPV module assembly was conducted by Canadian module assemblers together with companies in other countries that share a corporate or arms-length supplier relationship with the Canadian firms.

Table IV-11
CSPV products: Canadian module assemblers' global connections, 2012-16

* * * * * * *

Mexico

Overview

The Commission issued foreign producer questionnaires to 13 firms believed to produce CSPV products in Mexico. Three firms in Mexico responded to the Commission's questionnaire with useable information, accounting for approximately *** percent of module capacity in Mexico in 2016. No producers of CSPV cells in Mexico provided a response to the Commission's questionnaire. Table IV-12 lists the Mexican producers of CSPV modules that responded to the Commission's questionnaire and certain summary data for the period January 2012 through December 2016 reported in those responses.

Table IV-12
CSPV products: Summary data on firms in Mexico, January 2012 through December 2016

* * * * * * *

Changes in operations

The responding producers in Mexico reported operational and organizational changes since January 1, 2012. Details concerning the changes reported are presented in table IV-13.

Table IV-13
CSPV products: Mexican producers' reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

The Commission also asked the Mexican producers to report anticipated changes in the character of their operations relating to CSPV products in the future. Two producers in Mexico reported that they do not anticipate any changes in the character of their CSPV operations, whereas one firm reported the following details presented in table IV-14 concerning the anticipated changes.

Table IV-14
CSPV products: Mexican producers' anticipated changes in operations

* * * * * * *

Operations on CSPV cells

The three responding producers/exporters of CSPV modules in Mexico did not report any production of CSPV cells. Publicly available information indicates that i3 Group, a holding company, is the only manufacturer of CSPV cells in Mexico, which are produced via its subsidiaries. The firm's production has expanded over time with the acquisition and importation of PV production lines previously owned by European producers. One subsidiary reported production capacity of 250 MW, though it is not clear if this is for CSPV cells, modules, or both and if it only includes production in Mexico. The combined cell production capacity of the two plants acquired in 2013 and 2014 was likely greater than 150 MW at that time.[18]

Operations on CSPV modules

Publicly available information indicates that there were at least five producers of CSPV modules in Mexico as of the end of 2016. Total production capacity at these plants is more than 1,500 MW. The largest producer is SunPower with an annual capacity greater than 1,000 MW,

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[18] Manufacturer, "Desde México, Solartec se Abre Paso Por el Mundo," August 10, 2016, http://www.manufactura.mx/industria/2016/08/10/desde-mexico-solartec-se-abre-paso-por-el-mundo; Solartec Website, http://solartec.mx/index.php, accessed July 13, 2017; Fredrick, James, "Mexican Solar Manufacturer Looks to Compete Abroad," BN Americas, March 22, 2013, https://www.bnamericas.com/en/interviews/electricpower/miguel-medina-aguilar-solartec?position=1&aut=true&idioma=en; El Fianciero, "Solartec Adquiere Activos de Bosch Solar," July 21, 2014, http://www.elfinanciero.com.mx/empresas/solartec-adquiere-activos-de-bosch-solar.html; Fredrick, James, "Mexico's Solarcell to Produce 75MW Cells Annually," BN Americas, March 21, 2013, https://www.bnamericas.com/en/news/electricpower/mexicos-solarcell-to-produce-75mw-cells-annually; Fredrick, James, "Mexico's First Solar Cell Plant Delays Startup, Decreases Capacity," BN America, October 15, 2013, https://www.bnamericas.com/en/news/electricpower/mexicos-first-solar-cell-plant-delays-startup-decreases-capacity.

but at least three other producers have more than 100 MW of annual production capacity.[19] In August 2016, SunPower announced that it would close its module assembly plant in the Philippines and move production tools to Mexico, which would increase annual capacity in Mexico to 2 GW.[20]

Three companies closed module plants in Mexico during 2012-16. Panasonic closed its 50 MW module plant in 2012, Siliken closed its 75 MW module plant in 2012, and Kyocera closed its 300 MW module plant in 2016.[21]

Several other firms produced modules in Mexico on a contract basis during 2012-16, but have closed or the status of their manufacturing operations is unclear. Flex Limited started production of modules in Mexico in 2015 for SunEdison, but the subsequent bankruptcy of SunEdison led to the end of manufacturing for this partner.[22] Information is not available on whether the firm manufactures in Mexico for any other companies. Production capacity at the plant was approximately 400 MW.[23] Other contract manufacturers that announced production

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[19] These data do not include plants that closed during 2016. IUSASOL Website, http://www.iusasol.mx/Home/why_us, accessed July 13, 2017; Manufacturer, "Desde México, Solartec se Abre Paso Por el Mundo," August 10, 2016, http://www.manufactura.mx/industria/2016/08/10/desde-mexico-solartec-se-abre-paso-por-el-mundo; Solartec Website, http://solartec.mx/index.php (accessed July 13, 2017); Solarvatio Website, http://solarvatio.com/energy/proceso/, accessed July 13, 2017; ERDM Website, http://stores.erdm-solar.com/About-Us.html (accessed July 13, 2017); SunPower, "SunPower Awarded Approximately 500 Megawatts of Solar in Mexico's First Electricity Auction," News release, April 1, 2016, http://newsroom.sunpower.com/2016-04-01-SunPower-Awarded-Approximately-500-Megawatts-of-Solar-in-Mexicos-First-Electricity-Auction.

[20] Osborne, Mark, "SunPower Streamlining Project Development Focus and Closing Module Assembly Plant," *PV Tech*, August 9, 2016, https://www.pv-tech.org/news/sunpower-streamlining-project-development-focus-and-closing-module-assembly.

[21] USITC Publication 4519, p. VII-35; USITC Publication 4360, p. VII-17; Dennis, William, "Panasonic Consolidates Solar Panel Production," *Engineering and Technology*, August 23, 2012, https://prod-eandt.theiet.org/content/articles/2012/08/panasonic-consolidates-solar-panel-production/; Stromsta, Karl-Erik, "Siliken Shuts Doors at Mexican PV Plant After Just 16 Months," *Recharge*, September 6, 2012, http://www.rechargenews.com/solar/840385/siliken-shuts-doors-at-mexican-pv-plant-after-just-16-months; Nikkei Asian Review, "Kyocera Profit Seen Slumping 18% for Fiscal 2016," January 18, 2017, http://asia.nikkei.com/Markets/Tokyo-Market/Kyocera-profit-seen-slumping-18-for-fiscal-2016; Romero-Hernandez, Sergio et al., "Solar Energy Potential in Mexico's Northern Border States," Woodrow Wilson International Center, July 2012, p. 8.

[22] Osborne, Mark, "Flextronics to Produce Solar Modules for SunEdison in Mexico," *PV Tech*, April 7, 2015, https://www.pv-tech.org/news/flextronics_to_produce_solar_modules_for_sunedison_in_mexico; Osborne, Mark, "Flex Confirms Solar Business with SunEdison Went From US$500 Million to Zero," *PV Tech*, January 27, 2017, https://www.pv-tech.org/news/flex-confirms-solar-business-with-sunedison-went-from-us500-million-to-zero.

[23] Grajeda, Jose, "Ciudad Juarez Dominates Solar Panel Manufacturing in Mexico," August 4, 2015, https://www.tecma.com/solar-panel-manufacturing-in-mexico-is-dominant-in-ciudad-juarez/.

plants in Mexico but may no longer actively produce CSPV products include Jabil Circuit and Foxconn subsidiary Fox Energy.[24]

The three responding Mexican producers' reported capacity, production, capacity utilization, and shipments generally increased from 2012 to 2016 (table IV-15).[25] Capacity and production increased by *** percent and *** percent, respectively, from 2012 to 2016, and the capacity utilization for firms producing CSPV modules in Mexico ranged from *** percent to *** percent during 2012-16. The responding Mexican producers project capacity, production, and capacity utilization to increase in 2017-18. Inventories of CSPV modules held by these three firms in Mexico have fluctuated over the period, but were *** percent higher in 2016 compared with 2012. Aggregate home market sales, which accounted for *** percent of total shipments by the Mexican producers in 2016, increased by *** percent during 2012-16. Meanwhile, exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the Mexican producers in 2016, increased by *** percent from *** kW in 2012 to *** kW in 2016. Responding firms project further increases in exports to the United States during 2017 and 2018, although they project that the exports to the United States will account for a smaller share of total shipments, declining from *** percent of total shipments in 2016 to *** percent in 2018. Export markets other than the United States for CSPV modules produced in Mexico accounted for between *** percent and *** percent of the responding Mexican producers' total shipments since 2012, although responding firms project that these exports will account for a larger share of their total shipments during 2017-18. Other major export markets identified by producers in Mexico for CSPV modules include ***.

Table IV-15
CSPV modules: Data on the industry in Mexico, 2012-16 and projected 2017-18

* * * * * * *

Home market

Producers of CSPV products in Mexico were asked whether they compete with imports of CSPV products in their home market. ***, which reported *** shipments of CSPV products to the home market during the period of investigation, and ***, which reported ***, indicated that they do not compete with imports in the home market. ***, which reported *** shipments of CSPV products were to the home market during the period of investigation, indicated that it competes with imports in the home market and commented on "unfair competition from China," although it noted that the trend in home market competition with imports has decreased since January 1, 2012.

[24] USITC Publication 4519, p. VII-35.
[25] Two producers/exporters in Mexico responded to the Commission's questionnaire in this proceeding.

Export markets

Producers of CSPV products in Mexico were asked to identify export markets other than the United States that they have developed or where they increased sales since January 1, 2012. *** reported that it has not developed any other export market other than the United States. *** reported that their other major export markets include the following: ***. There were no trade barriers identified in this investigation with respect to certain CSPV products originating in Mexico.[26] Export data compiled by GTA for Mexico are not presented in this report because the PV-specific data do not appear to capture all exports of PV products.

The industries in Asia

China

Market

China was the largest PV global market in 2016, with installations increasing from 3.2 GW in 2012 to 34.5 GW in 2016.[27] China's feed-in tariff ("FIT") is one of the main policies that the government has used to encourage domestic solar installations. China's FIT establishes a rate for PV-generated electricity, with this rate varying by region and type of installation (distributed and ground mounted). FIT rates have been revised downward several times since the start of 2012, including in 2013, 2016, and 2017.[28]

Downward revisions in the FIT rates (which did not always occur at the same time of year during 2012-16) have periodically led to a spike in installations as developers seek to complete projects in time to receive the higher rates. In 2013, for example, installations increased in the second half of the year as developers sought to complete projects before the

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[26] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

[27] Lv Fang, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2015," IEA PVPS, n.d., p. 4, http://www.iea-pvps.org/?id=93; IEA, PVPS, 2016 Snapshot of Global Photovoltaic Markets, Report IEA PVPS T1-31:2017, 2017, 4, 10, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf.

[28] The FIT for distributed systems was implemented in 2013. Zhu, Joseph, "China Feed-In Tariff Brings Solar Shares Higher," Seeking Alpha, September 11, 2013, https://seekingalpha.com/article/1686722-china-feed-in-tariff-brings-solar-shares-higher; EnergyTrend, "China's 2016 FiT Rates Lower than Expectation," December 17, 2015, http://pv.energytrend.com/news/China_2016_FiT_Rates_Lower_than_Expectation.html; Frank Xie and Josefin Berg, "China Confirms 2017 PV FiT Rates - Growing concerns Over 2016 PV Installations," IHS Markit, January 10, 2017, https://www.pv-tech.org/news/china-trials-wind-and-solar-certificate-scheme-in-move-away-from-feed-in-ta.

end of the year in order to receive the higher FIT rate.[29] According to Bloomberg New Energy Finance, *** percent of large-scale projects installed during 2013 were completed in the ***.[30]

In December 2015, China announced lower FIT rates for 2016. However, projects approved by regional governments in 2015 or meeting certain other criteria were eligible for the higher 2015 rate as long as they were completed by the end of June 2016.[31] This led to higher installations in the first half of the year as developers sought to complete projects in time to receive the higher FIT rate.[32] Of China's 34.5 GW installed in 2016, more than 20 GW was completed in the first half of the year (figure IV-5).[33] China also revised the FIT downward in 2017, but approved projects could receive the higher prior year rate if completed by June 30.[34] China installed 24.4 GW in the first half of 2017 and another 10.5 GW in July 2017, but is forecast to install only 5 to 10 GW in the remainder of 2017.[35]

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[29] Haugwitz, Frank, "Will China's Next Five-year Plan be the Initial Phase of its Energy Transition?" *PV Tech*, December 17, 2015, https://www.pv-tech.org/guest-blog/will-chinas-next-five-year-plan-be-the-initial-phase-of-its-energy-transiti.

[30] ***. Bloomberg New Energy Finance database, https://www.bnef.com (accessed August 22, 2017).

[31] EnergyTrend, "China's 2016 FiT Rates Lower than Expectation," December 17, 2015, http://pv.energytrend.com/news/China_2016_FiT_Rates_Lower_than_Expectation.html.

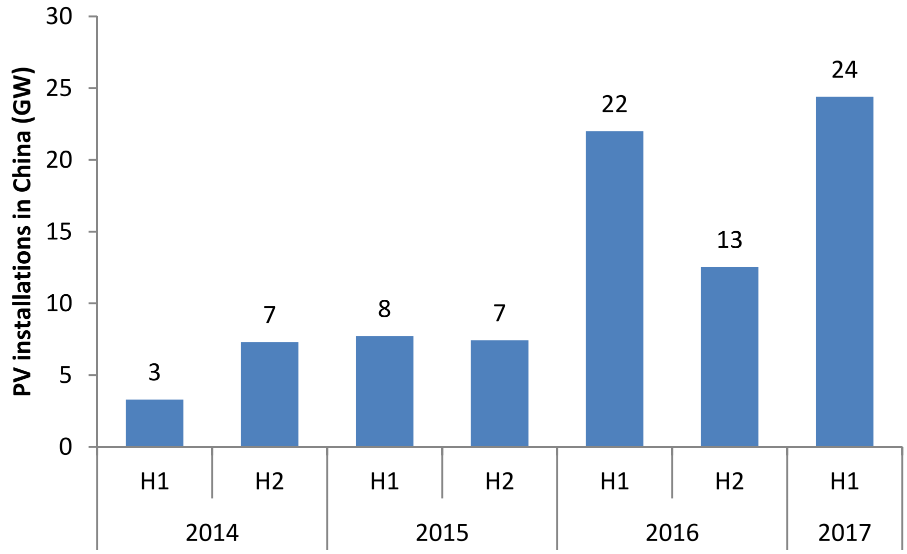
[32] Reuters, "China Installed 20 GW of Solar Power in First-half; Triple from a Year Ago," July 22, 2016, http://www.reuters.com/article/us-china-solar-idUSKCN1020P7; Deign, Jason, "Why China's Solar Market Won't Have Another Year Like 2016," Greentech Media, June 5, 2017, https://www.greentechmedia.com/articles/read/why-chinas-solar-market-wont-have-another-year-like-2016.

[33] China's National Energy Administration (NEA) reported that the total was 22 GW, but various contemporaneous media reports indicated that the total might have been lower. ***. Parnell, John, "China's PV grid connections hit 22GW in H1 2016," *PV Tech*, July 26, 2016, https://www.pv-tech.org/news/44394; IEA, PVPS, *2016 Snapshot of Global Photovoltaic Markets*, Report IEA PVPS T1-31:2017, 2017, 4, 10, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf; Bloomberg New Energy Finance database, https://www.bnef.com (accessed August 22, 2017).

[34] Xie, Frank and Josefin Berg, "China Confirms 2017 PV FiT Rates - Growing concerns Over 2016 PV Installations," IHS Markit, January 10, 2017, https://www.pv-tech.org/news/china-trials-wind-and-solar-certificate-scheme-in-move-away-from-feed-in-ta.

[35] Hutchins, Mark, "AECEA: China Installations to Surpass 40 GW in 2017," PV Magazine, August 22, 2017, https://www.pv-magazine.com/2017/08/22/aecea-china-installations-to-surpass-40-gw-in-2017/.

Figure IV-5
Chinese PV installations, 2014 to 1st half 2017



Source: *Bloomberg News*, "China Adds Australia-Sized Solar Capacity in Energy Push," August 7, 2014, https://www.bloomberg.com/news/print/2014-08-07/china-add-australia-sized-solar-capacity-in-energy-push.html; Meza, Edgar, "China Increases Solar Installation Target for 2015," *PV Magazine*, October 9, 2015, https://www.pv-magazine.com/2015/10/09/china-increases-solar-installation-target-for-2015_100021478/; Parnell, John, "China's PV grid connections hit 22GW in H1 2016," *PV Tech*, July 26, 2016, https://www.pv-tech.org/news/44394; Clover, Ian "China Installed 24.4 GW of Solar in First Half of 2017, Shows Official NEA Data," *PV Magazine*, August 7, 2017, https://www.pv-magazine.com/2017/08/07/china-installed-24-4-gw-of-solar-in-first-half-of-2017-shows-official-nea-data/; IEA, PVPS, *2016 Snapshot of Global Photovoltaic Markets*, Report IEA PVPS T1-31:2017, 2017, 4, 10, http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf; Lv Fang, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2015," IEA PVPS, n.d., p. 4, http://www.iea-pvps.org/?id=93.
Note: H1: 1st half of the year; H2: 2nd half of the year. Data start from 2014 as first and second half installation data for 2013 were not readily available.

China has implemented a number of other policies to encourage PV installations. For example, the Solar Poverty Alleviation program provides financial support for low-income households to purchase solar modules and guarantees a set rate for excess electricity sent to the electric grid.[36] The Top Runner Program, which was introduced in 2015, is a reverse auction designed to support the installation, and therefore the development and production, of more advanced solar technologies. Modules installed as part of the program must met certain minimum energy efficiency levels.[37]

Overview of data collection

The Commission issued foreign producer questionnaires to 274 firms believed to produce CSPV products in China. Thirty-five firms in China responded to the Commission's questionnaire with useable information, accounting for approximately 57 percent of total CSPV cell production and 67 percent of total CSPV module production in China in 2016. Table IV-16 lists the Chinese producers of CSPV products that responded to the Commission's questionnaire and certain summary data reported in those responses.

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[36] Deign, Jason, "Why China's Solar Market Won't Have Another Year Like 2016," Greentech Media, June 5, 2017, https://www.greentechmedia.com/articles/read/why-chinas-solar-market-wont-have-another-year-like-2016; EnergyTrend, "PV Poverty Alleviation Projects will Boom in China," June 20, 2016, http://pv.energytrend.com/news/PV_Poverty_Alleviation_Projects_will_Boom_in_China.html.

[37] Longi, "Assisted by the Top Runner Program, the Mono-crystalline Market Share in China Rising to 25%," News release, September 30, 2016, http://en.longigroup.com/content/details53_1303.html; GCL, "GCL System Received CQC's 'TOP Runner' Program Level-One Energy Efficiency Certification in China," News release, April 25, 2016, http://www.prnewswire.com/news-releases/gcl-system-received-cqcs-top-runner-program-level-one-energy-efficiency-certification-in-china-300256475.html; EnergyTrend, "Analysis on China's Top Runner Program: Mono-si Products Obtain Advantage, Company Brand Image Enhanced," July 8, 2017, http://pv.energytrend.com/research/Analysis_on_China_Top_Runner_Program.html; Benjamin Attia and Yongyong Ji, "The Top Runner Program as a Driver of Competitive, High-Efficiency Utility-Scale Demand in China," GTM Research, July 2017, https://www.greentechmedia.com/research/report/the-top-runner-program-as-a-driver-of-demand-in-china.

Table IV-16
CSPV products: Summary data on firms in China, January 2012 through December 2016, by product type

Firm	Production (kW)	Share of reported production (percent)	Exports to the United States (kW)	Share of reported exports to the United States (percent)	Total shipments (kW)	Share of firm's total shipments exported to the United States (percent)
CSPV cells:						
Anji DaSol	***	***	***	***	***	***
Canadian Solar	***	***	***	***	***	***
Changzhou Trina	***	***	***	***	***	***
Chint Zheijiang	***	***	***	***	***	***
Cixi Rixing	***	***	***	***	***	***
Delsolar WuJiang	***	***	***	***	***	***
ET Solar	***	***	***	***	***	***
GCL System	***	***	***	***	***	***
Hanwha Qidong	***	***	***	***	***	***
Hengdian DMEGC	***	***	***	***	***	***
Jiawei Solar	***	***	***	***	***	***
Jinizhou Huachang	***	***	***	***	***	***
Jinko Solar	***	***	***	***	***	***
Jolywood Suzhou	***	***	***	***	***	***
Lightway Green	***	***	***	***	***	***
Longi Solar	***	***	***	***	***	***
Neo Solar	***	***	***	***	***	***
Ningbo Komaes	***	***	***	***	***	***
Risen Energy	***	***	***	***	***	***
Shanghai BYD	***	***	***	***	***	***
Shanghai JA Solar	***	***	***	***	***	***
ShenZhen Jiawei	***	***	***	***	***	***
Shenzhen Sungold	***	***	***	***	***	***
Shenzhen Topray	***	***	***	***	***	***
Star Power	***	***	***	***	***	***
Sumec Hardware	***	***	***	***	***	***
Suzhou Talesun	***	***	***	***	***	***
Wanxiang Solar	***	***	***	***	***	***
Wuhan FYY	***	***	***	***	***	***
Wuxi Suntech	***	***	***	***	***	***
Wuxi Tianran	***	***	***	***	***	***
Yingli Green	***	***	***	***	***	***
Zhejiang Era	***	***	***	***	***	***
Total	94,190,736	100.0	***	***	***	***

Table continued on following page.

Table IV-16—Continued
CSPV products: Summary data on firms in China, January 2012 to December 2016, by product type

Firm	Production (kW)	Share of reported production (percent)	Exports to the United States (kW)	Share of reported exports to the United States (percent)	Total shipments (kW)	Share of firm's total shipments exported to the U.S. (percent)
CSPV modules:						
Anji DaSol	***	***	***	***	***	***
Canadian Solar	***	***	***	***	***	***
Changzhou Trina	***	***	***	***	***	***
Chint Zheijiang	***	***	***	***	***	***
Cixi Rixing	***	***	***	***	***	***
Delsolar WuJiang	***	***	***	***	***	***
ET Solar	***	***	***	***	***	***
GCL System	***	***	***	***	***	***
Hanwha Qidong	***	***	***	***	***	***
Hengdian DMEGC	***	***	***	***	***	***
Jiawei Solar	***	***	***	***	***	***
Jinizhou Huachang	***	***	***	***	***	***
Jinko Solar	***	***	***	***	***	***
Jolywood Suzhou	***	***	***	***	***	***
Lightway Green	***	***	***	***	***	***
Longi Solar	***	***	***	***	***	***
Neo Solar	***	***	***	***	***	***
Ningbo Komaes	***	***	***	***	***	***
Risen Energy	***	***	***	***	***	***
Shanghai BYD	***	***	***	***	***	***
Shanghai JA Solar	***	***	***	***	***	***
ShenZhen Jiawei	***	***	***	***	***	***
Shenzhen Sungold	***	***	***	***	***	***
Shenzhen Topray	***	***	***	***	***	***
Star Power	***	***	***	***	***	***
Sumec Hardware	***	***	***	***	***	***
Suzhou Talesun	***	***	***	***	***	***
Wanxiang Solar	***	***	***	***	***	***
Wuhan FYY	***	***	***	***	***	***
Wuxi Suntech	***	***	***	***	***	***
Wuxi Tianran	***	***	***	***	***	***
Yingli Green	***	***	***	***	***	***
Zhejiang Era	***	***	***	***	***	***
Total	115,123,001	100.0	***	***	112,885,289	***

Note.--Foreign producer data on module assembly does not necessarily equate to the country-of-origin classification used for U.S. import statistics. Most China module assemblers use Chinese or Taiwanese-origin CSPV cells.

Source: Compiled from data submitted in response to Commission questionnaires.

Foreign capacity expansions by leading Chinese firms

Based on questionnaire responses, the six largest firms[38] producing CSPV cells and modules in China increased their global capacity to produce CSPV cells by *** percent over the period to *** kW in 2016 (table IV-17). These six firms accounted for *** percent of reported global cell capacity in 2016, up from *** percent in 2012. Capacity increased in China by *** percent for these six firms during 2012-16 to *** kW. Four of the six firms added cell manufacturing capacity in one or more of the following five countries during the period of investigation: Korea, Malaysia, the Netherlands, Thailand, and Vietnam. Cell capacity in these five countries grew by *** percent during the period, from *** kW to *** kW.

[38] Canadian Solar, Hanwha, JA Solar, Jinko, Trina, and Yingli Green. Hanwha is based in Korea, but *** of its cell and module production occurred in China. Hanwha's first large scale entry into the solar business was via its 2010 acquisition of 49.99 percent of Solarfun, a Chinese firm that was at the time the fourth largest module producer in China. In 2012, Hanwha acquired bankrupt German manufacturer QCells, which had production in Germany and Malaysia. Reuters, "Hanwha Chem to buy 50 percent of Solarfun for $370 million," August 3, 2010, http://www.reuters.com/article/us-hanwha-solarfun-idUSTRE6724RS20100803; Hanwha, "Hanwha Chemical Acquires 49.99% Stake in Solarfun Power," News release, August 3, 2010, http://www.hanwha.com/en/news_and_media/press_release/hanwha_chemical_acquires_49_99_stake_in_solarfun_power.html; Hanwha, "Hanwha Acquires Q.CELLS, One of the World's Leading Photovoltaics Companies," News release, August 30, 2012, http://www.hanwha.com/en/news_and_media/press_release/hanwha_acquires_q_cells_one_of_the_worlds_leading_photovoltaics_companies.html.

Table IV-17

CSPV products: Cell capacity for largest Chinese producers regardless of global location, 2012-16

Item	Calendar year 2012	2013	2014	2015	2016
	Quantity (kW)				
Global capacity to produce cells by.-- Canadian solar	***	***	***	***	***
Canadian Solar (China)	***	***	***	***	***
Canadian Solar (Canada)	***	***	***	***	***
Canadian Solar (Malaysia)	***	***	***	***	***
Canadian Solar (Thailand)	***	***	***	***	***
Canadian Solar (Vietnam)	***	***	***	***	***
Canadian Solar (Indonesia)	***	***	***	***	***
Hanwha	***	***	***	***	***
Hanwha (Korea)	***	***	***	***	***
Hanwha (Germany)	***	***	***	***	***
Hanwha Qidong (China)	***	***	***	***	***
Hanwha (Canada)	***	***	***	***	***
Hanwha HongKong (China)	***	***	***	***	***
Hanwha (Malaysia)	***	***	***	***	***
JA Solar	***	***	***	***	***
Shanghai JA Solar (China)	***	***	***	***	***
JA Solar (Malaysia)	***	***	***	***	***
Jinko	***	***	***	***	***
Jinko Solar (China)	***	***	***	***	***
Jinko Solar (Malaysia)	***	***	***	***	***
Trina	***	***	***	***	***
Changzhou Trina (China)	***	***	***	***	***
Trina Solar (Netherlands)	***	***	***	***	***
Trina Solar (Thailand)	***	***	***	***	***
Trina Solar (Vietnam)	***	***	***	***	***
Yingli Green	***	***	***	***	***
Subtotal	***	***	***	***	***
All other firms	***	***	***	***	***
Total cell capacity	27,337,286	31,220,500	36,439,876	43,341,003	56,877,024
	Share of quantity (percent)				
Global capacity to produce cells by.-- Canadian solar	***	***	***	***	***
Hanwha	***	***	***	***	***
JA Solar	***	***	***	***	***
Jinko	***	***	***	***	***
Trina	***	***	***	***	***
Yingli Green	***	***	***	***	***
Subtotal	***	***	***	***	***
All other firms	***	***	***	***	***
Total cell capacity	100.0	100.0	100.0	100.0	100.0

Source: Compiled from data submitted in response to Commission questionnaires.

With respect to modules, these same six firms reported a ***-percent increase in global capacity to produce CSPV modules over the period to *** kW in 2016 (table IV-18). Their capacity increased in China by *** percent during 2012-16 to *** kW. Four of the six firms added module production capacity in one or more of the following six countries during the period of investigation: Canada, Indonesia, Korea, Malaysia, Thailand, and Vietnam.[39] Module capacity in these six countries grew from *** kW in 2012 to *** kW in 2016. Except for a ***, none of the six largest module manufacturers in China had established any module production capacity in any of these six countries prior to 2015.

[39] The data presented here only include internal production capacity added in these countries. These firms have also expanded production capacity in foreign countries through the use of contract manufacturers. For example, Flex Ltd opened a 360 MW module plant in Brazil to make modules for Canadian Solar. Trina Solar opened a cell plant in Vietnam, but reportedly contracted with Vina Solar for module assembly. Kenning, Tom, "Canadian Solar and Flextronics Partner on 360MW Module Factory in Brazil," PV Tech, June 20, 2016, https://www.pv-tech.org/news/canadian-solar-and-flextronics-partner-on-360mw-module-factory-in-brazil; EnergyTrend, "Vina Solar Wins Cooperations with GCL-SI and Trina Solar for 1.6GW of Solar Cell Capacity," January 19, 2017, http://pv.energytrend.com/news/Vina_Solar_Wins_Cooperations_with_GCL_SI_and_Trina_Solar.html.

Table IV-18

CSPV products: Module assembly capacity for largest Chinese producers regardless of global location, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kW)				
Global capacity to assemble modules by.-- Canadian solar	***	***	***	***	***
Canadian Solar (China)	***	***	***	***	***
Canadian Solar (Canada)	***	***	***	***	***
Canadian Solar (Malaysia)	***	***	***	***	***
Canadian Solar (Thailand)	***	***	***	***	***
Canadian Solar (Vietnam)	***	***	***	***	***
Canadian Solar (Indonesia)	***	***	***	***	***
Hanwha	***	***	***	***	***
Hanwha (Korea)	***	***	***	***	***
Hanwha (Germany)	***	***	***	***	***
Hanwha Qidong (China)	***	***	***	***	***
Hanwha (Canada)	***	***	***	***	***
Hanwha HongKong (China)	***	***	***	***	***
Hanwha (Malaysia)	***	***	***	***	***
JA Solar	***	***	***	***	***
Shanghai JA Solar (China)	***	***	***	***	***
JA Solar (Malaysia)	***	***	***	***	***
Jinko	***	***	***	***	***
Jinko Solar (China)	***	***	***	***	***
Jinko Solar (Malaysia)	***	***	***	***	***
Trina	***	***	***	***	***
Changzhou Trina (China)	***	***	***	***	***
Trina Solar (Netherlands)	***	***	***	***	***
Trina Solar (Thailand)	***	***	***	***	***
Trina Solar (Vietnam)	***	***	***	***	***
Yingli Green	***	***	***	***	***
Subtotal	***	***	***	***	***
All other firms	***	***	***	***	***
Total module assembly capacity	25,220,429	29,175,177	36,411,804	47,912,657	66,611,870
	Share of quantity (percent)				
Global capacity to assemble modules by.-- Canadian solar	***	***	***	***	***
Hanwha	***	***	***	***	***
JA Solar	***	***	***	***	***
Jinko	***	***	***	***	***
Trina	***	***	***	***	***
Yingli Green	***	***	***	***	***
Subtotal	***	***	***	***	***
All other firms	***	***	***	***	***
Total module assembly capacity	100.0	100.0	100.0	100.0	100.0

Source: Compiled from data submitted in response to Commission questionnaires.

Changes in operations

Of the responding 35 producers in China, 27 firms reported operational or organizational changes since January 1, 2012. Details concerning the changes reported are presented in table IV-19.

Table IV-19
CSPV products: Reported changes in operations by producers in China, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products, 27 firms reported that they do not anticipate any changes, whereas 8 firms reported the following details presented in table IV-20 concerning the anticipated changes.

Table IV-20
CSPV products: Chinese producers' anticipated changes in operations

* * * * * * *

Operations on CSPV cells

According to publicly available information, China's production of CSPV cells increased from 21 GW in 2012 to 49 GW in 2016. CSPV cell production capacity totaled 53 GW in 2015 (the latest year available), up from more than 40 GW in 2012.[40] CSPV cell capacity, production, capacity utilization, inventories, and shipments as reported by Chinese firms responding to the Commission's questionnaire in this investigation generally increased from 2012 to 2016 (table IV-21). Capacity and production increased by 98.4 and 149.7 percent, respectively, from 2012 to 2016, and the capacity utilization for firms producing CSPV cells in China increased from 66.6 percent in 2012 to 83.8 percent in 2016. Likewise, inventories of CSPV cells increased by 301.5 percent during 2012-16. Further increases in these indicators are projected during 2017 and 2018.

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[40] National Survey Report of PV Power Applications in China 2012, International Energy Agency Co-Operative Programme on Photovoltaic Power Systems, July 16, 2013, http://www.iea-pvps.org/?id=93; National Survey Report of PV Power Applications in China 2015, International Energy Agency, Photovoltaic Power Systems Programme, http://www.iea-pvps.org/?id=93; Liu Yuanyuan, "China's Solar PV Industry Saw Continued Recovery in 2016," *Renewable Energy World*, March 31, 2017, http://www.renewableenergyworld.com/articles/2017/03/china-s-solar-pv-industry-saw-continued-recovery-in-2016.html.

Table IV-21
CSPV cells: Data on industry in China, 2012-16 and projected 2017 and 2018

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	16,698,039	19,299,708	22,186,285	26,457,091	33,133,986	39,838,953	42,936,065
Production	11,124,972	14,027,686	18,537,642	22,720,444	27,779,992	33,929,420	37,287,607
End-of-period inventories	337,542	515,034	889,532	792,602	1,355,270	1,436,005	1,560,587
Shipments: Home market shipments: Internal consumption/ transfers	9,674,468	11,896,126	16,131,422	18,760,718	24,213,257	29,589,168	32,215,243
Commercial home market shipments	1,003,794	1,162,736	1,175,209	3,502,607	2,551,812	3,136,876	3,245,012
Total home market shipments	10,678,262	13,058,862	17,306,631	22,263,325	26,765,069	32,726,044	35,460,255
Export shipments to: United States[1]	***	***	***	***	***	***	***
European Union[2]	***	***	***	***	***	***	***
All other markets[3]	***	***	***	***	***	***	***
Total exports	404,262	810,543	871,646	519,073	504,106	1,153,448	1,735,693
Total Shipments	11,082,524	13,869,405	18,178,277	22,782,398	27,269,175	33,879,492	37,195,948
	Ratios and shares (percent)						
Capacity utilization	66.6	72.7	83.6	85.9	83.8	85.2	86.8
Inventories/production	3.0	3.7	4.8	3.5	4.9	4.2	4.2
Inventories/total shipments	3.0	3.7	4.9	3.5	5.0	4.2	4.2
Share of shipments: Home market shipments: Internal consumption/ transfers	87.3	85.8	88.7	82.3	88.8	87.3	86.6
Commercial home market shipments	9.1	8.4	6.5	15.4	9.4	9.3	8.7
Total home market shipments	96.4	94.2	95.2	97.7	98.2	96.6	95.3
Export shipments to: United States[1]	***	***	***	***	***	***	***
European Union[2]	***	***	***	***	***	***	***
All other markets[3]	***	***	***	***	***	***	***
Total exports	3.6	5.8	4.8	2.3	1.8	3.4	4.7
Total shipments	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Antidumping and countervailing duty orders associated with the *CSPV 1* investigations became effective December 7, 2012. Antidumping and countervailing duty orders associated with the *CSPV 2* investigations became effective February 18, 2015.
[2] European Union country markets include ***.
[3] Other markets include ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Home market shipments of CSPV cells (including internal consumption and commercial home market sales), which accounted for 98.2 percent of total shipments by the Chinese producers in 2016, increased by 150.7 percent during the period. Conversely, exports of CSPV cells to the United States, which accounted for *** percent of total shipments by the Chinese producers in 2016, declined from *** kW to *** kW (or by *** percent) during 2012-16. Responding firms project that there will be *** exports of CSPV cells from China to the United States during 2017 and 2018. Export markets other than the United States for CSPV cells produced in China accounted for *** percent of the responding Chinese producers' total shipments in 2016. Other major export markets identified by producers in China for CSPV cells include ***.

Operations on CSPV modules

Publicly available information indicates that total production of CSPV modules in China reached 53 GW in 2016, more than double the 2012 production total of 23 GW.[41] Module production was relatively evenly divided between the first and second half of the year, with 27 GW produced in the first six months.[42] Maximum production capacity for CSPV modules totaled 71 GW in 2015 (the latest year available) compared to more than 40 GW of maximum capacity available to produce modules in 2012.[43]

CSPV module capacity, production, capacity utilization, inventories, and shipments as reported by Chinese producers responding to the Commission's questionnaire in this investigation generally increased from 2012 to 2016 (table IV-22). Capacity and production increased by 130.5 and 184.6 percent, respectively, from 2012 to 2016, and the capacity utilization for firms producing CSPV modules in China increased from 61.9 percent in 2012 to 82.9 percent in 2015, before declining somewhat to 76.4 percent in 2016. Likewise, inventories of CSPV modules increased by 142.2 percent during the same period. Further increases in production, capacity, and inventories of CSPV modules in China are expected during 2017 and 2018.

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[41] National Survey Report of PV Power Applications in China 2012, International Energy Agency Co-Operative Programme on Photovoltaic Power Systems, July 16, 2013, http://www.iea-pvps.org/?id=93 ; Liu Yuanyuan, "China's Solar PV Industry Saw Continued Recovery in 2016," *Renewable Energy World*, March 31, 2017, http://www.renewableenergyworld.com/articles/2017/03/china-s-solar-pv-industry-saw-continued-recovery-in-2016.html.

[42] Reuters, "China Installed 20 GW of Solar Power in First-half; Triple from a Year Ago," July 22, 2016, http://www.reuters.com/article/us-china-solar-idUSKCN1020P7.

[43] National Survey Report of PV Power Applications in China 2012, International Energy Agency Co-Operative Programme on Photovoltaic Power Systems, July 16, 2013, http://www.iea-pvps.org/?id=93; National Survey Report of PV Power Applications in China 2015, International Energy Agency, Photovoltaic Power Systems Programme, http://www.iea-pvps.org/?id=93.

Table IV-22
CSPV modules: Data on the industry in China, 2012-16 and projected 2017-18

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	20,131,407	22,767,513	27,994,412	34,715,630	46,399,800	55,038,389	78,766,489
Production	12,462,092	16,326,264	22,071,981	28,792,042	35,470,622	45,703,333	51,174,260
End-of-period inventories	996,167	1,029,494	1,862,398	1,997,237	2,412,340	2,783,744	2,999,914
Shipments: Home market shipments: Internal consumption/ transfers	968,505	2,092,486	2,523,312	3,057,385	3,520,910	6,332,468	8,201,620
Commercial home market shipments	1,487,587	3,851,669	5,210,754	9,807,680	17,165,586	21,212,011	23,345,830
Total home market shipments	2,456,092	5,944,155	7,734,066	12,865,065	20,686,496	27,544,479	31,547,450
Export shipments to: United States[1]	1,316,838	2,115,531	3,409,946	3,655,744	2,916,685	738,216	770,204
European Union[2]	4,394,209	2,953,923	2,633,524	2,157,664	858,562	1,162,273	1,012,757
All other markets[3]	3,896,496	5,323,014	7,601,138	9,812,562	10,153,579	15,889,776	17,325,548
Total exports	9,607,543	10,392,468	13,644,608	15,625,970	13,928,826	17,790,265	19,108,509
Total shipments	12,063,635	16,336,623	21,378,674	28,491,035	34,615,322	45,334,744	50,655,959
	Ratios and shares (percent)						
Capacity utilization	61.9	71.7	78.8	82.9	76.4	83.0	65.0
Inventories/production	8.0	6.3	8.4	6.9	6.8	6.1	5.9
Inventories/total shipments	8.3	6.3	8.7	7.0	7.0	6.1	5.9
Share of shipments: Home market shipments: Internal consumption/ transfers	8.0	12.8	11.8	10.7	10.2	14.0	16.2
Commercial home market Shipments	12.3	23.6	24.4	34.4	49.6	46.8	46.1
Total home market Shipments	20.4	36.4	36.2	45.2	59.8	60.8	62.3
Export shipments to: United States[1]	10.9	12.9	16.0	12.8	8.4	1.6	1.5
European Union[2]	36.4	18.1	12.3	7.6	2.5	2.6	2.0
All other markets[3]	32.3	32.6	35.6	34.4	29.3	35.0	34.2
Total exports	79.6	63.6	63.8	54.8	40.2	39.2	37.7
Total shipments	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Antidumping and countervailing duty orders associated with the *CSPV 1* investigations became effective December 7, 2012. Antidumping and countervailing duty orders associated with the *CSPV 2* investigations became effective February 18, 2015.
[2] European Union country markets include ***.
[3] Other markets include ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Home market shipments of CSPV modules (including internal consumption and commercial home market sales), which accounted for 59.8 percent of total shipments of modules by the Chinese producers in 2016, increased by 742.3 percent during 2012-16. Exports of CSPV modules to the United States, which accounted for 8.4 percent of total shipments by the Chinese producers in 2016, increased from 1,316,838 kW to 3,655,744 kW between 2012 and 2015, but declined in 2016 to 2,916,685 kW, 121.5 percent higher than that reported for 2012. Firms project that their exports of CSPV modules from China to the United States during 2017 and 2018 will decline. Export markets other than the United States for CSPV modules produced in China, which accounted for 31.8 percent of the responding Chinese producers' total shipments in 2016, represented a declining share of total shipments from 2012 to 2016. Other major export markets identified by producers in China for CSPV modules include European Union country markets (***) and other markets (***).

Home market

Regarding competition in the home market, twenty-eight responding producers in China indicated that they do not compete with imports in the home market; whereas six producers in China indicated that they do compete with imports in the home market. Five Chinese producers noted that the trend in home market competition with imports has remained constant, one indicated that it has increased, and one indicated that it has fluctuated since January 1, 2012. Explanations for the trends in home market competition in China with imports provided by Chinese producers include the following:

* * * * * * *

Export markets

Producers of CSPV products in China were asked to identify export markets other than the United States that they have developed or where they have increased sales since January 1, 2012. These other major export markets include the following: ***. Chinese producer *** explained that the "***." *** noted that, ***. It also noted that "***." As noted in detail in *Part I* of this report, trade barriers exist in the United States and several other countries for certain CSPV products originating in China.[44]

According to official export statistics,[45] the leading export markets for CSPV products from China are Japan, India, and the United States, which accounted for 22.6, 21.6, and 11.8 percent, respectively, of the total exports of CSPV products from China during 2016 (table IV-23).

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[44] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

[45] Official exports statistics under China-specific HS numbers 8541.40.20 as reported by China's statistical authority in the GTA database, accessed July 14, 2017.

Table IV-23
CSPV products: China exports by destination market, 2012-16

Destination market	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
China exports to the United States	1,402,183	1,206,397	1,816,973	1,634,309	1,342,504
China exports to other major destination markets.-- Japan	892,923	2,794,321	4,395,596	3,341,568	2,558,643
India	193,756	510,191	488,652	1,356,333	2,448,109
Netherlands	3,829,267	1,496,753	1,037,245	945,463	576,655
Korea	109,257	234,524	416,780	378,369	357,115
Australia	732,282	427,169	397,404	366,473	354,404
Brazil	2,628	4,465	4,969	34,309	341,121
Pakistan	8,489	56,056	188,939	366,794	328,211
Turkey	6,712	41,974	80,542	256,953	321,683
All other destination markets	5,597,675	3,378,370	3,493,044	4,218,518	2,708,604
Total China exports	12,775,173	10,150,221	12,320,143	12,899,089	11,337,050
	Share of value (percent)				
China exports to the United States	11.0	11.9	14.7	12.7	11.8
China exports to other major destination markets.-- Japan	7.0	27.5	35.7	25.9	22.6
India	1.5	5.0	4.0	10.5	21.6
Netherlands	30.0	14.7	8.4	7.3	5.1
Korea	0.9	2.3	3.4	2.9	3.1
Australia	5.7	4.2	3.2	2.8	3.1
Brazil	0.0	0.0	0.0	0.3	3.0
Pakistan	0.1	0.6	1.5	2.8	2.9
Turkey	0.1	0.4	0.7	2.0	2.8
All other destination markets	43.8	33.3	28.4	32.7	23.9
Total China exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under China-specific HS number 8541.40.20 as reported by China's statistical authority in the GTA database, accessed July 14, 2017.

India

Overview

The Commission issued foreign producer questionnaires to 113 firms believed to produce CSPV products in India. Five firms in India responded to the Commission's questionnaire with useable information, accounting for approximately *** percent of cell production capacity and *** percent of module production capacity in India. Table IV-24 lists the Indian producers of CSPV cells that responded to the Commission's questionnaire and certain summary data reported in those responses.

Table IV-24
CSPV products: Summary data on responding firms in India, January 2012 to December 2016

*   *   *   *   *   *   *

Changes in operations

Three of the five responding producers in India reported operational or organizational changes since January 1, 2012 (table IV-25).

Table IV-25
CSPV products: Indian producers' reported changes in operations, since January 1, 2012

*   *   *   *   *   *   *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products, four producers in India reported that they do not anticipate any changes in the character of their CSPV operations. One firm (***) reported that it anticipates "***."

Operations on CSPV cells

According to publicly available information, India's solar cell manufacturing capacity increased from 848 MW at the end of 2012 to 1,753 MW at the end of 2016.[46] Of the 1,753

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[46] Intersolar, "Status of PV Manufacturing in India," http://www.intersolar.in/en/news-press/news/industry-news/status-of-pv-manufacturing-in-india.html (accessed July 13, 2017); Ministry of New & Renewable Energy, National Solar Mission Division, Solar Cell and Module Capacities, January 31, 2017, p. 2, http://mnre.gov.in/file-manager/UserFiles/information-sought-from-all-Solar-Cell-&-Module-manufacturers-31012017.pdf.

MW in installed capacity, 1,448 MW was operational at the end of 2016.[47] India had 16 producers of CSPV cells at the end of 2016, with an average production capacity of 110 MW. Capacity at the largest producer was 300 MW.[48] The Adani Group, as of the second half of 2016, was building a 1,200 MW plant that was expected to be commissioned by the end of the year. The company indicated that it plans to expand this plant to 2,000 MW in 2017.[49]

Two firms (Indosolar and Renewsys) provided a response to the Commission's questionnaire in this proceeding concerning production of CSPV cells in India. Table IV-26 presents information on the CSPV cell operations of the responding producers/exporters in India.

Table IV-26
CSPV cells: Data on the industry in India, 2012-16 and projected 2017-18

* * * * * * *

Capacity, production, and capacity utilization for CSPV cells produced by the responding Indian firms generally increased during 2012-16. Capacity reported by the responding Indian producers increased by *** percent from 2012 to 2016, whereas production increased by *** in 2012. Capacity utilization for firms producing CSPV cells in India increased from *** percent in 2012 to *** percent in 2016. The firms project these upward trends to continue into 2017 and 2018. Inventories of CSPV cells held by producers in India fluctuated during the period of investigation, although the ratio of inventories to production and shipments reveal steady declines from 2012 to 2016. Inventories accounted for *** percent of responding Indian producers' production and total shipments during 2016.

Home market shipments, all of which were commercial sales, accounted for *** percent of total shipments by the responding Indian producers in 2016. These home market shipments in 2016 were *** higher than the level reported in 2012. Conversely, exports of CSPV cells to the United States, were *** during 2012-16, with *** shipments reported during 2014-16. Responding firms in India reported that they expect exports of CSPV cells to the United States to increase to *** kW by 2018. Export markets other than the United States for CSPV cells produced in India accounted for *** percent of the responding Indian producers' total shipments in 2016. Other major export markets identified by producers in India for CSPV cells include ***.

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[47] Ministry of New & Renewable Energy, National Solar Mission Division, Solar Cell and Module Capacities, January 31, 2017, p. 2, http://mnre.gov.in/file-manager/UserFiles/information-sought-from-all-Solar-Cell-&-Module-manufacturers-31012017.pdf.

[48] Ministry of New & Renewable Energy, National Solar Mission Division, Solar Cell and Module Capacities, January 31, 2017, p. 2, http://mnre.gov.in/file-manager/UserFiles/information-sought-from-all-Solar-Cell-&-Module-manufacturers-31012017.pdf.

[49] The Indian Express, "Adani's Solar Equipment Mfg Facility May Commence by Year-end," The Indian Express, August 30, 2016, http://indianexpress.com/article/business/companies/adanis-solar-equipment-mfg-facility-may-commence-by-year-end-3004201/.

__Operations on CSPV modules__

According to publicly available information, India's PV module capacity increased from 2,000 MW at the end of 2012 to 6,913 MW at the end of 2016.[50] Of this 2016 capacity, 5,287 MW was operational. India had 103 module producers at the end of 2016, with an average capacity of 67 MW. The three largest plants were 500 MW each.[51] The Adani Group was also planning 1,200 MW of module production by the end of 2016, with plans to expand production to 2,000 MW in 2017.[52]

Four firms (Renewsys, Sonali Energees, Sova Solar, and Udhaya Energy) provided a response to the Commission's questionnaire in this proceeding concerning production of CSPV modules in India (table IV-27).

Table IV-27
CSPV modules: Data on the industry in India, 2012-16 and projected 2017-18

*　　*　　*　　*　　*　　*　　*

Indian capacity, production, capacity utilization, inventories, and shipments CSPV modules generally increased during the period. Capacity increased from *** kW in 2012 to *** kW in 2016 and production increased from *** kW in 2012 to *** kW in 2016. Capacity utilization for responding firms producing CSPV modules in India increased from *** percent in 2012 to *** percent in 2016. Although inventories of CSPV modules held by the responding module producers in India increased from *** kW in 2012 to *** kW in 2016, they fluctuated downward to *** percent of total shipments by 2016. The responding producers project substantial increases in these indicators in 2017 and 2018.

Home market sales, which accounted for *** percent of total shipments by the Indian producers in 2016, declined during 2012-14, but increased substantially in 2015 and 2016. Conversely, exports of CSPV modules to the United States, which accounted for *** percent of total shipments of modules by the responding Indian producers in 2016, increased from *** in 2012 and 2013 to *** kW in 2016. These Indian producers project their exports of CSPV modules to the United States will increase further to *** kW by 2018. Export markets other than the United States for CSPV modules produced in India by the responding producers

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[50] Intersolar, "Status of PV Manufacturing in India," http://www.intersolar.in/en/news-press/news/industry-news/status-of-pv-manufacturing-in-india.html (accessed July 13, 2017); Ministry of New & Renewable Energy, National Solar Mission Division, Solar Cell and Module Capacities, January 31, 2017, p. 2, http://mnre.gov.in/file-manager/UserFiles/information-sought-from-all-Solar-Cell-&-Module-manufacturers-31012017.pdf.

[51] Ministry of New & Renewable Energy, National Solar Mission Division, Solar Cell and Module Capacities, January 31, 2017, p. 2, http://mnre.gov.in/file-manager/UserFiles/information-sought-from-all-Solar-Cell-&-Module-manufacturers-31012017.pdf.

[52] The Indian Express, "Adani's Solar Equipment Mfg Facility May Commence by Year-end," The Indian Express, August 30, 2016, http://indianexpress.com/article/business/companies/adanis-solar-equipment-mfg-facility-may-commence-by-year-end-3004201/.

increased between 2012 and 2016, both in absolute quantity and as a share of total shipments. Exports to markets other than the United States accounted for *** percent of the responding Indian producers' total shipments of modules during 2016. Other major export markets identified by producers in India for CSPV modules include ***.

Home market

According to publicly available information, Indian manufacturers supplied less than 15 percent of the Indian module market during April 2016 to March 2017 (including nonsubject thin film products). The largest Indian supplier, ***, accounted for 3.3 percent of the market, and the second largest, ***, accounted for 2.0 percent of the market.[53]

Regarding competition with imports of CSPV products in their home market, one producer in India indicated that it does not compete with imports in the home market, whereas the remaining responding producers in India indicated that they do compete with imports in the home market. Two firms noted that the trend in home market competition with imports has decreased, two firms indicated that it has increased, and one noted that it has fluctuated since January 1, 2012. Comments concerning the trend in home market competition with imports include the following:

*   *   *   *   *   *   *

Export markets

Responding producers of CSPV products in India identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012. These other major export markets include the following: ***. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in India.[54]

According to official exports statistics[55] of CSPV products from India, the leading export market for CSPV products from India is the United Kingdom, which accounted for 47.1 percent of the total exports of CSPV products from India during 2016 (table IV-28).

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[53] Bridge to India, India Solar Map, March 2017, http://www.bridgetoindia.com/reports/india-solar-map-march-2017-edition/.

[54] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

[55] Official exports statistics under India-specific HS number 8541.40.11 as reported by India's statistical authority in the GTA database, accessed July 14, 2017.

Table IV-28
CSPV products: Exports from India, 2012-16

Destination market	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
India exports to the United States	5,102	1,324	57,310	10,201	5,358
India exports to other major destination markets.-- United Kingdom	461	36,096	75,485	74,327	53,889
Belgium	766	6,044	6,407	7,737	8,320
Italy	8,927	3,204	4,752	1,830	5,558
Nepal	600	1,310	1,559	1,352	5,047
China	1,993	3,239	497	5,222	4,867
Spain	190	4,555	1,383	2,104	4,217
Canada	512	169	669	1,553	3,632
Germany	10,925	78,949	28,350	2,156	2,918
All other destination markets	73,275	101,939	36,574	27,766	20,530
Total India exports	102,752	236,828	212,986	134,248	114,337
	Share of value (percent)				
India exports to the United States	5.0	0.6	26.9	7.6	4.7
India exports to other major destination markets.-- United Kingdom	0.4	15.2	35.4	55.4	47.1
Belgium	0.7	2.6	3.0	5.8	7.3
Italy	8.7	1.4	2.2	1.4	4.9
Nepal	0.6	0.6	0.7	1.0	4.4
China	1.9	1.4	0.2	3.9	4.3
Spain	0.2	1.9	0.6	1.6	3.7
Canada	0.5	0.1	0.3	1.2	3.2
Germany	10.6	33.3	13.3	1.6	2.6
All other destination markets	71.3	43.0	17.2	20.7	18.0
Total India exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under India-specific HS number 8541.40.11 as reported by India's statistical authority in the GTA database, accessed July 14, 2017.

Indonesia

Overview

The Commission issued foreign producer questionnaires to one major firm (PT Len Industri Persero ("Persero")) that was believed to be a relatively large producer of CSPV products in Indonesia and otherwise made the questionnaire available on the Commission's website for additional firms in Indonesia to download and complete. Persero and two additional firms in Indonesia (Canadian Solar and Sky Industry) responded to the Commission's questionnaire with useable information, accounting for an estimated *** percent of CSPV capacity in Indonesia.[56] Table IV-29 lists the Indonesian producers of CSPV products that responded to the Commission's questionnaire and certain summary data reported in those responses.

Table IV-29
CSPV products: Summary data on responding firms in Indonesia, January 2012 to December 2016, by product type

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Changes in operations

One producer in Indonesia reported operational and organizational changes since January 1, 2012 (table IV-30).

Table IV-30
CSPV products: Indonesian producers' reported changes in operations, since January 1, 2012

* * * * * * *

[56] Production and capacity data for Indonesia are not readily available and it is difficult to estimate the coverage of total Indonesia production attributable to the responding three firms, but there are believed to be at least five additional manufacturers of CSPV products in Indonesia. The five additional firms include PT Adyawinsa Electrical & Power, PT Surya Utama Putra, PT Swadaya Prima Utama, PT Azet Surya Lestari, and PT Wijaya Karya Inatrade Energi. These five firms and Persero comprise the Indonesian Solar Module Manufacturer Association ("APAMSI"). Firms in the APAMSI are reported to have a combined annual production capacity of 90 mw. Global Business Guide, "Solar Panels in Indonesia: A Bright Future?" July 21, 2014, http://www.gbgindonesia.com/en/main/business_updates/2014/upd_solar_panels_in_indonesia_a_bright_future_.php.

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, three responding producers in Indonesia reported that they do not anticipate any changes in the character of their CSPV operations.

Operations on CSPV cells

The only responding producer of CSPV cells in Indonesia (Sky Energy) reported that it began production of CSPV cells in 2016 and that its capacity, production, capacity utilization, and shipments are projected to increase in 2017 compared with 2016 (table IV-31). The firm's capacity utilization for CSPV cells in Indonesia was *** percent in 2016 as it ramped up capacity. Sky Energy ***. Sky Energy reported that all of its production of cells in Indonesia ***. The firm indicated that it ***.

Table IV-31
CSPV cells: Data on the industry in Indonesia, 2012-16 and projected 2017-18

* * * * * * *

Operations on CSPV modules

Indonesian capacity, production, inventories, and shipments for CSPV module operations generally increased during 2012-16 (table IV-32). Capacity and production were *** larger, respectively, in 2016 compared with 2012, and the capacity utilization for responding firms producing CSPV modules in Indonesia ranged from *** percent to *** percent during 2012-16. Likewise, inventories of CSPV modules increased during the same period. Production, inventories, and capacity utilization are projected to increase in 2017 and 2018. Home market sales, which accounted for *** percent of total shipments by the Indonesian producers in 2016, declined from *** percent in 2012-14. Exports of CSPV modules to the United States began in 2015 and reached *** kW in 2016, accounting for *** percent of total shipments by the Indonesian producers in 2016. Export markets other than the United States for CSPV modules produced in Indonesia accounted for between *** percent and *** percent of the responding Indonesian producers' total shipments since 2015. Other major export markets identified by producers in Indonesia for CSPV modules include ***.

Table IV-32
CSPV modules: Data on the industry in Indonesia, 2012-16 and projected 2017-18

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Home market

Regarding competition with imports of CSPV products in their home market, two producers in Indonesia indicated that they do not compete with imports in the home market. The one producer in Indonesia that indicated that it competes with imports in the home market noted that the trend in home market competition with imports has increased since January 1, 2012.

Export markets

Responding producers of CSPV products in Indonesia identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012. These other major export markets include the following: ***. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in Indonesia.[57]

According to official exports statistics,[58] the leading export markets for CSPV products from Indonesia are the United States and Canada (table IV-33). During 2016, the United States was the top export market for CSPV products from Indonesia, accounting for 66.6 percent, followed by Canada, accounting for 14.8 percent of total Indonesian exports.

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[57] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

[58] Official exports statistics under Indonesia-specific HS numbers 8541.40.2100 and 8541.40.2200 as reported by Indonesia's statistical authority in the GTA database, accessed July 14, 2017.

Table IV-33
CSPV products: Indonesia exports by destination market, 2012-16

Destination market	Calendar year 2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Indonesia exports to the United States	---	---	1	568	1,868
Indonesia exports to other major destination markets.-- Canada	---	---	---	88	415
Japan	108	256	239	317	246
Yemen	---	---	---	39	91
Germany	---	---	27	23	87
Singapore	565	976	2,271	77	46
Maldives	---	---	---	---	29
China	---	---	---	---	16
United Arab Emirates	---	---	0	---	3
All other destination markets	57	9	1,087	1,174	4
Total Indonesia exports	731	1,241	3,625	2,286	2,806
	Share of value (percent)				
Indonesia exports to the United States	---	---	0.0	24.9	66.6
Indonesia exports to other major destination markets.-- Canada	---	---	---	3.9	14.8
Japan	14.8	20.6	6.6	13.9	8.8
Yemen	---	---	---	1.7	3.2
Germany	---	---	0.8	1.0	3.1
Singapore	77.4	78.7	62.6	3.4	1.6
Maldives	---	---	---	---	1.0
China	---	---	---	---	0.6
United Arab Emirates	---	---	0.0	---	0.1
All other destination markets	7.8	0.7	30.0	51.3	0.2
Total Indonesia exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under Indonesia-specific HS numbers 8541.40.2100 and 8541.40.2200 as reported by Indonesia's statistical authority in the GTA database, accessed July 14, 2017.

Japan

Market

According to publicly available information, approximately 12 firms manufactured CSPV cells and/or modules in Japan in 2015, the largest of which was Kyocera. Shipments of all CSPV cells by the industry in Japan declined by 20 percent during 2014-16 to 1.5 GW. Multicrystalline cells represented 56 percent of these shipments in 2014, growing to 65 percent in 2016 (table IV-34). During the same period, shipments of CSPV modules by the industry in Japan fell by 38 percent to 1.7 GW (table IV-35). Monocrystalline modules accounted for the larger share of the industry's shipments until 2016, when multicrystalline modules gained the larger share.

Table IV-34
CSPV cells: Data on the industry in Japan, 2014-16

Item	2014	2015	2016
	Quantity (kW)		
Shipments			
Monocrystalline	829,517	754,470	519,317
Mutlicrystalline	1,038,059	1,019,014	966,543
Total	1,867,576	1,773,484	1,485,860
Exports			
Monocrystalline	66,772	38,152	35,667
Mutlicrystalline	28,863	309,431	214,065
Total	95,635	347,583	249,732

Note.—Data reflect fiscal year from April to March.

Source: Data compiled from the Japan Photovoltaic Energy Association, PV shipment statistics, http://www.jpea.gr.jp/en/statistic/index.html.

Table IV-35
CSPV modules: Data on the industry in Japan, 2014-16

Item	2014	2015	2016
	Quantity (kW)		
Shipments			
Monocrystalline	1,457,569	1,119,077	761,204
Mutlicrystalline	1,304,793	1,015,517	954,987
Total	2,762,362	2,134,594	1,716,191
Exports			
Monocrystalline	20,044	30,702	30,321
Mutlicrystalline	79,854	35,672	27,982
Total	99,898	66,374	58,303

Note.—Data reflect fiscal year from April to March.

Source: Data compiled from the Japan Photovoltaic Energy Association, PV shipment statistics, http://www.jpea.gr.jp/en/statistic/index.html.

Exports of cells from Japan, on the other hand, grew by 161 percent to nearly 250 MW during 2014-16, whereas exports of modules declined by 42 percent during the period to 58 MW.[59] The share of total shipments for the industry in Japan represented by exports of cells rose over the period, from 5 percent in 2014 to 17 percent in 2016. Exports of modules, however, accounted for a more stable share of total shipments for the industry in Japan during the period, ranging between 3 and 4 percent.

During the period of investigation, several companies reported changes in operations. New entrants to CSPV manufacturing include Denka Shinki and INFINI (Japan Solar), which started operating new PV module factories in 2015.[60] E-Solar KK opened an 80 MW CSPV module plant in Matsuyama in 2015.[61] Its Taiwan parent company, Eversol Corporation, is a leading producer of wafers, which E-Solar indicates helps to cut costs.[62] Kyocera added 200 MW of capacity to its Yasu CSPV cell manufacturing plant in 2013. The firm also added 200 MW of capacity to its Shiga Prefecture cell manufacturing facility in 2012.[63]

Overview of data collection

The Commission issued foreign producer questionnaires to 25 firms believed to produce CSPV products in Japan and otherwise made the questionnaire available on the Commission website for additional firms in Japan to download and complete. One firm in Japan responded to the Commission's questionnaire with useable information, accounting for approximately *** percent of total CSPV cell production and *** percent of total CSPV module production in Japan in 2016. Table IV-36 presents the Japanese producer of CSPV products that responded to the Commission's questionnaire and certain summary data reported in that response.

Table IV-36
CSPV products: Summary data on firm in Japan, January 2012 through December 2016, by product type

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[59] Export data presented for Japan are from the Japan Photovoltaic Energy Association. Export data compiled by the GTA for Japan are not presented in this report because data specific to PV products are not available.

[60] National Survey Report of PV Power Applications in Japan 2015, http://www.iea-pvps.org/?id=93.

[61] Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017.

[62] About E-Solar, E-Solar company website, http://www.esolar.co.jp/corp_en.html#corp, accessed July 13, 2017.

[63] Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017.

Changes in operations

The producer in Japan reported operational or organizational changes since January 1, 2012 (table IV-37).

Table IV-37
CSPV products: Reported changes in operations by the producer in Japan since January 1, 2012

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Anticipated changes in operations

Kyocera reported that it *** changes in the future concerning the character of its operations in Japan relating to CSPV products.

Operations on CSPV cells

Based on questionnaire data from the one responding producer in Japan (Kyocera), production, capacity utilization, and shipments generally increased from 2012 to 2015, but fell somewhat in 2016 (table IV-38). Production and shipments increased overall by *** percent from 2012 to 2016 and the capacity utilization for the firm producing CSPV cells in Japan ranged from *** percent to *** percent during 2012-16.[64] Kyocera (Japan) reported that ***.[65] The firm projects an overall decrease in CSPV cell production and shipments in 2017 and 2018.

Table IV-38
CSPV cells: Data on the industry in Japan, 2012-16 and projected 2017-18

* * * * * * *

Operations on CSPV modules

According to questionnaire data, production of CSPV modules by Kyocera in Japan increased by *** percent from *** kW in 2012 to *** kW in 2014, before falling to *** kW in 2016. Capacity utilization for the firm producing CSPV modules in Japan ranged from *** percent to *** percent during 2012-16 (table IV-39).[66] Inventories of CSPV modules increased from *** kW in 2012 to *** kW in 2014, but declined thereafter to a level in 2016 that was *** percent higher than reported in 2012. The ratio of inventories to total shipments was *** percent in 2016 compared with *** percent in 2012. Home market sales accounted for *** percent of Kyocera's total shipments in Japan during 2016, whereas exports of CSPV modules to

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[64] Kyocera (Japan) incorrectly reported ***.
[65] Staff requested that Kyocera (Japan) confirm that ***.
[66] Kyocera (Japan) incorrectly reported ***.

markets in the European Union accounted for the remaining *** percent of total shipments. *** exports of CSPV modules to the United States were reported by Kyocera (Japan) during 2012-16, the firm projected that exports to the United States will account for *** percent of its total shipments of CSPV modules by 2018.

Table IV-39
CSPV modules: Data on the industry in Japan, 2012-16 and projected 2017-18

* * * * * * *

Home market

Regarding competition with imports of CSPV products in its home market, the producer in Japan, which reported *** of its shipments were to the home market during the period of investigation, indicated that it does not compete with imports in the home market.

Export markets

The producer of CSPV products in Japan indicated that it has not developed any export markets other than the United States since January 1, 2012. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in Japan.[67] Export data compiled by GTA for Japan are not presented in this report because the PV-specific data do not appear to accurately capture exports of PV products.

Korea

Overview

The Commission issued foreign producer questionnaires to 27 firms believed to produce CSPV products in Korea. Four firms in Korea responded to the Commission's questionnaire with useable information, accounting for approximately *** percent of cell production capacity and *** percent of module production capacity in Korea in 2016. Table IV-40 lists the Korean producers of CSPV products that responded to the Commission's questionnaire and certain summary data reported in those responses.

Table IV-40
CSPV products: Summary data on responding firms in Korea, January 2012 to December 2016, by product type

* * * * * * *

[67] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Changes in operations

Four producers in Korea reported operational or organizational changes since January 1, 2012 (table IV-41).

Table IV-41
CSPV products: Korean producers' reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, three producers in Korea reported that they do not anticipate any changes in the character of their CSPV operations. One firm reported the following details concerning anticipated changes (table IV-42).

Table IV-42
CSPV products: Korean producers' anticipated changes in operations

* * * * * * *

Operations on CSPV cells

Reported Korean capacity, production, capacity utilization, inventories, and shipments generally increased from 2012 to 2016 (table IV-43). Capacity and production were *** and *** times larger, respectively, in 2016 compared with 2012, and the capacity utilization for firms producing CSPV cells in Korea ranged from *** percent to *** percent during 2012-16. Reported inventories of CSPV cells were *** larger in 2016 compared with 2012. Responding firms project capacity and production to increase by *** percent and *** percent, respectively, and product inventory to remain constant.

Table IV-43
CSPV cells: Data on the industry in Korea, 2012-16 and projected 2017-18

* * * * * * *

Home market sales, which accounted for *** percent of total shipments by the responding Korean cell producers in 2016, remained relatively stable from 2012 to 2016. Exports of CSPV cells to the United States were *** percent of total shipments in 2016. Export markets other than the United States[68] for CSPV cells produced in Korea accounted for between

[68] Exports of Korean CSPV cells to U.S. *** percent of total exports in 2016.

*** percent and *** percent of the responding Korean producers' total shipments since 2012. Other major export markets identified by producers in Korea for CSPV cells include ***.

Operations on CSPV modules

Reported Korean capacity, production, inventories, and shipments generally increased from 2012 to 2016 (table IV-44). Capacity and production were *** and *** times larger, respectively, in 2016 compared with 2012, and the capacity utilization for firms producing CSPV modules in Korea ranged from *** to *** percent during 2012-16. Inventories of CSPV modules were *** higher in 2016 compared with 2012. Reporting firms project capacity, production, capacity utilization, inventories, and shipments to increase in 2017 and 2018. Home market sales, which accounted for *** percent of total shipments by the Korean producers in 2016, are at their lowest share since 2012. Conversely, exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the Korean producers in 2016, increased ten-fold, from *** kW to *** kW during the period. Export markets other than the United States for CSPV modules produced in Korea accounted for between *** percent and *** percent of the responding Korean producers' total shipments since 2012. Other major export markets identified by responding producers in Korea for CSPV modules include ***.

Table IV-44
CSPV modules: Data on the industry in Korea, 2012-16 and projected 2017-18

* * * * * * *

Home market

Regarding competition with imports of CSPV products in their home market, two producers in Korea indicated that they do not compete with imports in the home market. One producer in Korea that indicated that it competes with imports in the home market noted that the trend in home market competition with imports has remained constant since January 1, 2012, while the fourth producer in Korea that indicated that it competes with imports in the home market but noted a decrease in competition.

Export markets

Producers of CSPV products in Korea identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012 including: ***. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in Korea.[69]

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[69] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

According to official exports statistics,[70] the leading export markets for CSPV products from Korea are the United States and Japan (table IV-45). During 2016, the United States was the top export market for CSPV products from Korea, accounting for 67.9 percent, followed by Japan, accounting for 12.3 percent of total exports from Korea.

Table IV-45
CSPV products: Korea exports by destination market, 2012-16

Destination market	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Korea exports to the United States	299,274	134,495	238,900	634,051	1,288,914
Korea exports to other major destination markets.-- Japan	133,827	503,062	384,736	323,211	234,338
Malaysia	10,724	5,830	20,101	61,512	76,880
Netherlands	1,430	49,285	88,490	59,112	68,876
Germany	119,037	58,273	49,233	15,109	56,941
China	16,860	40,969	22,160	29,887	31,555
Thailand	6,474	2,993	3,211	3,398	21,673
Hong Kong	12,165	12,667	20,103	17,586	19,242
Australia	19,031	11,271	15,110	11,543	18,014
All other destination markets	129,411	87,795	132,177	167,690	81,091
Total Korea exports	748,233	906,640	974,222	1,323,097	1,897,523
	Share of value (percent)				
Korea exports to the United States	40.0	14.8	24.5	47.9	67.9
Korea exports to other major destination markets.-- Japan	17.9	55.5	39.5	24.4	12.3
Malaysia	1.4	0.6	2.1	4.6	4.1
Netherlands	0.2	5.4	9.1	4.5	3.6
Germany	15.9	6.4	5.1	1.1	3.0
China	2.3	4.5	2.3	2.3	1.7
Thailand	0.9	0.3	0.3	0.3	1.1
Hong Kong	1.6	1.4	2.1	1.3	1.0
Australia	2.5	1.2	1.6	0.9	0.9
All other destination markets	17.3	9.7	13.6	12.7	4.3
Total Korea exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under Korea-specific HS numbers 8541.40.9010 and 8541.40.9020 as reported by Korea's statistical authority in the GTA database, accessed July 14, 2017.

[70] Official exports statistics under Korea-specific HS numbers 8541.40.9010 and 8541.40.9020 as reported by Korea's statistical authority in the GTA database, accessed July 14, 2017.

Malaysia

Overview

The Commission issued foreign producer questionnaires to 19 firms believed to produce CSPV products in Malaysia. Ten firms in Malaysia responded to the Commission's questionnaire with useable information, accounting for all known cell capacity and 93 percent of module capacity in 2015 in Malaysia.[71] Table IV-46 lists the Malaysian producers of CSPV products that responded to the Commission's questionnaire and certain summary data reported in those responses.

Table IV-46
CSPV products: Summary data on responding firms in Malaysia, January 2012 to December 2016, by product type

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Changes in operations

Ten producers and one exporter in Malaysia reported operational or organizational changes since January 1, 2012 (table IV-43).

Table IV-47
CSPV products: Malaysian producers'/exporters' reported changes in operations, since January 1, 2012

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Anticipated changes in operations

The Commission also asked Malaysian producers to report anticipated changes in the character of their operations relating to CSPV products in the future. Eight firms in Malaysia reported that they do not anticipate any changes in the character of their CSPV operations, whereas three firms anticipated changes (table IV-48).

Table IV-48
CSPV products: Malaysian producers' anticipated changes in operations

* * * * * * *

[71] An eleventh firm in Malaysia (Canadian Solar (Malaysia)) provided a questionnaire response with data concerning exports from Malaysia; ***.

Operations on CSPV cells

Based on questionnaire responses, capacity, production, capacity utilization, inventories, and shipments of the industry in Malaysia increased from 2012 to 2016 (table IV-49). Capacity and production increased by *** and *** percent, respectively, from 2012 to 2016, and the capacity utilization for firms producing CSPV cells in Malaysia fluctuated upward from *** percent in 2012 to *** percent in 2016. Future increases are projected for these indicators in 2017 and 2018.

Home market sales, which accounted for *** percent of total shipments by the Malaysian producers in 2016, increased from *** kW in 2012 to *** kW in 2016. Exports of CSPV cells to the United States were non-existent until 2016, when *** kW were exported to the United States, and are expected to increase further in 2017 and 2018. Export markets other than the United States for CSPV cells produced in Malaysia accounted for *** percent of the responding Malaysian producers' total shipments in 2016. Other major export markets identified by producers in Malaysia for CSPV cells include ***.

Table IV-49
CSPV cells: Data on the industry in Malaysia, 2012-16 and projected 2017-18

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Operations on CSPV modules

Based on questionnaire responses, capacity, production, capacity utilization, inventories, and shipments of the industry in Malaysia increased from 2012 to 2016 (table IV-50). Capacity and production in 2016 were *** higher than reported in 2012, respectively. Capacity utilization for firms producing CSPV modules in Malaysia ranged from a low of *** percent in 2012 to a high of *** percent during 2014. Inventories of CSPV modules increased during 2012-16 to a level in 2016 that was *** higher than the level reported in 2012.

Table IV-50
CSPV modules: Data on the industry in Malaysia, 2012-16 and projected 2017-18

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Home market sales, which accounted for *** percent of total shipments by the Malaysian producers in 2016, increased from *** in 2012 to *** kW in 2016. Future increases in 2017 and 2018 are expected by the firms. Exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the Malaysian producers in 2016, increased to *** kW. Export markets other than the United States for CSPV modules produced in Malaysia accounted for *** percent of the total shipments in 2016. Other major export markets identified by producers in Malaysia for CSPV modules include ***.

Home market

Regarding competition with imports of CSPV products in their home market, seven firms in Malaysia indicated that they do not compete with imports in the home market. Four firms indicated that they do compete with imports in the home market. Two firms noted that the trend in home market competition with imports has decreased since January 1, 2012, one firm reported that the trend was constant, and the fourth firm indicated that the trend fluctuated. Company explanations for the trend in home market competition with imports include the following:

* * * * * * *

Export markets

Producers of CSPV products in Malaysia identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012 for Malaysian CSPV products including: ***. As noted in detail in *Part I* of this report, trade barriers exist in the European Union and India for certain CSPV products originating in Malaysia.[72] Export data compiled by the GTA for Malaysia are not presented in this report because data specific to PV products are not available.

Philippines

Overview

The Commission issued foreign producer questionnaires to two firms believed to produce CSPV products in the Philippines. One firm in the Philippines responded to the Commission's questionnaire with useable information, accounting for all known production of CSPV products in the Philippines. Table IV-51 identifies the responding producer of CSPV cells and modules in the Philippines and provides certain summary data reported in that response.

Table IV-51
CSPV products: Summary data on the responding firm in the Philippines, January 2012 to December 2016, by product type

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[72] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Changes in operations

The producer in the Philippines reported operational or organizational changes since January 1, 2012 (table IV-52). According to publicly available information, one additional firm—Solar Philippines—opened its first module plant in the Philippines in March 2017. The plant's initial production capacity is 200 MW, and is expected to increase to 800 MW in 2018.[73]

Table IV-52
CSPV products: Reported changes in operations by the producer in the Philippines, since January 1, 2012

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Anticipated changes in operations

Reported anticipated changes in the character of the sole responding firm's operations relating to CSPV products in the future are presented in table IV-53.

Table IV-53
CSPV products: Anticipated changes in operations by the producer in the Philippines

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Operations on CSPV cells

Based on questionnaire data from the one responding producer in the Philippines, production, capacity utilization, inventories and shipments generally increased from 2012 to 2016 (table IV-54). Production increased by *** percent from 2012 to 2016, and the capacity utilization for the firm producing CSPV cells in the Philippines ranged from *** percent to *** percent during 2012-16. The firm's capacity remained constant from 2012 to 2016. The firm projects a decrease in capacity, production, and shipments in 2017 and 2018. Reported inventory levels of CSPV cells were *** larger in 2016 compared with 2012.

Table IV-54
CSPV cells: Data on the industry in the Philippines, 2012-16 and projected 2017-18

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[73] Publicover, Brian, "Solar Philippines Inaugurates Country's First PV Panel Factory," *PV Magazine*, August 25, 2017, https://www.pv-magazine.com/2017/08/25/solar-philippines-inaugurates-countrys-first-pv-panel-factory/.

Home market sales accounted for *** percent of total shipments by the producer in the Philippines during 2016. The firm reported *** exports of CSPV cells to the United States during 2016. Export markets other than the United States for CSPV cells produced in the Philippines accounted for between *** percent and *** percent of the responding producers' total shipments since 2012. Major export markets identified by the producer in the Philippines for CSPV cells include ***.

Operations on CSPV modules

According to questionnaire data, capacity and production for CSPV modules in the Philippines decreased by *** percent and *** percent, respectively, from 2012 to 2016, and the capacity utilization for the firm producing CSPV modules in the Philippines ranged from *** percent to *** percent during 2012-16 (table IV-55). Inventories of CSPV modules decreased by *** percent from 2012 to 2016. Home market sales accounted for *** percent of total shipments by the producer in the Philippines during 2016. Exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the producer in the Philippines during 2016, decreased by *** percent from 2012 to 2016. Export markets other than the United States for CSPV modules produced in the Philippines accounted for between *** percent and *** percent of the responding producers' total shipments since 2012. Other major export markets identified by the producer in the Philippines for CSPV modules include ***. ***. Therefore, it projected ***.

Table IV-55
CSPV modules: Data on the industry in the Philippines, 2012-16 and projected 2017-18

* * * * * * *

Home market

Regarding competition with imports of CSPV products in its home market, the producer in the Philippines, which reported *** shipments to the home market during the period of investigation, indicated that it does not compete with imports in the home market.

Export markets

The producer of CSPV products in the Philippines identified export markets other than the United States that it developed or where it increased sales since January 1, 2012. These export markets include the following: ***. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in the Philippines.[74] Export data compiled by GTA for the Philippines are not presented in this report because the PV-specific data do not appear to accurately capture exports of PV products.

Singapore

Overview

The Commission issued foreign producer questionnaires to two firms believed to produce CSPV products in Singapore. One firm in Singapore responded to the Commission's questionnaire with useable information, accounting for all known production of CSPV products in Singapore. Table IV-56 identifies the responding producer of CSPV cells and modules in Singapore and provides certain summary data reported in that response.

Table IV-56
CSPV products: Summary data on firms in Singapore, January 2012 through December 2016, by product type

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Changes in operations

One producer in Singapore reported operational and organizational changes since January 1, 2012 (table IV-57).

Table IV-57
CSPV products: Singaporean producer's reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

The sole responding producer in Singapore indicated that it does not anticipate any changes in the character of its CSPV operations.

[74] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Operations on CSPV cells

According to questionnaire data, capacity, production, capacity utilization, and shipments in Singapore generally increased from 2012 to 2016 (table IV-58). Capacity and production increased by *** percent and *** percent, respectively, from 2012 to 2016, and capacity utilization for the firm producing CSPV cells in Singapore ranged from *** percent to *** percent during 2012-16. The firm projects capacity and production to *** percent and *** percent, respectively, in 2017 and constant levels of capacity and production in 2018. The firm *** of CSPV cells from 2012 to 2016 and projects no growth in inventory in 2017 and 2018.

Table IV-58
CSPV cells: Data on the industry in Singapore, 2012-16 and projected 2017-18

* * * * * * *

Home market sales, which accounted for *** percent of total shipments by the Singaporean cell producer in 2016, increased by *** percent from 2012 to 2016. The firm *** export CSPV cells to the United States from 2012 to 2016 and does not expect growth in exports to the United States in 2017 or 2018. Export markets other than the United States for CSPV cells produced in Singapore accounted for between *** percent and *** percent of the responding Singaporean producer's total shipments since 2012. Other major export markets identified by producers in Singapore for CSPV cells include ***.

Operations on CSPV modules

Based on questionnaire data, capacity, production, capacity utilization, inventories, and shipments of the producer in Singapore generally increased from 2012 to 2016 (table IV-59). Capacity and production increased by *** percent and *** percent, respectively, from 2012 to 2016, and the capacity utilization for the firm producing CSPV modules in Singapore ranged from *** percent to *** percent during 2012-16. The firm projects capacity and production to decline by *** percent and *** percent, respectively, in 2017 and then increase by *** percent and *** percent, respectively, in 2018. Likewise, inventory of CSPV modules increased by *** percent from 2012 to 2016. The firm expects inventory to decrease by *** percent from 2016 to 2018.

Table IV-59
CSPV modules: Data on the industry in Singapore, 2012-16 and projected 2017-18

* * * * * * *

Home market sales, which accounted for *** percent of total shipments by the Singaporean producer in 2016, declined by *** percent from 2012 to 2016. Exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the producer in Singapore during 2016, increased by *** percent during 2012-16. Export markets other than the United States for CSPV modules produced in Singapore accounted for between *** percent and *** percent of the responding Singaporean producer's total shipments since 2012. Other major export markets identified by producers in Singapore for CSPV modules include ***.

Home market

Regarding competition with imports of CSPV products in the home market, the producer in Singapore indicated that it competes with imports in the home market and commented that "***." It also noted, however, that the trend in home market competition with imports has decreased since January 1, 2012.

Export markets

The producer of CSPV products in Singapore was asked to identify export markets other than the United States that it has developed or where it has increased sales since January 1, 2012, and it reported several export markets, including: ***. There were no trade barriers identified in these proceedings with respect to certain CSPV products originating in Singapore.[75] Export data compiled by GTA for Singapore are not presented in this report because the PV-specific data do not appear to accurately capture exports of PV products.

Taiwan

Overview

The Commission issued foreign producer questionnaires to 43 firms believed to produce CSPV products in Taiwan. Fifteen firms in Taiwan responded to the Commission's questionnaire with useable information, accounting for approximately 82 percent of cell capacity and 31 percent of module capacity in Taiwan in 2016. Table IV-60 lists the Taiwanese producers of CSPV products that responded to the Commission's questionnaire and certain summary data reported in those responses.

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[75] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Table IV-60
CSPV products: Summary data on responding firms in Taiwan, January 2012 to December 2016, by product type

Firm	Production (kW)	Share of reported production (percent)	Exports to the United States (kW)	Share of reported exports to the United States (percent)	Total shipments (kW)	Share of firm's total shipments exported to the United States (percent)
CSPV cells:						
Anji Technology	***	***	***	***	***	***
AU Optronics	***	***	***	***	***	***
Big Sun Energy	***	***	***	***	***	***
EEPV	***	***	***	***	***	***
E-Ton Solar	***	***	***	***	***	***
Gintech Energy	***	***	***	***	***	***
Gintung Energy	***	***	***	***	***	***
Inventec Energy	***	***	***	***	***	***
LOF Solar	***	***	***	***	***	***
Motech	***	***	***	***	***	***
Neo Solar Power	***	***	***	***	***	***
Sino-American	***	***	***	***	***	***
Solartech	***	***	***	***	***	***
TSEC	***	***	***	***	***	***
Win Win	***	***	***	***	***	***
Total	30,468,920	100.0	921,580	100.0	30,247,574	3.0
CSPV modules:						
Anji Technology	***	***	***	***	***	***
AU Optronics	***	***	***	***	***	***
Big Sun Energy	***	***	***	***	***	***
EEPV	***	***	***	***	***	***
E-Ton Solar	***	***	***	***	***	***
Gintech Energy	***	***	***	***	***	***
Gintung Energy	***	***	***	***	***	***
Inventec Energy	***	***	***	***	***	***
LOF Solar	***	***	***	***	***	***
Motech	***	***	***	***	***	***
Neo Solar Power	***	***	***	***	***	***
Sino-American	***	***	***	***	***	***
Solartech	***	***	***	***	***	***
TSEC	***	***	***	***	***	***
Win Win	***	***	***	***	***	***
Total	2,672,535	100.0	198,695	100.0	2,645,921	7.5

Note.--Foreign producer data on module assembly does not necessarily equate to the country-of-origin classification used for U.S. import statistics. Taiwan module assemblers indicated that they primarily sourced *** cells.

Source: Compiled from data submitted in response to Commission questionnaires.

Changes in operations

Eleven producers in Taiwan reported operational or organizational changes since January 1, 2012 (table IV-61).

Table IV-61
CSPV products: Taiwanese producers' reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Taiwanese producers were asked whether they anticipated changes in the character of their operations relating to CSPV products in the future, with twelve producers indicating that they do not anticipate any changes in the character of their CSPV operations. Conversely, three firms anticipated several changes (table IV-62).

Table IV-62
CSPV products: Taiwanese producers' anticipated changes in operations

* * * * * * *

Operations on CSPV cells

According to questionnaire data, capacity, production, capacity utilization, inventories, and shipments of the industry in Taiwan generally increased from 2012 to 2016 (table IV-63). Capacity and production increased by 75.3 and 100.7 percent, respectively, from 2012 to 2016, and the capacity utilization for firms producing CSPV cells in Taiwan fluctuated upward from 76.7 percent in 2012 to 87.8 percent in 2016. Inventories of CSPV cells increased by 107.6 percent from 2012 to 2016. The industry in Taiwan, however, projects declines in these indicators in 2017 and 2018.

Home market shipments, which accounted for 16.7 percent of total shipments by the responding Taiwanese producers in 2016, were largely internal consumption. These home market shipments were more than three times higher in 2016 than the level reported in 2012. Exports of CSPV cells to the United States, which accounted for a declining share of total shipments by producers in Taiwan, fluctuated downward from 271,448 kW to 174,748 kW during 2012-16. A noticeable decline in exports was observed in 2014, which was the year in which the Commission conducted the *CSPV 2* investigations that included CSPV products from Taiwan. Exports to the United States accounted for 2.3 percent of total shipments by the Taiwanese producers in 2016. Export markets other than the United States for CSPV cells produced in Taiwan accounted for 80.9 percent of the responding Taiwanese producers' total shipments in 2016. Other major export markets identified by producers in Taiwan for CSPV cells include countries within the EU market (i.e., ***) and other countries (i.e., ***).

Table IV-63
CSPV cells: Data on the industry in Taiwan, 2012-16 and projected 2017-18

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	4,962,979	5,797,147	7,146,811	8,112,324	8,698,953	8,174,602	8,271,988
Production	3,806,669	5,165,941	6,313,934	7,544,196	7,638,180	6,911,256	7,115,248
End-of-period inventories	168,633	176,910	291,513	231,037	350,131	240,520	217,180
Shipments: Home market: Internal consumption/ transfers	123,562	148,340	269,222	516,473	901,882	728,032	1,032,728
Commercial Shipments	262,480	372,743	359,552	510,665	358,081	417,493	450,584
Subtotal, home market shipments	386,042	521,083	628,774	1,027,138	1,259,963	1,145,525	1,483,312
Export shipments to: United States	271,448	228,707	62,962	183,715	174,748	39,362	43,421
European Union[1]	1,209,500	1,148,384	835,618	1,088,477	1,160,656	1,164,405	1,157,346
All other markets[2]	1,919,091	3,257,099	4,644,512	5,306,768	4,932,889	4,671,575	4,454,509
Total exports	3,400,039	4,634,190	5,543,092	6,578,960	6,268,293	5,875,342	5,655,276
Total shipments	3,786,081	5,155,273	6,171,866	7,606,098	7,528,256	7,020,867	7,138,588
	Ratios and shares (percent)						
Capacity utilization	76.7	89.1	88.3	93.0	87.8	84.5	86.0
Inventories/production	4.4	3.4	4.6	3.1	4.6	3.5	3.1
Inventories/total shipments	4.5	3.4	4.7	3.0	4.7	3.4	3.0
Share of shipments: Home market: Internal consumption/ transfers	3.3	2.9	4.4	6.8	12.0	10.4	14.5
Commercial shipments	6.9	7.2	5.8	6.7	4.8	5.9	6.3
Subtotal, home market shipments	10.2	10.1	10.2	13.5	16.7	16.3	20.8
Export shipments to: United States	7.2	4.4	1.0	2.4	2.3	0.6	0.6
European Union[1]	31.9	22.3	13.5	14.3	15.4	16.6	16.2
All other markets[2]	50.7	63.2	75.3	69.8	65.5	66.5	62.4
Total exports	89.8	89.9	89.8	86.5	83.3	83.7	79.2
Total shipments	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] European Union country markets include ***.

[2] Other markets include ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Operations on CSPV modules

According to questionnaire data, capacity, production, capacity utilization, inventories, and shipments of the industry in Taiwan generally increased from 2012 to 2016 (table IV-64).

Table IV-64
CSPV modules: Data on the industry in Taiwan, 2012-16 and projected 2017-18

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	559,900	714,850	1,003,184	1,188,644	938,177	1,071,972	1,498,820
Production	210,415	370,057	663,285	831,700	597,078	754,793	1,192,080
End-of-period inventories	17,090	17,659	41,363	45,920	49,195	33,193	36,584
Shipments: Home market: Internal consumption/ transfers	7,899	13,155	42,477	56,509	61,793	91,113	185,281
Commercial shipments	60,560	151,480	226,006	311,639	221,359	371,393	616,310
Subtotal, home market shipments	68,459	164,635	268,483	368,148	283,152	462,506	801,591
Export shipments to: United States	74,901	26,817	22,349	56,069	18,559	24,303	42,633
European Union[1]	40,140	52,233	150,211	247,766	204,911	193,367	220,022
All other markets[2]	20,369	129,584	198,538	163,415	87,182	90,619	122,443
Total exports	135,410	208,634	371,098	467,250	310,652	308,289	385,098
Total shipments	203,869	373,269	639,581	835,398	593,804	770,795	1,186,689
	Ratios and shares (percent)						
Capacity utilization	37.6	51.8	66.1	70.0	63.6	70.4	79.5
Inventories/production	8.1	4.8	6.2	5.5	8.2	4.4	3.1
Inventories/total shipments	8.4	4.7	6.5	5.5	8.3	4.3	3.1
Share of shipments: Home market: Internal consumption/ transfers	3.9	3.5	6.6	6.8	10.4	11.8	15.6
Commercial Shipments	29.7	40.6	35.3	37.3	37.3	48.2	51.9
Subtotal, home market shipments	33.6	44.1	42.0	44.1	47.7	60.0	67.5
Export shipments to: United States	36.7	7.2	3.5	6.7	3.1	3.2	3.6
European Union[1]	19.7	14.0	23.5	29.7	34.5	25.1	18.5
All other markets[2]	10.0	34.7	31.0	19.6	14.7	11.8	10.3
Total exports	66.4	55.9	58.0	55.9	52.3	40.0	32.5
Total shipments	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] European Union country markets include ***.
[2] Other markets include ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Capacity and production increased from 2012 to 2015, but declined in 2016 to levels that were 67.6 and 183.8 percent higher, respectively, than reported in 2012. The capacity utilization for responding firms producing CSPV modules in Taiwan increased from 37.6 percent in 2012 to 70.0 percent in 2015, but declined to 63.6 percent in 2016. Increases in capacity, production, and capacity utilization over the 2016 levels are projected by firms in Taiwan for 2017 and 2018. Inventories of CSPV modules increased by 187.9 percent from 2012 to 2016.

Home market sales, which accounted for 47.7 percent of total shipments by the responding Taiwanese producers in 2016, were more than four times higher in 2016 than in 2012. Exports of CSPV modules to the United States, which accounted for a declining share of total shipments by producers in Taiwan, fluctuated downward from 2012 to 2016. Exports to the United States accounting for 3.1 percent of total shipments by the Taiwanese producers in 2016. Export markets other than the United States for CSPV modules produced in Taiwan accounted for 49.2 percent of the responding Taiwanese producers' total shipments in 2016. Other major export markets identified by responding producers in Taiwan for CSPV modules include ***.

Home market

Regarding competition with imports of CSPV products in their home market, twelve producers in Taiwan indicated that they do not compete with imports in the home market. Conversely, three producers in Taiwan that indicated that they compete with imports in the home market noted that the trend in home market competition with imports has remained constant or increased since January 1, 2012. Comments made by individual firms on the trend in home market competition with imports include the following:

*   *   *   *   *   *   *

Export markets

Producers of CSPV products in Taiwan identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012 including: ***. *** noted that "***." Trade barriers exist in the United States and in the European Union and India for certain CSPV products originating in Taiwan.[76]

According to GTA, the leading export markets for CSPV products from Taiwan are China and Vietnam, accounting for 31.3 percent and 20.8 percent, respectively, of total exports from Taiwan in 2016 (table IV-65). During 2016, the United States was the seventh largest export market for CSPV products from Taiwan, accounting for 2.8 percent of total exports.

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[76] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Table IV-65
CSPV products: Exports from Taiwan, 2012-16

Destination market	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Taiwan exports to the United States	265,142	183,913	85,618	109,040	79,458
Taiwan exports to other major destination markets.-- China	651,109	1,144,906	1,383,605	1,071,635	884,957
Vietnam	416	668	8,802	261,710	587,722
Germany	323,687	307,377	263,494	283,046	238,848
Japan	235,414	617,010	725,597	329,629	176,934
Netherlands	81,637	43,784	127,532	160,349	128,016
Singapore	23,283	58,129	95,666	148,394	111,374
Canada	147,162	52,917	135,500	178,836	64,217
Turkey	2,770	11,056	58,456	57,249	59,995
All other destination markets	790,428	602,509	807,832	705,822	497,203
Total Taiwan exports	2,521,047	3,022,270	3,692,102	3,305,709	2,828,722
	Share of value (percent)				
Taiwan exports to the United States	10.5	6.1	2.3	3.3	2.8
Taiwan exports to other major destination markets.-- China	25.8	37.9	37.5	32.4	31.3
Vietnam	0.0	0.0	0.2	7.9	20.8
Germany	12.8	10.2	7.1	8.6	8.4
Japan	9.3	20.4	19.7	10.0	6.3
Netherlands	3.2	1.4	3.5	4.9	4.5
Singapore	0.9	1.9	2.6	4.5	3.9
Canada	5.8	1.8	3.7	5.4	2.3
Turkey	0.1	0.4	1.6	1.7	2.1
All other destination markets	31.4	19.9	21.9	21.4	17.6
Total Taiwan exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under Taiwan-specific HS numbers 8541.40.21 and 8541.40.22 as reported by Taiwan's statistical authority in the GTA database, accessed July 14, 2017.

Thailand

Overview

The Commission issued foreign producer questionnaires to 12 firms believed to produce CSPV products in Thailand. Four firms in Thailand responded to the Commission's questionnaire with useable information, accounting for approximately 52 percent of cell production capacity in 2016 and 44 percent of module capacity in Thailand in 2016. Table IV-66 lists the Thai producers of CSPV cells and modules that responded to the Commission's questionnaire and certain summary data reported in those responses.

Table IV-66
CSPV products: Summary data on responding firms in Thailand, January 2012 to December 2016, by product type

*   *   *   *   *   *   *

Changes in operations

Since January 2012, there have been several firms in Thailand that have experienced changes in the character of their operations. Near year-end 2015, Zhongli Talesun Solar Co. fully commissioned a manufacturing plant with capacity for 500 MW of crystalline silicon cells and modules. Gintech Energy announced the construction of a 350 MW cell and module plant in 2015.[77] Trina Solar Ltd. started production at its new Rayong facility in early 2016, with 700 MW of cell capacity and 500 MW of module capacity.[78]

Regarding operational or organizational changes since January 1, 2012, four producers in Thailand provided details concerning such changes (table IV-67).

Table IV-67
CSPV products: Thai producers' reported changes in operations, since January 1, 2012

*   *   *   *   *   *   *

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[77] Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017.

[78] Trina Solar Launches Operations at Thailand Manufacturing Facility and Signs a US$143 million Syndicated Financing Facilities Agreement, March 28, 2016, http://ir.trinasolar.com/phoenix.zhtml?c=206405&p=irol-newsArticle&ID=2151042.

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, two producers in Thailand reported that they do not anticipate any changes in the character of their CSPV operations, whereas two firms reported the following details presented in table IV-68 concerning the anticipated changes.

Table IV-68
CSPV products: Thai producers' anticipated changes in operations

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Operations on CSPV cells

Reporting firms operating in the CSPV cell industry in Thailand began production in 2016 so historical data are unavailable. Reporting firms estimate Thai capacity, production, capacity utilization, inventories, and shipments will increase from 2016 to 2018 (table IV-69). Home market sales accounted for *** percent of total shipments by the Thai producers in 2016 and are anticipated to fall to *** percent by 2018. Thai CSPV cell producers did not report any exports of CSPV cells to the United States and do not anticipate exporting to the United States in 2017 or 2018. Export markets other than the United States for CSPV cells produced in Thailand accounted for *** percent of the responding Thai producers' total shipments in 2016. Other major export markets identified by producers in Thailand for CSPV cells include ***.

Table IV-69
CSPV cells: Data on the industry in Thailand, 2012-16 and projected 2017-18

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Operations on CSPV modules

Responding firms operating in the CSPV module industry in Thailand reported production only for 2015 and 2016 so historical data are limited. Reporting firms estimate Thai capacity, production, and shipments will increase from 2016 to 2018 (table IV-70). The capacity utilization for firms producing CSPV modules in Thailand increased from *** percent in 2015 to *** percent in 2016. Likewise, inventories of CSPV modules increased from 2015 to 2016. Home market sales accounted for *** percent of total shipments by the Thai producers in 2016. Exports of CSPV modules to the United States accounted for *** percent of total shipments by the Thai producers in 2016. Reporting firms project an overall decline in exports to the United States and an increase to non-U.S., non-EU markets in 2018 over 2016 levels. Export markets other than the United States for CSPV modules produced in Thailand accounted for *** percent of the responding Thai producers' total shipments in 2016. Other major export markets identified by producers in Thailand for CSPV modules include ***.

Table IV-70
CSPV modules: Data on the industry in Thailand, 2012-16 and projected 2017-18

* * * * * * *

Home market

Regarding competition with imports of CSPV products in their home market, three of the responding producers in Thailand indicated that they do not compete with imports in the home market. The one producer in Thailand that indicated that it competes with imports in the home market noted that the trend in home market competition with imports has *** since January 1, 2012, commenting that there are "***."

Export markets

Responding producers of CSPV products in Thailand identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012 including: ***. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in Thailand.[79]

According to GTA, the leading export market for CSPV products from Thailand is the United States, which accounted for 62.0 percent of total exports from Thailand in 2016 (table IV-71). The Netherlands and Malaysia accounted for another 12.6 percent and 6.6 percent, respectively, of CSPV product exports from Thailand in 2016.

[79] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Table IV-71
CSPV products: Exports from Thailand, 2012-16

Destination market	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Thailand exports to the United States	360	224	7	44,617	442,073
Thailand exports to other major destination markets.-- Netherlands	68	681	833	41	89,794
Malaysia	312	45	125	1,624	47,350
Vietnam	0	0	0	323	37,953
Turkey	---	---	---	1	25,925
Korea South	212	---	---	14	19,080
Switzerland	0	7	16	4	10,247
Germany	89	201	114	152	10,105
South Africa	---	1	2	2,400	9,499
All other destination markets	4,465	2,731	3,245	12,173	20,672
Total Thailand exports	5,506	3,889	4,341	61,349	712,698
	Share of value (percent)				
Thailand exports to the United States	6.5	5.8	0.2	72.7	62.0
Thailand exports to other major destination markets.-- Netherlands	1.2	17.5	19.2	0.1	12.6
Malaysia	5.7	1.2	2.9	2.6	6.6
Vietnam	0.0	0.0	0.0	0.5	5.3
Turkey	---	---	---	0.0	3.6
Korea South	3.8	---	---	0.0	2.7
Switzerland	0.0	0.2	0.4	0.0	1.4
Germany	1.6	5.2	2.6	0.2	1.4
South Africa	---	0.0	0.0	3.9	1.3
All other destination markets	81.1	70.2	74.8	19.8	2.9
Total Thailand exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under Thailand-specific HS numbers 8541.40.1000, 8541.40.2000 and 8541.40.9001 as reported by Thailand's statistical authority in the GTA database, accessed July 14, 2017.

Vietnam

Overview

The Commission issued foreign producer questionnaires to 14 firms believed to produce CSPV products in Vietnam. Five firms in Vietnam responded to the Commission's questionnaire with useable information, accounting for approximately *** percent of cell capacity and *** percent of module capacity in Vietnam in 2016. Table IV-72 lists the Vietnamese producers of CSPV cells and modules that responded to the Commission's questionnaire and certain summary data reported in those responses.

Table IV-72
CSPV cells: Summary data on responding firms in Vietnam, January 2012 to December 2016, by product type

* * * * * * *

Changes in operations

All five responding producers in Vietnam reported operational or organizational changes since January 1, 2012. Four firms provided details concerning plant openings and three firms provided details concerning plant expansions (table IV-73).

Table IV-73
CSPV products: Vietnamese producers' reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, four producers in Vietnam reported that they do not anticipate any changes in the character of their CSPV operations, whereas one firm indicated that it anticipates increases in the capacity to produce CSPV cells and modules (table IV-74).

Table IV-74
CSPV products: Vietnamese producers' anticipated changes in operations

* * * * * * *

Operations on CSPV cells

There was no reported capacity or production of CSPV cells in Vietnam in 2012 or 2013. Two of the responding firms in Vietnam (***) opened CSPV cell manufacturing facilities in *** and one firm (***) began cell manufacturing in Vietnam in *** (table IV-75). Since 2014, reporting Vietnamese firms' capacity, production, capacity utilization, inventories, and shipments increased as production ramped up at the three cell facilities. Vietnamese production was reported at *** percent of the *** kW of capacity during 2016. Further increases in capacity, production, and capacity utilization are projected by the three firms into 2017 and 2018. Reported year-end inventories of CSPV cells increased from 2014 to 2016, but are projected to decline in 2017 and 2018.

Table IV-75
CSPV cells: Data on the industry in Vietnam, 2012-16 and projected 2017-18

* * * * * * *

Home market shipments, all of which are reported as internal consumption, accounted for *** percent of total shipments by the responding Vietnamese producers in 2016. These shipments are expected to decline as a share of total shipments in 2017 and 2018, as exports to non-U.S. markets and non-European markets are projected to grow. These other major export markets identified by *** responding producers of cells in Vietnam include ***. There were no exports of CSPV cells to the United States reported during the period of investigation and no exports to the United States are projected for 2017 and 2018. Exports of CSPV cells to the EU were reported by *** only during 2016 and accounted for *** percent of total shipments by the Vietnamese producers in that year. Exports to the EU are projected to be *** in 2017 and 2018. European Union country markets identified by *** for CSPV cells include ***.

Operations on CSPV modules

According to questionnaire data, capacity, production, inventories, and shipments of the industry in Vietnam increased overall from 2012 to 2016 as three of the four reporting firms in Vietnam reported opening and ramping up module assembly operations during that period. Vietnamese production was reported at *** percent of the more than *** kW of capacity during 2016 (table IV-76). Further increases in capacity, production, and capacity utilization are projected by the four module assemblers into 2017 and 2018. Reported year-end inventories of CSPV modules increased from 2012 to 2016, but are projected to decline in 2017 and 2018.

Table IV-76
CSPV modules: Data on the industry in Vietnam, 2012-16 and projected 2017-18

* * * * * * *

Home market shipments of modules, all of which are reported as commercial sales, accounted for a declining share of the responding Vietnamese producers' total shipments since 2013. During 2016, home market shipments of CSPV modules by producers in Vietnam accounted for less than *** percent of total shipments. However, the responding firms project increasing home market sales to *** percent of total shipments by 2018. Exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the responding Vietnamese producers in 2016, increased from *** kW in 2012 to almost *** kW in 2016. They project further increases in their exports to the United States in 2017 and 2018, although they expect U.S. exports will account for a declining share of total shipments as they expect greater increases for exports to non-U.S. and non-EU markets. The EU export market for CSPV modules produced in Vietnam accounted for *** percent of the responding Vietnamese producers' total shipments in 2016 and other non-U.S. export markets accounted for *** percent of total shipments. Major export markets identified by producers in Vietnam for CSPV modules include ***.

Home market

Regarding competition with imports of CSPV products in their home market, four firms in Vietnam indicated that they do not compete with imports in the home market, whereas one firm (***) indicated that it has competed with imports in the home market since January 1, 2012. Concerning the import competition in its home market, *** noted "***."

Export markets

Producers of CSPV products in Vietnam identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012 including ***. There were no trade barriers identified in this investigation with respect to certain CSPV products originating in Vietnam.[80] Export data compiled by the GTA for Vietnam are not presented in this report because data specific to PV products are not available.

The industries in other countries with free trade agreements with the United States

Although the foreign producer questionnaire was available on the Commission's website for download and completion by firms, the Commission did not receive any responses to its questionnaire in this proceeding from firms in Australia, CAFTA-DR countries, Colombia, Israel, Jordan, Panama, or Peru.

[80] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Australia

Overview

Tindo Solar, which is wholly Australian owned, is the sole known CSPV producer in Australia. The firm started production in 2012 at its plant in Adelaide, with a maximum production capacity for multicrystalline silicon (mc-Si) modules of 60 MW throughout the period of investigation. Tindo produces both DC and AC panels with 250W output that are sold to both wholesale and retail PV markets.[81] Production data are not available.

Exports

Export data compiled by GTA for Australia are not presented because data specific to PV products are not available.

CAFTA-DR

Overview

Of the CAFTA-DR member countries, only the Dominican Republic and El Salvador are known to have had capacity to produce CSPV modules during the period of investigation. In the Dominican Republic, Fluitecnik SA (Spain) opened a 12 MW CSPV module production facility in 2008.[82] In El Salvador, Alba Petróleos and Speedtech Energy (Taiwan) operate a 15 MW capacity CSPV module plant that started production in 2015.[83]

Exports

Export data compiled by GTA for the Dominican Republic and El Salvador are not presented because data specific to PV products are not available.

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[81] IEA, National Survey Report of PV Power Applications in AUSTRALIA 2015, http://www.iea-pvps.org/?id=93.

[82] Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017.

[83] Bloomberg New Energy Finance database, https://about.bnef.com/, accessed April 27, 2017; Inaugurada primera fábrica de módulos solares de Centroamérica, March 2, 2015, https://www.pv-magazine-latam.com/2015/03/02/inaugurada-primera-fbrica-de-mdulos-solares-de-centroamrica/.

Jordan

Overview

Philadelphia Solar is the only known CSPV producer in Jordan. It produces both monocrystalline and multicrystalline modules, and has an annual production capacity of 120 MW.[84]

Exports

Export data compiled by GTA for Jordan are not presented because data specific to PV products are not available.

Panama

Overview

Visel Group is the only producer identified in Panama. The firm produces PV modules, and has a production capacity of 15 MW at its plant in Panama. The firm produces monocrystalline and multicrystalline modules from 80 to 340 watts for grid-connected and off-grid applications, though it is not clear whether all of these products are produced at their plant in Panama.[85]

Exports

Export data compiled by GTA for Panama are not presented because data specific to PV products are not available.

Other countries with FTAs

No production of CSPV cells or modules was identified for other FTA partner countries not otherwise separately presented in this part of the report, including Colombia, Israel, and Peru or in countries benefitting from the Caribbean Basin Economic Recovery Act preferential trade act program.

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[84] LinkedIn Website, https://www.linkedin.com/company/philadelphia-solar (accessed July 21, 2017).

[85] The firm also has 35 MW of production capacity in China. Visel Group, “Moving the Sun Light to the World,” pp. 14, 17–18, http://viselpaneles.com/sites/default/files/viselpaneles.pdf (accessed July 21, 2017).

The industries in other countries

Brazil

Overview

The foreign producer questionnaire was available on the Commission's website for download and completion by firms in Brazil. One firm in Brazil responded to the Commission's questionnaire with useable information, accounting for less than *** percent of 2016 module production capacity in Brazil. Table IV-77 identifies the Brazilian producer of CSPV modules that responded to the Commission's questionnaire and certain summary data reported in that response.

Table IV-77
CSPV products: Summary data on firms in Brazil, January 2012 through December 2016

* * * * * * *

Changes in operations

One producer in Brazil reported operational and organizational changes since January 1, 2012 (table IV-78).

Table IV-78
CSPV products: Brazilian producers' reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, the producer in Brazil reported that it does not anticipate any changes in the character of its CSPV operations.

Operations on CSPV cells

There was no capacity to produce CSPV cells reported by the sole responding firm in Brazil.

Operations on CSPV modules

The sole responding firm in Brazil began production in 2016 so there are no historic data to compare. The producer projects higher capacity, production, and shipments in 2017 and 2018 compared with 2016 levels (Table IV-79). The capacity utilization for the firm producing CSPV modules in Brazil was *** percent during 2016 and the firm ***. Home market sales accounted for *** percent of total shipments by the Brazilian producer in 2016 and the producer projects this will continue in 2017 and 2018. The producer *** CSPV modules in 2016 and *** in 2017 or 2018.

Table IV-79
CSPV modules: Data on the industry in Brazil, 2012-16 and projected 2017-18

* * * * * * *

According to publicly available information, the number of PV module producers in Brazil increased from one prior to 2015 to at least nine as of July 2017. Production capacity during this time period increased from 25 MW to more than 1 GW.[86] In order to qualify for financing by the National Bank for Economic and Social Development ("BNDES"), the Brazilian Development bank for Brazilian projects, companies are required to assemble modules in Brazil.[87]

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[86] BYD, "BYD Launches R$150 Million Solar Panel Factory in Brazil," News release, April 9, 2017, http://www.byd.com/news/news-391.html; Canadian Solar, "Canadian Solar Opens Brazil's Largest Capacity Solar Module Manufacturing Facility," News release, December 12, 2016, http://investors.canadiansolar.com/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=2228908; Globo Brasil Website, http://www.paineisglobobrasil.com.br/globobrasil (accessed July 23, 2017); Lopez, Blanca Diaz and Edgar Meza, "Brazil: Pure Energy Secures $10 Million for New Module Fab," *PV Magazine*, January 7, 2015, https://www.pv-magazine.com/2015/01/07/brazil-pure-energy-secures-10-million-for-new-module-fab_100017679/; Photon.info, "Soliker to Build PV Module Factory in Brazilian State of Tocantins," March 4, 2015, https://www.photon.info/en/news/soliker-build-pv-module-factory-brazilian-state-tocantins; Osborne, Mark, "S4 Solar do Brazil Readies Module Production in Brazil," PV tech, June 3, 2016, https://www.pv-tech.org/news/s4-solar-do-brazil-readies-module-production-in-brazil; Associação Brasileira de Distribuidores e Processadores de Vidros Planos (Abravidro) Website, http://abravidro.org.br/en/uma-luz-para-o-nosso-setor/ (accessed July 23, 2017); Ministry of Economic Affairs of The Netherlands, *Market Study: PV Energy in Brazil*," April 23, 2015, p. 15, https://www.rvo.nl/sites/default/files/2015/04/Final%20-%20Solar%20PV%20Study%20Brazil%2024%20April%202015.v2.pdf.

[87] Starting in 2020, BNDES will also require domestic cell production. Kenning, Tom, "Brazil Solar Policy Needed to Support Domestic Manufacturing – Absolar," PV Tech, September 7, 2015, https://www.pv-tech.org/news/specific_policy_needed_for_brazilian_solar_manufacturing_absolar.

Home market

Regarding competition with imports of CSPV products in the home market, the producer in Brazil that indicated that it competes with imports in the home market noted that the trend in home market competition with imports has increased since January 1, 2012 because the firm's production began in 2016.

Export markets

The responding producer of CSPV products in Brazil did not identify any major export markets other than the United States that it had developed or where it had increased sales since January 1, 2012. There were no trade barriers identified in this proceeding with respect to certain CSPV products originating in Brazil.[88]

According to GTA, the leading export markets for CSPV cells and modules from Brazil are Colombia, Paraguay, the United States, and Germany (table IV-80). The leading export market for CSPV products from Brazil during 2016 was Colombia, which accounted for 36.3 percent of total exports. Paraguay, the United States, and Germany accounted for 12.5, 12.1, and 10.9 percent of total exports from Brazil during 2016, respectively.

[88] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Table IV-80
CSPV products: Brazil exports by destination market, 2012-16

Destination market	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Brazil exports to the United States	1	1	10	1	9
Brazil exports to other major destination markets.-- Colombia	2	8	1	0	26
Paraguay	0	6	2	8	9
Germany	2	10	17	0	8
Chile	7	---	1	1	4
Argentina	5	2	13	15	4
Ecuador	4	1	1	1	3
Uruguay	4	1	1	2	3
Bolivia	2	0	---	3	2
All other destination markets	61	34	73	118	4
Total Brazil exports	89	63	117	149	71
	Share of value (percent)				
Brazil exports to the United States	1.3	1.5	8.4	0.8	12.1
Brazil exports to other major destination markets.-- Colombia	2.0	12.8	1.0	0.3	36.3
Paraguay	0.4	9.8	1.3	5.2	12.5
Germany	2.7	15.3	14.3	0.0	10.9
Chile	8.2	---	0.4	0.9	5.7
Argentina	5.6	3.4	10.9	9.8	5.3
Ecuador	4.3	0.8	0.6	0.9	4.1
Uruguay	4.0	1.1	0.9	1.3	3.9
Bolivia	2.5	0.4	---	1.8	3.3
All other destination markets	69.0	54.8	62.1	79.1	6.0
Total Brazil exports	100.0	100.0	100.0	100.0	100.0

Source: Official exports statistics under Brazil-specific HS numbers 8541.40.16, 8541.40.32 and 8541.40.39 as reported by Brazil's statistical authority in the GTA database, accessed July 14, 2017.

Germany

Overview

The Commission issued foreign producer questionnaires to 35 firms believed to produce CSPV products in Germany. Five firms in Germany responded to the Commission's questionnaire with useable information, accounting for all known cell capacity and 51 percent of module production capacity in Germany in 2016. Table IV-81 lists the German producers of CSPV cells and modules that responded to the Commission's questionnaire and certain summary data reported in those responses. *** producer, accounting for *** percent of reported CSPV cell production and *** percent of reported CSPV module production in Germany during 2012-16.

Table IV-81
CSPV cells: Summary data on responding firms in Germany, January 2012 to December 2016, by product type

* * * * * * *

Changes in operations

Three of the responding producers in Germany reported operational or organizational changes since January 1, 2012 (table IV-82).

Table IV-82
CSPV products: German producers' reported changes in operations, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, four producers in Germany reported that they did not anticipate any changes in the character of their CSPV operations, whereas one firm (***) reported the following concerning changes it anticipated (table IV-83).

Table IV-83
CSPV products: German producers' anticipated changes in operations

* * * * * * *

Operations on CSPV cells

German capacity, production, inventories, and shipments increased from 2012 to 2016 (table IV-84). Aggregate capacity and production were *** greater in 2016 than the level reported in 2012, while capacity utilization for firms producing CSPV cells in Germany fluctuated between *** and *** percent during 2012-16. Year-end inventories of CSPV cells fluctuated somewhat but increased overall by *** percent at year-end 2016 over the level reported at year-end 2012.

Table IV-84
CSPV cells: Data on the industry in Germany, 2012-16 and projected 2017-18

* * * * * * *

Home market shipments, which were virtually all internal consumption of cells in the production of modules, accounted for *** percent of total cell shipments by the responding German producers in 2016. These home market shipments in 2016 were *** home market shipments reported in 2012. Exports of CSPV cells to the United States, which accounted for *** percent of total shipments by the responding German producers in 2016, increased from *** kW in 2012 to *** kW in 2016. Other export markets for CSPV cells produced in Germany, which accounted for *** percent of the responding German producers' total shipments since 2012, include ***.

Operations on CSPV modules

Publicly available data for Germany indicated that module production capacity totaled 2,795 MW in 2016, down from 3,472 MW in 2011.[89] SolarWorld AG,[90] a fully integrated manufacturer, is Germany's largest PV firm. Manufacturing capacity at its two German locations totaled 860 MW for modules in 2016. At least 18 other firms produce only modules, with a combined production capacity of more than 1,935 MW.[91]

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[89] Photovoltaics–Made In Germany, Germany Trade & Invest, October 2016. https://www.powerhouse-eastern-germany.de/PEG/Content/DE/Zukunftsfelder/Cleantech-Industrie/pdf_solar.pdf?v=2; Lothar Wissing, National Survey Report of PV Power Applications in Germany 2011, p. 21, http://www.iea-pvps.org/?id=93.

[90] SolarWorld AG Filed for Bankruptcy in May 2017. Jonathan Gifford, "Breaking: SolarWorld Insolvent," *PV Magazine*, May 10, 2017, https://www.pv-magazine.com/2017/05/10/breaking-solarworld-insolvent/.

[91] Photovoltaics–Made In Germany, Germany Trade & Invest, October 2016. https://www.powerhouse-eastern-germany.de/PEG/Content/DE/Zukunftsfelder/Cleantech-Industrie/pdf_solar.pdf?v=2.

Reported questionnaire data show that German capacity, production, and total shipments generally increased from 2012 to 2016 (table IV-85). Capacity and production increased by *** and *** percent, respectively, from 2012 to 2016, as one firm (***) opened module assembly facilities and another (***) increased capacity in 2014. Capacity utilization for firms producing CSPV modules in Germany fluctuated within the range of *** and *** percent during 2012-16. Likewise, inventories of CSPV modules, which were *** and *** percent of production and total shipments, respectively, in 2016, fluctuated from 2012 to 2016.

Table IV-85
CSPV modules: Data on the industry in Germany, 2012-16 and projected 2017-18

* * * * * * *

Home market shipments, which were virtually all commercial sales during 2012-16, accounted for *** percent of total CSPV module shipments by the responding German producers in 2016. These home market shipments declined by *** percent from 2012 to 2014, before increasing in 2015 and 2016 to a level in 2016 that was *** percent below that reported in 2012. Exports of CSPV modules to the United States, which accounted for *** percent of total shipments by the German producers in 2016, increased from *** kW in 2012 to *** kW in 2016. Other export markets for CSPV modules produced in Germany accounted for a relatively large and increasing share of the German producers' total shipments. Exports of CSPV modules to other countries in the European Union accounted for *** percent of total shipments by German producers in 2016. European Union export markets identified by producers in Germany for CSPV modules include ***. Exports to other third market countries accounted for *** percent of total shipments by German producers in 2016. These third market countries identified by responding producers in Germany include ***.

Home market

Regarding competition with imports of CSPV products in their home market, one producer in Germany indicated that it did not compete with imports in the home market. Three of the remaining responding producers in Germany that indicated that they compete with imports in the home market noted that the trend in home market competition with imports has increased since January 1, 2012, whereas the others noted that competition with imports has either been constant or fluctuated over time. Individual company explanations for trends in home market competition with imports include the following:

* * * * * * *

Export markets

Responding producers of CSPV products in Germany identified export markets other than the United States that they have developed or where they have increased sales since January 1, 2012 including ***. SolarWorld noted that "***."

There were no trade barriers identified in these proceedings with respect to certain CSPV products originating in Germany.[92] Export data compiled by the GTA for Germany are not presented in this report because data specific to PV products are not available.

The Netherlands

Overview

The foreign producer questionnaire was available on the Commission's website for download and completion by firms in the Netherlands. One firm in the Netherlands responded to the Commission's questionnaire with useable information, accounting for all known production of CSPV products in the Netherlands. Table IV-86 lists the producer of CSPV cells in the Netherlands that responded to the Commission's questionnaire and certain summary data reported in the response.

Table IV-86
CSPV cells: Summary data on responding firms in the Netherlands, January 2012 to December 2016

* * * * * * *

Changes in operations

The responding producer in the Netherlands reported operational or organizational changes since January 1, 2012 (table IV-87).

Table IV-87
CSPV products: Reported changes in operations by the producer in the Netherlands, since January 1, 2012

* * * * * * *

Anticipated changes in operations

Regarding anticipated changes in the character of their operations relating to CSPV products in the future, the producer in the Netherlands reported ***.

Operations on CSPV cells

The only responding firm in the Netherlands began production in 2016 so there are no historic data to compare. The producer projects significantly lower capacity, production, and

[92] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

shipments in 2017 and 2018 compared with 2016 levels (table IV-88). The capacity utilization for the firm producing CSPV cells in the Netherlands was *** percent in 2016. Home market sales accounted for *** percent of total shipments by producers in the Netherlands and the producer *** in 2016. Export markets other than the United States for CSPV cells produced in the Netherlands accounted for *** percent of the responding Dutch producer's total shipments in 2016 and the company projects future production will be *** in 2017 and 2018. Other major export markets identified by the producer in the Netherlands for CSPV cells include ***.

Table IV-88
CSPV cells: Data on the industry in the Netherlands, 2012-16 and projected 2017-18

* * * * * * *

Operations on CSPV modules

The responding producer/exporter in the Netherlands did not report any production or exports of CSPV modules in 2016, nor did it project any future production for 2017 and 2018.

Home market

Regarding competing with imports of CSPV products in its home market, the only firm the Netherlands that responded to the questionnaire indicated that it does not compete with imports in the home market.

Export markets

The producer of CSPV products in the Netherlands did not identify any export markets that it has developed or where it increased sales because 2016 was its first year in operation. There were no trade barriers identified in these proceedings with respect to certain CSPV products originating in the Netherlands.[93] Export data compiled by the GTA for the Netherlands are not presented in this report because data specific to PV products are not available.

The responding industries combined

Combined information on the CSPV product operations of the 101 producers/exporters in all 16 countries that provided responses to the Commission's foreign producer/exporter questionnaire in this investigation for calendar years 2012-16, as well as their combined projections for 2017-18, is presented in table VII-89 (CSPV cells) and table VI-90 (CSPV modules).

[93] For further information on trade barriers in third-country markets, see section titled "Restraints on Exports to, or on Imports into, Third-Country Markets" in *Part I* of this report.

Table IV-89
CSPV cells: Data on industry in all sources, 2012-16 and projected calendar years 2017 and 2018

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	27,337,286	31,220,500	36,439,876	43,341,003	56,877,024	65,476,392	70,185,416
Production	18,401,207	23,968,755	31,231,437	37,959,187	47,958,366	56,741,719	62,510,568
End-of-period inventories	664,204	858,421	1,422,907	1,451,376	2,438,250	2,208,907	2,351,748
Shipments: Home market: Internal consumption/ transfers	11,957,204	14,842,865	20,201,636	23,910,251	34,087,283	41,816,479	46,324,708
Commercial shipments	1,299,882	1,577,769	1,607,903	4,146,612	3,113,585	4,228,746	4,496,413
Subtotal, home market shipments	13,257,086	16,420,634	21,809,539	28,056,863	37,200,868	46,045,225	50,821,121
Export shipments to: United States	274,108	247,001	117,695	252,896	607,797	439,855	536,685
European Union	1,689,294	1,721,314	1,627,561	1,925,903	1,441,285	1,637,417	1,667,336
All other markets	3,069,039	5,373,824	7,055,581	7,688,450	7,842,416	8,729,700	9,375,508
Total exports	5,032,441	7,342,139	8,800,837	9,867,249	9,891,498	10,806,972	11,579,529
Total shipments	18,289,527	23,762,773	30,610,376	37,924,11	47,092,366	56,852,197	62,400,650
	Ratios and shares (percent)						
Capacity utilization	67.3	76.8	85.7	87.6	84.3	86.7	89.1
Inventories/production	3.6	3.6	4.6	3.8	5.1	3.9	3.8
Inventories/total shipments	3.6	3.6	4.6	3.8	5.2	3.9	3.8
Share of shipments: Home market: Internal consumption/ transfers	65.4	62.5	66.0	63.0	72.4	73.6	74.2
Commercial shipments	7.1	6.6	5.3	10.9	6.6	7.4	7.2
Subtotal, home market shipments	72.5	69.1	71.2	74.0	79.0	81.0	81.4
Export shipments to: United States	1.5	1.0	0.4	0.7	1.3	0.8	0.9
European Union	9.2	7.2	5.3	5.1	3.1	2.9	2.7
All other markets	16.8	22.6	23.0	20.3	16.7	15.4	15.0
Total exports	27.5	30.9	28.8	26.0	21.0	19.0	18.6
Total shipments	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Compiled from data submitted in response to Commission questionnaires.

Table IV-90

CSPV modules: Data on industry in all sources, 2012-16 and projected calendar years 2017 and 2018

Item	Actual experience					Projections	
	Calendar year						
	2012	2013	2014	2015	2016	2017	2018
	Quantity (kW)						
Capacity	25,220,429	29,175,177	36,411,804	47,912,657	66,611,870	75,849,494	101,319,724
Production	15,789,716	20,848,784	28,619,986	38,441,620	51,430,556	63,146,950	70,921,329
End-of-period inventories	1,469,841	1,632,198	2,754,735	3,090,425	3,963,102	4,152,019	4,369,156
Shipments: Home market: Internal consumption/ transfers	1,118,524	2,392,560	2,878,762	3,407,500	3,617,734	6,482,549	8,497,106
Commercial shipments	2,327,088	4,874,199	6,665,802	11,274,345	18,473,701	23,084,322	25,786,450
Subtotal, home market shipments	3,445,612	7,266,759	9,544,564	14,681,845	22,091,435	29,566,871	34,283,556
Export shipments to: United States	2,311,545	3,208,589	4,727,225	7,828,975	11,822,895	8,772,953	8,439,592
European Union	5,396,870	4,080,856	4,400,864	3,926,287	4,369,185	4,808,192	5,734,442
All other markets	4,270,515	6,176,012	9,040,159	11,619,823	11,822,125	19,720,333	21,989,157
Total exports	11,978,930	13,465,457	18,168,248	23,375,085	28,014,205	33,301,478	36,163,191
Total shipments	15,424,542	20,732,216	27,712,812	38,056,930	50,105,640	62,868,349	70,446,747
	Ratios and shares (percent)						
Capacity	62.6	71.5	78.6	80.2	77.2	83.3	70.0
Production	9.3	7.8	9.6	8.0	7.7	6.6	6.2
End-of-period inventories	9.5	7.9	9.9	8.1	7.9	6.6	6.2
Shipments: Home market: Internal consumption/ transfers	7.3	11.5	10.4	9.0	7.2	10.3	12.1
Commercial shipments	15.1	23.5	24.1	29.6	36.9	36.7	36.6
Subtotal, home market shipments	22.3	35.1	34.4	38.6	44.1	47.0	48.7
Export shipments to: United States	15.0	15.5	17.1	20.6	23.6	14.0	12.0
European Union	35.0	19.7	15.9	10.3	8.7	7.6	8.1
All other markets	27.7	29.8	32.6	30.5	23.6	31.4	31.2
Total exports	77.7	64.9	65.6	61.4	55.9	53.0	51.3
Total shipments	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Compiled from data submitted in response to Commission questionnaires.

PART V: OTHER COMPETITIVE DYNAMICS OF THE U.S. MARKET

Market overview

As discussed in *Part I*, there are four primary market segments for CSPV products.[1] The three on-grid market segments are residential, commercial, and utility. The off-grid market segment is relatively small and includes systems used in mobile power solutions, telecommunications power and lighting, and portable consumer goods. However, the vast majority of CSPV modules sold in the United States are connected to the grid.[2] Modules vary in size, nominal power output, and efficiency. Typical on-grid modules have 60 to 72 cells and a power output of between 240 watts and 340 watts.[3] Residential and small commercial solar installations typically use 60-cell modules due to their higher conversion efficiency and smaller size. The majority of utility-scale projects now use 72-cell modules which are typically less expensive to install due to lower labor and balance of system costs.[4] Overall, apparent U.S. consumption of CSPV products increased, by quantity, *** percent from 2012 to 2016.[5]

U.S. installations of on-grid PV systems have increased by 338 percent from 3,373 MW in 2012 to 14,762 MW in 2016.[6] All three on-grid market segments (residential, commercial, and utility) have experienced considerable growth in both the number of installations and the total wattage of installation projects during the period of investigation, with residential and utility installations increasing by 423 percent and 488 percent, respectively, from 2012 to 2016 (figure V-1).[7] While there has been growth in the overall market for CSPV products, demand trends vary across geographic markets, market segments, and customer types.

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[1] CSPV products is defined as certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products.

[2] Hearing transcript, pp. 185-86 (Card and Messer).

[3] SEIA's prehearing brief, p. 3 and appendix A, pp. 35-36; and hearing transcript, p. 174 (Messer).

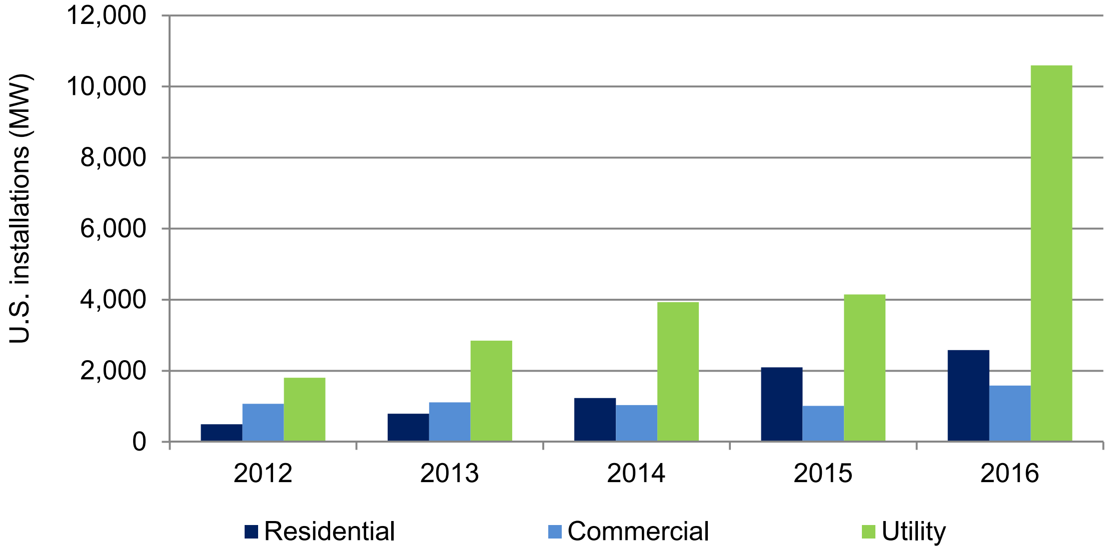
[4] Previously, utilities also purchased 60-cell modules, including 60-cell monocrystalline modules. *See, e.g.*, *CSPV 1*, USITC Pub. 4360.

[5] Overall, apparent U.S. consumption of 60-cell CSPV modules increased by *** percent and apparent U.S. consumption of 72-cell CSPV modules increased by *** percent from 2012 to 2016. See *Table C-5*.

[6] In 2016, there were over 370,000 individual new PV systems installed in the United States. GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, p. 6.

[7] According to the U.S. Energy Information Administration (EIA), the average size of a residential PV system is 5 kW, commercial PV systems average 200 kW, and a utility scale project is defined as having a capacity of 1 MW and above. U.S. Energy Information Administration, "Utility-scale solar has grown rapidly over the past five years," May 4 2017, https://www.eia.gov/todayinenergy/detail.php?id=31072; and U.S. Energy Information Administration, "More than half of small-scale photovoltaic generation comes from residential rooftops, June 1, 2017, https://www.eia.gov/todayinenergy/detail.php?id=31452. As the Commission noted in its prior AD/CVD investigations, the utility segment grew from the smallest segment of the U.S. market in 2009 to the largest by the first half of 2012. USITC Pub. 4360 at n.258.

Figure V-1
Annual U.S. installations of PV solar by market segment, 2012-2016



Source: GTM Research and the Solar Energy Industries Association (SEIA), U.S. Solar Market Insight: 2012-2016 Year in Review, Executive Summaries.

U.S. installations of PV solar grew 97 percent from 2015 to 2016 (figure V-1). This growth, particularly in the utility segment, was driven by the anticipated expiration of the 30 percent federal Investment Tax Credit which had been scheduled to step down at the end of 2016. The utility segment is the largest market segment.[8] As of December 2016, more than 19,770 MW of utility-scale solar PV generating capacity was in operation across the United States, representing 60 percent of total U.S. solar PV installations.[9] [10] The majority of U.S. importers' U.S commercial shipments of imported CSPV products and *** of U.S. producers' commercial shipments of CSPV products were sold to utilities during 2012-16 (see *Part I,* table I-1).[11]

[8] GTM Research and the Solar Energy Industries Association (SEIA), U.S. Solar Market Insight: 2016 Year in Review, Executive Summary, 2017, pp. 7-8.

[9] U.S. Energy Information Administration, *Electric Power Monthly*, Table 6.1.A., July 31, 2017.

[10] The average utility-scale solar project has increased from 10 MW in 2014 to more than 17 MW in 2016. U.S. Energy Information Administration, "More than half of small-scale photovoltaic generation comes from residential rooftops," June 1, 2017, https://www.eia.gov/todayinenergy/detail.php?id=31452. According to respondent SEIA, 82 percent of utility-scale installations were greater than 20 MW and 13 percent were less than 10 MW in 2016. SEIA's posthearing brief, p. 6.

[11] Respondent SEIA argues that SolarWorld and Suniva do not have the capacity to supply most utility-scale projects, which typically use 72-cell modules. SolarWorld reported that currently it is capable of supplying modules for projects up to ***, and that it has sold up to *** of modules for a single project during the period of investigation. SolarWorld's posthearing brief, exh. 1, pp. 23-26. SolarWorld stated that *** it added a U.S. 72-cell module-assembly line in 2016 due to increasing

Utility project development is the most concentrated market segment, with the top nine utility project developers accounting for 70 percent of the market in 2016.[12] Utility-scale projects often involve a bidding process. [13] Bids are generally submitted by the project developers or engineering, procurement, and construction ("EPC") firms; once a contract has been awarded, the EPC will enter into a supply agreement with a manufacturer to source modules.[14] [15] The utility segment is acutely price sensitive and bids can often involve price renegotiations throughout the project.[16]

U.S. supply

U.S. producers' capacity and production of CSPV cells increased year-on-year throughout the period. Additionally, global capacity to produce CSPV cells increased rapidly from 2012 to 2016, with China and Taiwan accounting for the largest share of global production.[17] Table V-1 reports U.S. producers' and major foreign producers' capacity, capacity utilization, inventories of CSPV cells, as well as sales of CSPV modules to various markets in 2012 and 2016.

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demand in the utility market. SolarWorld's posthearing brief, p. 10. Suniva reported that 45 percent of its overall cell manufacturing capacity went into 72-cell modules to service both the commercial and "small utility market" during the period. Hearing transcript, p. 164 (Card).

[12] Energy Acuity, *2016 Solar Report: Utility Scale*, March 2017, pp. 7, 11, https://www.energyacuity.com/energy-acuity-reports; Finlay Colville, "Top-10 Solar Cell Producers in 2016," *PV Tech*, January 30, 2017, https://www.pv-tech.org/editors-blog/top-10-solar-cell-producers-in-2016. See *Part I* for more information.

[13] Both Suniva and SolarWorld provided their firms' bids on utility projects during 2012-16. SolarWorld provided a list of *** utility-scale projects, totaling *** that it bid on during the period. Of these bids, SolarWorld won *** projects totaling *** and supplied an additional *** of modules to customers for utility projects through supply agreements with various companies. SolarWorld reported that it has supply agreements with *** and therefore, has limited information on specific bid proposals for which SolarWorld's modules were used. SolarWorld's posthearing brief, exh. 1, pp. 22-23. Suniva provided a list of *** utility-scale bids, which totaled *** during 2012-16. Suniva's posthearing brief, exh. 9, pp. 1-2 and attachment A.

[14] SolarWorld's posthearing brief, pp. 22-23; and staff correspondence with ***.

[15] According to NRG, one of the largest independent power producers in the United States, it specifies the design of a module required for a utility project three years in advance of construction, solicits RFPs approximately 12 months from construction, and makes its final module selection no later than 6 months before the start of construction. NRG stated that its projects can reach 200 MW in size. Hearing transcript, pp. 320-322 (Cornelius).

[16] Hearing transcript, pp. 175, 183, and 320-321 (Card, Messer, and Cornelius); SEIA's posthearing brief, appendix A, p. 36.

[17] IEA PVPS, Trends 2016 in Photovoltaic Power Applications, Report IEA PVPS T1-30:2016, 2016, p. 48, http://www.iea-pvps.org/fileadmin/dam/public/report/national/Trends_2016_-_mr.pdf. See *Part IV* for more information.

Table V-1
CSPV products: U.S. and foreign producers' capacity, capacity utilization, inventories, ability to shift to alternate products, and sales to various markets

* * * * * * *

U.S. producers

U.S. producers' overall capacity and production for CSPV cells increased during 2012-16. Domestic capacity utilization for CSPV cells increased from *** percent in 2012 to *** percent in 2016 (table V-1).[18] However, U.S. producers' capacity is slightly overstated in 2016. Tesla began the process to open a manufacturing facility in Buffalo, NY to produce CSPV cells and modules in 2016; however, this capacity is not currently being used for U.S. production and represented *** percent of total domestic capacity in 2016 .[19] ***.[20]

U.S. producers' inventories of CSPV cells, as a ratio to total shipments, fell from *** percent in 2012 to *** percent in 2016; and U.S. producers' inventories of CSPV modules, as a ratio to total shipments, increased overall from *** percent in 2012 to *** percent in 2016., with U.S. producers reporting that they generally sell produced-to-order products (see "Lead Times" later in this chapter). Export shipments of both CSPV cells and modules represented a small share of U.S. producers' total shipments during 2012-16; ***.

Based on available information, U.S. producers of CSPV products have the ability to respond to changes in demand with small to moderate changes in the quantity of shipments of U.S.-produced CSPV products to the U.S. market.[21] The main contributing factors to this degree

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[18] Domestic capacity utilization for CSPV modules fluctuated during the period, decreasing from *** percent in 2012 to *** percent in 2016.

[19] The small quantities (***) of U.S. CSPV cells produced by Tesla in 2016 were all used for R&D at its Fremont, CA facility. Tesla anticipates that it will begin production of 1 GW of CSPV cells and modules annually in 2019. Tesla 10-Q Quarterly Report, August 4, 2017, p. 4, http://ir.tesla.com/sec.cfm?view=all.

[20] Domestic capacity and production for CSPV cells continued to change during 2016 and the first half of 2017. Mission Solar, which accounted for *** percent of U.S. production during 2016, closed its cell production lines in September 2016 and its cell manufacturing lines are currently for sale. Suniva expanded its production capacity of CSPV cells in July 2016. ***. In addition, SunPower reported that it opened a $25 million R&D facility which produces CSPV cells in California which it can scale up to megawatts. Hearing transcript, p. 328 (Werner). See *Part III* for more information. Petitioners argue that the domestic industry has the ability to rapidly scale up CSPV cell production capacity. Hearing transcript, pp. 154-157 (Payne, Card, and Brightbill).

[21] Staff's U.S. supply analysis is based on the supply of U.S. CSPV cells, whether or not partially or fully assembled into other products. CSPV cells are used only in the production of CSPV modules and the production of modules requires CSPV cells. Therefore, the supply analysis is heavily weighted on the production and capacity of CSPV cells, but also takes into account inventory and export levels of CSPV modules which contain CSPV cells.

of responsiveness of supply are the overall domestic capacity level, some unused capacity, some inventories and limited ability to shift shipments from alternate markets.[22] [23]

Foreign producers

Foreign producers' reported CSPV cell capacity increased substantially in the nine identified countries (table V-1). Data for responding foreign producers suggest that capacity utilization for CSPV cells is moderately high. In general, foreign producers' inventories of CSPV cells, as a ratio to total shipments, were small. Similarly to U.S. producers, most responding importers reported that they generally sell produced-to-order products. The vast majority of U.S. imports of CSPV products entered the United States as CSPV modules. Foreign producers ship substantial amounts of CSPV modules to non-U.S. markets. The vast majority of responding foreign producers reported that they could not produce other products with the same equipment and workers used to produce CSPV products.

Based on available information, foreign producers of CSPV products have the ability to respond to changes in demand with large changes in the quantity of shipments of CSPV products to the U.S. market. The main contributing factors to this degree of responsiveness of supply are large and increasing capacity, the availability of unused capacity, and the ability to shift shipments from alternate markets and inventories. Factors mitigating responsiveness of supply include limited ability to shift production to or from alternate products.

Changes in availability of U.S. supply

According to firms' responses, the availability of both domestically produced and imported CSPV products in the U.S. market has changed since 2012. Most U.S. producers, importers, and purchasers reported that the availability of U.S.-produced CSPV products has declined primarily due to a number of plant closures while the availability of imported CSPV products in the U.S. market has increased since 2012. According to U.S. producer ***, while U.S. capacity has remained relatively flat, foreign capacity has rapidly increased particularly in China, Taiwan, Thailand, Vietnam, Malaysia, Singapore, Korea, Mexico, and Canada in the last five years.[24]

Most firms anticipate further changes to the availability of both domestically produced and imported CSPV products. Most U.S. producers, importers, and purchasers stated that they anticipate further reductions in the availability of domestically produced CSPV products with firms noting the pending bankruptcies of SolarWorld's parent company and Suniva. Most firms anticipate that the decreased availability of domestic CSPV products will be offset by an increase in imported product.

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[22] Reported U.S. capacity to produce CSPV cells grew at a slower rate than apparent U.S. consumption from 2012 to 2016.

[23] Staff's analysis of how U.S. supply would shift due to changes in demand does not take into account ***.

[24] *** U.S. producer questionnaire response, section IV-13.

Supply constraints

Two-thirds of responding purchasers (66 of 104) reported that their suppliers were unable to supply CSPV products since 2012. Other firms noted that occasionally demand has outpaced the available supply. Purchaser *** stated that both Suniva and SolarWorld have had delayed deliveries. Purchaser *** reported that Suniva was unable to fulfil an order in the third quarter of 2016 and therefore, it switched suppliers and purchased from SolarWorld. A few purchasers stated that global market conditions have an impact on U.S. supply, with *** specifying that increased demand in China has created supply constraints and delayed shipments in the U.S. market. *** stated that there have been supply constraints for high volume purchases of higher wattage modules. Several purchasers also reported that since the filing of the 201 safeguard petition, their supply has been disrupted due to a surge in demand as firms purchase large quantities of CSPV products at current price levels ahead of any final ruling.

U.S. demand

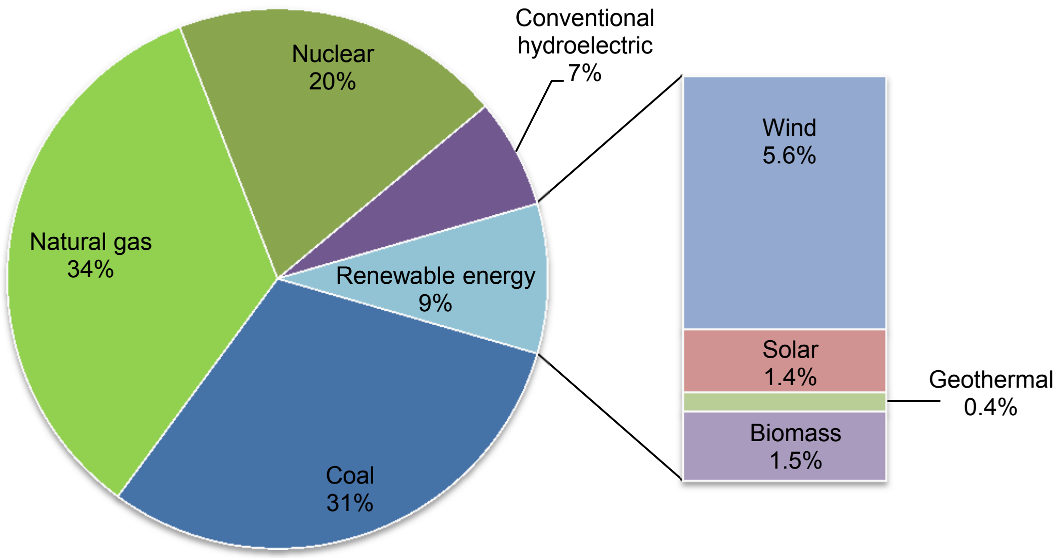
Based on available information, the overall demand for CSPV products is likely to experience moderately large to large changes in response to changes in price. The main contributing factors are the availability of substitute products and the large cost share of CSPV products in most of its end-use products.

The demand for CSPV products and modules is derived from the demand for solar electricity. The increasing demand for solar electricity is attributed to increasing cost of electricity and energy consumption, environmental concerns and the general movement toward “green energy” alternatives, cost competitiveness with traditional energy sources, a desire for national energy independence, and the availability of federal, state, and local incentives.

Electricity demand in the United States is supplied primarily by conventional sources, with coal and natural gas accounting for almost two-thirds of all electricity generated in 2016 (figure V-2). Renewable energy sectors (excluding hydroelectric) accounted for 9 percent of electricity generated in the United States in 2016, with solar energy accounting for 1.4 percent of total generated electricity. However, the share of electricity generated from renewable energy sources, such as solar, has been steadily increasing. While solar generated electricity is one of the smallest sectors, its yearly average output has grown 749 percent from 2012 to 2016.[25] In 2016, solar was the largest source of new electric generating capacity, accounting for 39 percent of all new electric generating capacity installed in the United States (figure V-3).

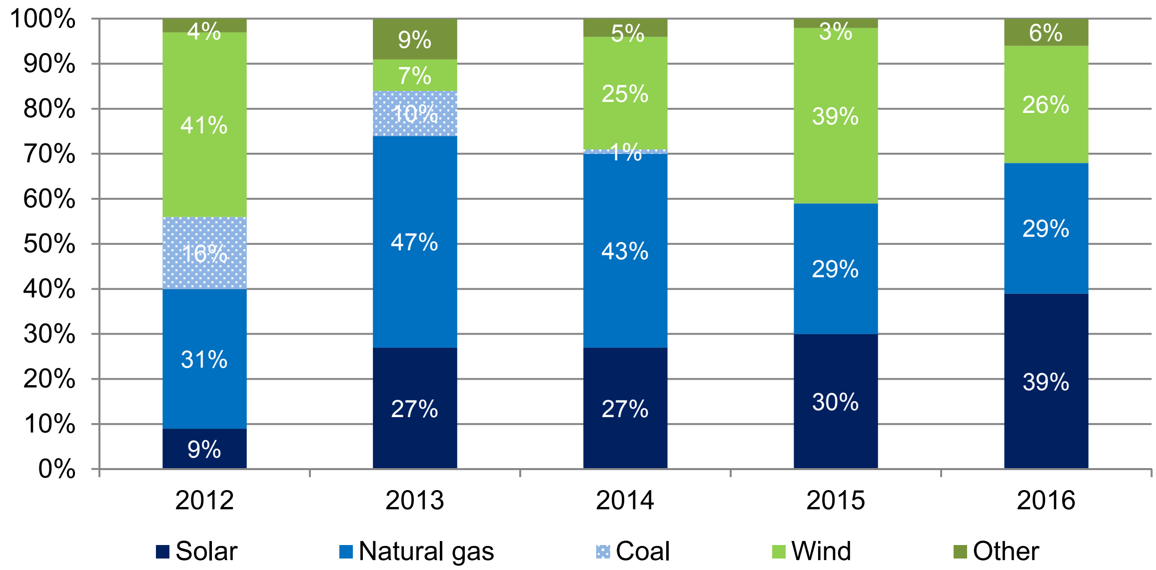
[25] U.S. Energy Information Administration, http://www.eia.gov/electricity/data/browser/, retrieved July 3, 2017.

Figure V-2
Net U.S. electricity generation, by sector, 2016



Source: U.S. Energy Information Administration, http://www.eia.gov/electricity/data/browser/, retrieved July 3, 2017.

Figure V-3
New U.S. electricity generating capacity additions, 2012-2016



Source: GTM Research and the Solar Energy Industries Association (SEIA), U.S. Solar Market Insight: 2016 Year in Review, Executive Summary, 2017, p. 7.

End uses, cost share, and installed cost

CSPV products account for a moderate-to-large share of the cost of the end-use products in which they are used. The primary end use for CSPV cells are modules, and for modules, the primary end use is some form of solar power generation installation or system (see *Part I* for more information). Firms reported the share of the total production cost of the end-use products (modules, residential systems, commercial systems, and utility systems) that is accounted for by CSPV cells (table V-2). Ten U.S. producers, 39 importers, and 34 purchasers reported that the cost share of CSPV cells in a module averaged 56 to 60 percent. Generally, the cost share of CSPV cells increases as the size of the installation project increases. For residential systems, two U.S. producers, 18 importers, and 37 purchasers reported that the average cost share of CSPV cells was between 19 to 26 percent. For commercial systems, two U.S. producers, 16 importers, and 50 purchasers reported that the average cost of CSPV cells was between 18 and 27 percent. For utility systems, one U.S. producer, 12 importers, and 38 purchasers reported that the average cost share of CSPV cells was between 29 and 31 percent. For off-grid portable consumer goods, 13 importers and 11 purchasers reported that the average cost share of CSPV cells was between 24 and 30 percent.[26]

Table V-2
CSPV products: Firms' estimates of cost share for CSPV cells in the following end uses

Item	Producers		Importers		Purchasers	
	Average	Range	Average	Range	Average	Range
Module	58	30 to 100	60	30 to 100	56	23 to 100
Residential system	19	11 to 28	25	7 to 67	26	10 to 65
Commercial system	18	17 to 19	27	9 to 67	26	1 to 70
Utility system	30	30	31	10 to 67	29	1 to 45
Off grid portable consumer goods	--	--	30	15 to 67	24	10 to 58

Source: Compiled from data submitted in response to Commission questionnaires

The price of an installed PV system is comprised of the price of the module and non-module costs which include inverters, mounting hardware, labor, permitting fees, overhead, and profit margin. According to several industry sources, average installed prices for PV solar installations have declined steadily in all three market segments during the period. According to one industry report, the median installed price of a PV system fell between 24.1 percent (residential system) and 43.6 percent (non-residential system >500 kW) from 2012 to 2015 (figure V-4).[27] According to another industry report, U.S. PV system pricing fell by almost 20 percent from the fourth quarter of 2015 to the fourth quarter of 2016. The steep decline in PV system prices during 2016 is attributed to large decreases in module prices combined with substantial declines in hardware costs.[28] Both reports noted that installed PV system prices vary

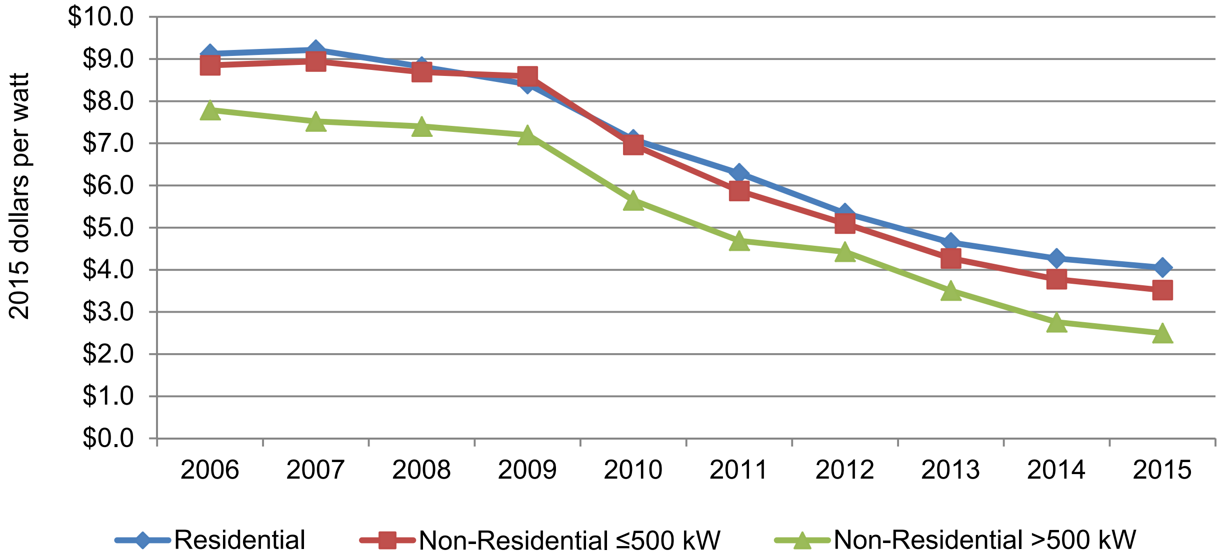
[26] No U.S. producer provided an estimate for the cost share of CSPV cells used in off-grid portable consumer goods.

[27] Tracking the Sun Public Data File, The Open PV Project, National Renewable Energy Laboratory, https://openpv.nrel.gov/search (accessed July 11, 2017).

[28] GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, p. 15.

greatly from state-to-state and project-to-project, with a considerable spread among the prices in each market segment.

Figure V-4
Average installed price of residential and non-residential PV systems, by system size, 2006-2015



Note: Data for 2016 were not available.

Source: Tracking the Sun Public Data File, The Open PV Project, National Renewable Energy Laboratory, https://openpv.nrel.gov/search (accessed July 11, 2017).

For most of the period, declining system prices largely reflect falling non-module costs, as module prices remained relatively stable from 2013 to 2015. In residential PV systems, module costs fell 9 percent while non-module costs fell 27 percent from 2012 to 2015 (figure V-5).[29] However, in 2016, declining system prices largely reflect falling module prices. Between the fourth quarter of 2015 and the fourth quarter of 2016, module prices fell by 35.4 percent. Declines in non-module costs (e.g. inverters, mounting hardware, labor, design/engineering, permitting fees, overhead, and profit margin) ranged from 6 percent for fixed-tilt utility systems, 13 percent for residential and non-residential systems, and 15 percent for single-axis tracking utility systems (figure V-6).[30]

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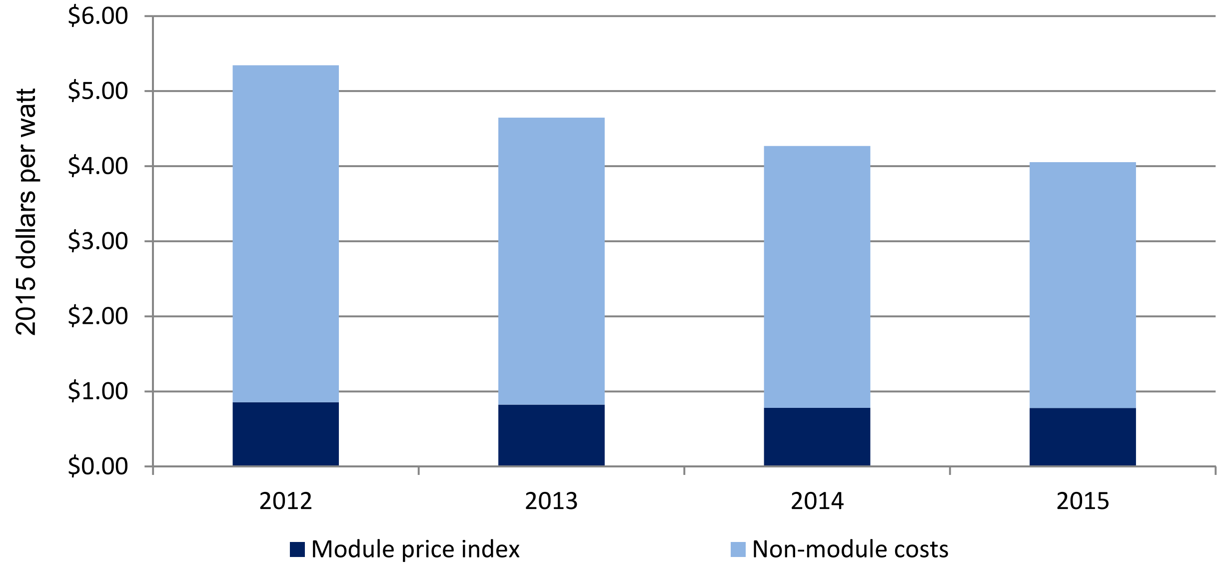
[29] Based on these data, the cost share for a PV module in a residential PV system increased from 16 percent in 2012 to 19 percent in 2015. Tracking the Sun Public Data File, The Open PV Project, National Renewable Energy Laboratory, https://openpv.nrel.gov/search (accessed July 11, 2017).

[30] Based on these data, the cost share of a PV module ranged from 15 to 19 percent in a residential PV system, 26-32 percent in a non-residential system, and 36-49 percent in a utility PV system. GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, p. 15.

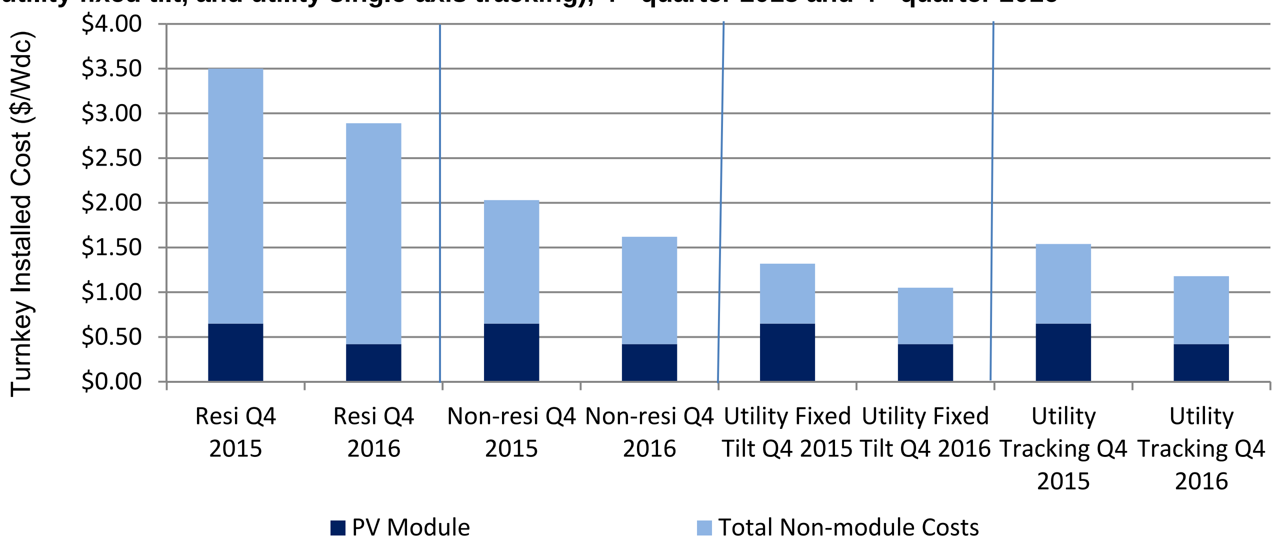
Figure V-5
Installed residential PV systems: module price index and implied non-module costs, 2012-15[1]



[1] The Module Price Index is the U.S. module price index published by SPV Market Research (Mints 2016). Implied non-module costs are calculated as the Total Installed Price minus the Module Price Index, and therefore include installer profit margin.

Source: Tracking the Sun Public Data File, The Open PV Project, National Renewable Energy Laboratory, https://openpv.nrel.gov/search (accessed July 11, 2017).

Figure V-6
Estimated U.S. national average system costs by market segment (residential, non-residential, utility fixed tilt, and utility single-axis tracking), 4th quarter 2015 and 4th quarter 2016[1]



[1] These data are based on GTM's tracked wholesale pricing of major solar components and data collected from interviews with major installers.

Source: GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, p.15.

Business cycles and conditions of competition

The majority of U.S. producers (8 of 10), importers (30 of 48), and purchasers (55 of 101) indicated that the market for CSPV products was subject to business cycles. Firms reported seasonal fluctuations due to weather conditions as well as incentive program deadlines. A plurality of firms indicated that demand is typically heavier in the latter half of the year, during the warmer summer months up until the end of the calendar year, in order to finish projects to qualify for various incentive programs for tax accounting purposes. Purchaser *** estimated that two-thirds of residential systems are installed during the second half of the year. Another firm, ***, stated that sales bookings were the heaviest during the second and third quarters, and installations and revenue were the heaviest in the third and fourth quarters.

Most U.S. producers (6 of 10) and importers (23 of 48) and nearly half of responding purchasers (46 of 101) indicated that the market was subject to distinct conditions of competition. Most firms identified government incentive programs and changes in global supply and demand. Several firms reported that policy changes in other countries (e.g., China's suspension of its feed-in tariff program) rapidly impacts demand in those countries and can also have an impact on prices in the U.S. market. Other factors identified included technology improvements and cost reductions. Importer *** stated that the average selling price of CSPV cells is driven by the top five to ten CSPV cell producers.

The majority of U.S. producers (6 of 9), importers (22 of 38), and purchasers (56 of 89) indicated that there have been changes to the business cycle and conditions of competition since 2012. Specifically, firms identified increased competition, market saturation, increased efficiency of CSPV cells, introduction and extension of various solar incentive programs such as the Investment Tax Credit, lower interest rates, and declining global prices of CSPV cells and systems.

Demand trends

The vast majority of firms reported that U.S. demand for CSPV products has increased since 2012 (table V-3). Most firms attributed the increased demand to a reduction in CSPV system prices and installation costs, as well as federal, state, and local incentive programs. Firms also attributed the increased demand to the public's increased knowledge and general interest in renewable energy,[31] increased technology improvements including module efficiency, and increased military use of solar energy.

[31] One firm, ***, stated that in the past two years, there has been an increase in demand for community solar and corporate solar.

Table V-3
CSPV products: Firms' responses regarding U.S. demand, by number of responding firms

Item	Number of firms reporting			
	Increase	No change	Decrease	Fluctuate
Demand inside the United States: U.S. producers	9	0	2	0
Importers	43	1	1	4
Purchasers	90	2	3	6
Demand outside the United States: U.S. producers	9	0	0	1
Importers	37	3	0	6
Purchasers	58	3	2	6

Source: Compiled from data submitted in response to Commission questionnaires.

The vast majority of firms also reported that demand for CSPV products outside the United States has increased since 2012 (table V-3). The increase in demand outside of the United States was attributed to similar reasons as the growth in the United States: overall cost reductions, reduced module prices, increased technology improvements, the existence of government incentives and mandatory renewable energy goals, and a growing trend towards green energy. Several firms noted that demand for CSPV products in China, Japan, India, Australia, the Middle East, and South America is growing rapidly.

Substitute products

The majority of firms reported that non-solar renewable energy products could not be substituted for CSPV products at the initial purchase decision. However, 4 of 7 U.S. producers, 14 of 51 importers, and 23 of 102 purchasers indicated that there were non-solar renewable energy substitutes for CSPV products. The most often identified non-solar renewable energy substitute product for CSPV products was wind turbines. One U.S. producer, ten importers, and 14 purchasers indicated that the change in wind energy prices affects the price of CSPV products. The remaining two importers and three purchasers reported that wind turbines did not affect the price of CSPV products, citing the lack of direct competition for most installations and the historically lower prices for wind energy. Other substitutes cited by firms include biomass, geothermal, and hydroelectric.

More than half of responding importers and purchasers indicated that other solar energy products cannot be substituted for CSPV products at the initial purchase decision. However, a majority of U.S. producers (7 of 11), 22 of 50 importers, and 47 of 99 responding purchasers indicated that other solar energy products, such as thin film, can be substituted for CSPV products.[32] Three U.S. producers, 14 importers, and 18 purchasers indicated that changes in thin film prices affect the price for CSPV products. The remaining 4 U.S. producers, 7 importers, and 25 purchasers reported that prices for thin film did not affect the price of CSPV products.

[32] Thin film was the most often cited solar energy substitute for CSPV products by firms.

SUBSTITUTABILITY OF DOMESTIC AND IMPORTED CSPV PRODUCTS

The degree of substitution between domestic and imported CSPV products depends upon such factors as relative prices, quality (e.g., standards, reliability of supply, defect rates, etc.), and conditions of sale (e.g., price discounts/rebates, lead times between order and delivery dates, payment terms, product services, etc.). Based on available data, staff believes that there is a high degree of substitutability between domestically produced CSPV products and imported CSPV products.

Lead times

CSPV products are primarily produced-to-order. U.S. producers reported that 54.0 percent of their commercial shipments were produced-to-order, with lead times averaging 43 days. The remaining 46.0 percent of their commercial shipments came from inventories, with lead times averaging 4 days. Importers reported that 54.6 percent of their commercial shipments were produced-to-order, with lead times averaging 62 days; 37.9 percent of importers' commercial shipments came from U.S. inventories, with lead times averaging 13 days. The remaining 7.5 percent of their sales came from foreign inventories, with lead times averaging 62 days.

Factors affecting purchasing decisions

The most often cited top three factors firms consider in their purchasing decisions for CSPV products were price (81 firms), quality/performance (77 firms), and availability (42 firms), as shown in table V-4. Quality/performance was the most frequently cited first- and second-most important factor, followed by price; and price was the most frequently reported third-most important factor.

Table V-4
CSPV products: Ranking of factors used in purchasing decisions as reported by U.S. purchasers, by factor

Factor	First	Second	Third	Total
Price	21	26	35	81
Quality/performance	44	29	11	77
Availability	8	19	16	42
Bankability	10	1	4	15
Credit/terms	2	4	6	12
Warranty	5	3	3	11
Country of origin/U.S. produced	6	2	2	10
Delivery time/delivery dependability	1	5	3	9
Specification/product range/custom built	3	2	4	9
Technology/works with purchaser technology	5	1	2	6
Producer's financial stability	1	2	3	6
Relationship with supplier/contract	3	1	2	6
Customer support	1	1	3	5
Other[1]	0	7	8	NA

[1] Other factors include "how long", longevity, and equity in consumer market for second factor; and lead time, shipping costs, ease of working with, product line consistency, distribution, appearance, and customer demand for the third factor.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. purchasers identified various principal factors they considered in determining the quality of CSPV products. Reported factors included output efficiency, longevity and long-term performance degradation, output tolerances, warranty (suppliers' ability to back up the warranty), historical failure rates, appearance (matching cell colors and frame structure), sales support, bankability, financial strength of manufacturer, third-party testing, and UL certification.

Purchasers were asked how frequently they purchased the lowest-priced product. A plurality of purchasers indicated that they sometimes purchase the lowest priced product (table V-5).

Table V-5
CSPV products: Frequency purchase decisions are based on price

Always	Usually	Sometimes	Never
3	30	49	23

Source: Compiled from data submitted in response to Commission questionnaires.

When asked if they purchased CSPV products from one source although a comparable product was available at a lower price from another source, 64 purchasers reported reasons including product quality, lead time, availability, product reliability, level of customer service, and financial viability of the manufacturer. One-third of purchasers (29 of 97) reported that certain types of product were only available from a single source. Several purchasers stated that the higher efficiency modules are manufactured primarily in Asia and are not available from any U.S. producers. Six purchasers reported that multicrystalline PERC cells are primarily only available in Taiwan, Korea, Japan, China, and Malaysia. Two purchasers stated that N-type monocrystalline cells are only available from LG in Korea.

Most purchasers always or usually make purchasing decisions based on the producer, while most of their customers either sometimes or never make purchasing decisions based on the producer (table V-6). However, most purchasers and their customers sometimes or never make purchasing decisions based on the country of origin. Of the 43 purchasers that reported that they always make decisions based on the manufacturer, 21 firms cited quality or quality factors (technology, long-term performance, efficiency, solar scorecard, and reliability); other reasons cited include quality of the firm (bankable manufacturer, capacity, financials, warranty history, and brand recognition), and a preference for domestically produced product.

Table V-6
CSPV products: Purchasing decisions based on producer and country of origin

Purchaser/Customer Decision	Always	Usually	Sometimes	Never
Purchaser makes decision based on producer	43	23	16	20
Purchaser's customers make decision based on producer	12	23	35	19
Purchaser makes decision based on country	21	11	33	37
Purchaser's customers make decision based on country	5	16	46	22

Source: Compiled from data submitted in response to Commission questionnaires.

Supplier qualification

Most purchasers reported that no domestic or foreign supplier had failed in its attempt to qualify product, or had lost its approved status, since 2012. However, 19 of 95 responding purchasers reported that a domestic or foreign supplier had failed in its attempt to qualify product, or had lost its approved status since 2012. Reasons suppliers were not qualified or were disqualified included: customer service, financial strength, broken commitments, cell cracks, use of thinner frame, quality control, bankability, failed audit, efficiency, delivery rates, and prefer local manufacturer. Three purchasers stated that both SolarWorld and Yingli lost their approved status due to financial distress. Sunrun stated that both SolarWorld and Suniva refused to participate in the Sunrun Vendor Quality Management Program - thereby preventing Sunrun from approving them as vendors for systems financed by investors.[33] SolarWorld stated that it chose not to participate in the program because Sunrun required SolarWorld to release its bill of material, which is SolarWorld's intellectual property.[34] Suniva stated that after it went through the preliminary levels of negotiation with Sunrun, it determined that Suniva was far apart on price and therefore it did not make sense to spend the money to go through the qualification process.[35]

Changes in purchasing patterns

Purchasers were asked about changes in their purchasing patterns from the United States and all other countries since January 2012 (table V-7). More than half of responding purchasers indicated that they had not purchased U.S.-origin CPSV products. Seven purchasers

[33] Hearing transcript, pp. 269-272 (Fenster).
[34] SolarWorld stated that it was unwilling to disclose to a third party the names of its approved suppliers and to divulge intellectual property. Hearing transcript, pp. 239-240 (Messer).
[35] Hearing transcript, p. 241 (Card).

provided reasons for not purchasing domestic product which included that U.S. manufacturers failed bankability requirements, did not meet quality requirements, had limited availability, and did not sell stand-alone CSPV products. Reasons reported for increasing purchases of U.S.-origin CPSV products included increased demand, expansion of business, preference for domestically produced CSPV products and superior Power Purchase Agreement (PPA) pricing for locally produced modules. Reasons reported for decreasing purchases of U.S.-origin CPSV products included lower import prices, lack of availability, and longer lead times. The majority of purchasers reported that they had increased their purchases of foreign-origin CSPV products. The most often cited reason for increasing purchases of foreign-origin CPSV products was lower price; other reasons included business expansion, availability, module efficiency, and increased demand.

Table V-7
CSPV products: Changes in purchase patterns from United States, all other countries

Source of purchases	Did not purchase	Decreased	Increased	Constant	Fluctuated
US-origin CPSV products	35	17	22	11	19
Foreign-origin CPSV products	4	12	51	18	22

Source: Compiled from data submitted in response to Commission questionnaires.

Comparisons of domestic products and imported articles

Most U.S. producers, importers, and purchasers reported that U.S.-produced CSPV products were interchangeable with imported CSPV products (table V-8). However, roughly one-third of responding importers and one-fourth of responding purchasers reported that U.S.-produced CSPV products were not interchangeable with imported CSPV products. Importer *** stated that certain cells are copyrighted and can only be used in specific applications. Three importers stated that performance data and bankability of the CSPV products can limit the degree of interchangeability. They also noted that certification requirements and standards are different for every country and CSPV products produced in a certain country may not be certified for installation in other countries. Importer *** reported that there are no U.S. manufacturers producing the type of cell required for small portable solar products. Three importers and one purchaser reported that interdigitated back contact (IBC) solar cells are not domestically produced and are not interchangeable with front-contact CSPV products. One purchaser noted that the pace of technological advancement has been very fast, resulting in technological differentiation and competition among suppliers.

Table V-8
CSPV products: Interchangeability and importance of factors other than price between product produced in the United States and in other countries

Item	Number of U.S. producers reporting		Number of U.S. importers reporting		Number of purchasers reporting	
	No	Yes	No	Yes	No	Yes
Interchangeable	1	10	14	33	24	78
Factors other than price	3	8	11	34	11	90

Source: Compiled from data submitted in response to Commission questionnaires.

In addition, the majority of responding U.S. producers, importers, and purchasers indicated that differences other than price between CSPV products produced in the United States and in other countries were a significant factor in sales of the products. In further comments, firms identified technology, quality, availability, bankability, warranty terms, product range (PERC cells, small 100W panels, N-type cells, etc.), lead time, and credit terms as important non-price factors. Importer *** stated that quality and technical support are more advanced in Japan and Germany. Importer *** reported that price and availability are the key purchasing factors. U.S. producer *** stated that regardless of the advantages that U.S.-produced CSPV products can offer, they do not overcome the very low prices of imported product. Three importers stated that developers, installers, and project owners chose module suppliers with high bankability that are listed as Tier 1 by Bloomberg and that funding for projects using low Tier modules are often rejected by financiers.

ELASTICITY ESTIMATES

This section discusses elasticity estimates. Parties were encouraged to comment on these estimates in their prehearing or posthearing brief. As noted below, respondent SEIA commented on the domestic supply elasticity. No other party comments were received regarding elasticities.

U.S. supply elasticity

The domestic supply elasticity[36] for CSPV products[37] measures the sensitivity of the quantity supplied by U.S. producers to changes in the U.S. market price of CSPV products. The elasticity of domestic supply depends on several factors including the level of excess capacity, the ease with which producers can alter capacity, producers' ability to shift to production of other products, the existence of inventories, and the availability of alternate markets for U.S.-produced CSPV products. In the prehearing report, staff estimated that the U.S. supply elasticity for CSPV products was in the range of 4 to 6. Respondent SEIA took issue with the estimate, and argued that the operational U.S. cell producers ***, that U.S. inventory levels, as a ratio to total shipments decreased from 2012 to 2016, and that the majority of U.S. producers' exports ***. SEIA suggested that the U.S. supply elasticity for CSPV cells would be in the range of 0 to 1 and the U.S. supply elasticity for CSPV modules would be in the range of 1 to 2.[38] After receiving revised questionnaire data, additional information, and party arguments, staff is revising its estimated range to 2 to 4.

[36] A supply function is not defined in the case of a non-competitive market.

[37] The U.S. supply elasticity estimate applies to U.S. CSPV cells, whether or not partially or fully assembled into other products.

[38] SEIA's prehearing brief, pp. 42-44.

Import supply elasticity

The import supply elasticity[39] for CSPV products measures the sensitivity of the quantity supplied by U.S. importers (in connection with foreign producers) to changes in the U.S. market price of CSPV products. It depends on the same type of factors as the elasticity of domestic supply. Analysis of these factors above indicates that U.S. imports have the ability to greatly increase or decrease shipments to the U.S. market; an estimate in the range of 6 to 8 is suggested.

U.S. demand elasticity

The U.S. demand elasticity for product measures the sensitivity of the overall quantity demanded to a change in the U.S. market price of product. This estimate depends on factors discussed earlier such as the existence, availability, and commercial viability of substitute products, as well as the component share of CSPV products in the production of any downstream products. Based on the available information, the aggregate demand for CSPV products is likely to be elastic; a range of -1.0 to -1.5 is suggested.

Substitution elasticity

The elasticity of substitution depends upon the extent of product differentiation between the domestic and imported products.[40] Product differentiation, in turn, depends upon such factors as quality (e.g., appearance, efficiency, etc.) and conditions of sale (e.g., availability, sales terms/ discounts/warranty, etc.). Based on available information, the elasticity of substitution between U.S.-produced product and imported product is likely to be in the range of 3 to 5.

FACTORS AFFECTING PRICES

Raw material costs

Raw material costs is the largest component of total cost of goods sold ("COGS") for both cells and modules. Raw material costs for the production of CSPV cells accounted for *** percent of U.S. cell producers' total COGS during 2016, up from *** percent in 2012. The main underlying raw material input for CSPV cells is polysilicon. Raw material costs for the production of CSPV modules (much of which are the cost of cells which reflects purchased cells and internally-produced cells) accounted for 84.9 percent of U.S. module producers' total COGS in 2016, up from 58.2 percent in 2012.

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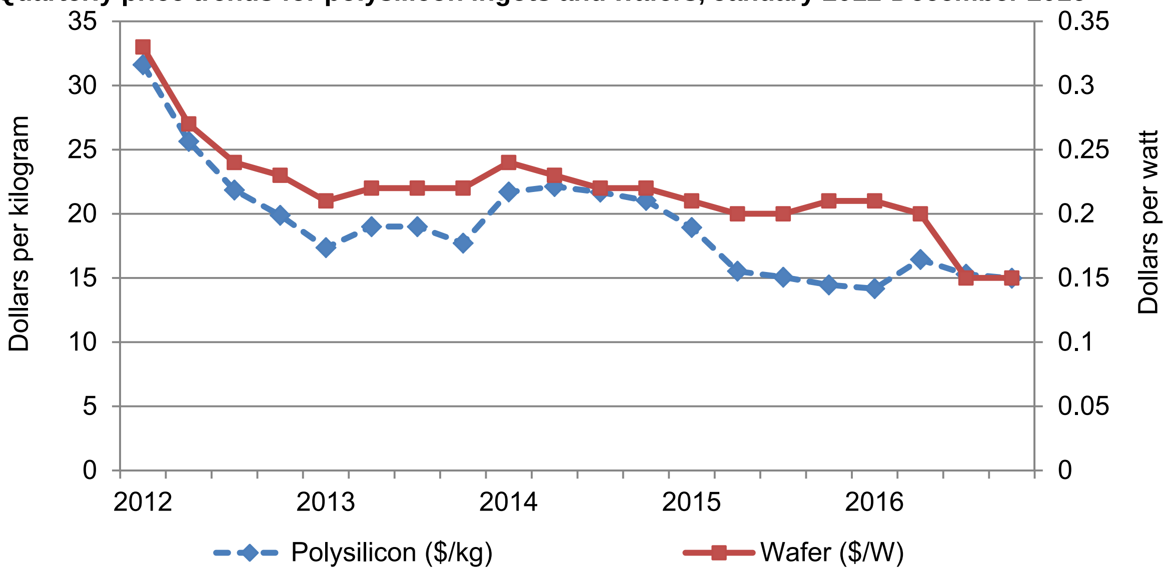
[39] A supply function is not defined in the case of a non-competitive market.

[40] The substitution elasticity measures the responsiveness of the relative U.S. consumption levels of the subject imports and the domestic like products to changes in their relative prices. This reflects how easily purchasers switch from the U.S. product to the subject products (or vice versa) when prices change.

The majority of U.S. producers (9 of 11) and importers (32 of 44) reported that prices of raw materials for CSPV products have declined since 2012. Several firms reported that polysilicon and wafer prices have declined since 2012. U.S. producer *** stated that raw material prices have declined until recently; it reported that in late 2016 and into 2017, the price of monocrystalline wafers began to increase due to high global demand. Importer *** stated that in addition to the price of wafers, the price for silver paste has declined over the past years.

The price of polysilicon ingots and wafers fluctuated during the period but declined overall. According to industry reports, due to overcapacity of polysilicon, the price of polysilicon ingots and wafers fell 52.6 percent and 54.5 percent, respectively, from the first quarter of 2012 to the fourth quarter of 2016 (figure V-7).

Figure V-7
Quarterly price trends for polysilicon ingots and wafers, January 2012-December 2016



Source: GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2012-2016 Year in Review*, Executive Summaries.

U.S. inland transportation costs

Seven of ten responding U.S. producers and 40 of 46 importers reported that they typically arrange transportation to their customers. Most U.S. producers reported that their U.S. inland transportation costs ranged from 2 to 3 percent, while most importers reported costs of 1 to 5 percent. U.S. producers reported that *** percent of sales were shipped within 100 miles of their production facility, *** percent were shipped between 101 and 1,000 miles, and *** percent were shipped over 1,000 miles. Importers of CSPV products reported that 33.9 percent of sales were shipped within 100 miles of their U.S. point of shipment, 51.9 percent between 101 and 1,000 miles, and 14.1 percent were shipped over 1,000 miles.

PRICING PRACTICES

Pricing methods

U.S. producers and importers reported using transaction-by-transaction negotiations, contracts, and price lists. As presented in table V-9, U.S. producers and importers sell primarily on a transaction-by-transaction basis.

Table V-9
CSPV products: U.S. producers' and importers' reported price setting methods, by number of responding firms[1]

Method	U.S. producers	Importers
Transaction-by-transaction	9	34
Contract	4	22
Set price list	4	21
Other	3	6
Responding firms	11	51

[1] The sum of responses down may not add up to the total number of responding firms as each firm was instructed to check all applicable price setting methods employed.

Source: Compiled from data submitted in response to Commission questionnaires.

Both U.S. producers and importers reported selling their CSPV products primarily under contracts in 2016 (table V-10). U.S. producers reported selling the majority of their CSPV products through short-term contracts with the remaining share sold on a spot basis, while importers reported selling most of their CSPV products through a mix of short-term, annual, and long-term contracts.

Table V-10
CSPV products: U.S. producers' and importers' shares of U.S. commercial shipments by type of sale, 2016

Type of sale	U.S. producers	Importers
	Share (percent)	
Long-term contracts	***	17.0
Annual contracts	***	24.3
Short-term contracts	***	47.8
Spot sales	***	10.8
Total	100.0	100.0

Note.--Because of rounding, figures may not add to the totals shown.

Source: Compiled from data submitted in response to Commission questionnaires.

Five U.S. producers reported using short-term contracts with an average duration ranging from 30 to 183 days and 23 importers reported using short-term contracts averaging 105 days. All five responding U.S. producers and most importers reported that their short-term contracts did not allow for price renegotiation, have fixed prices and quantities, and did not have meet-or-release provisions. Four U.S. producers and 16 importers reported using annual contracts. U.S. producers' responses were split, with two firms reporting that their annual contracts did not allow for price renegotiations, have fixed prices and quantities, and did not have meet-or-release provisions. The majority of U.S. importers reported that their annual contracts allowed for price renegotiations, have fixed prices and quantities, and did not have a meet-or-release provision. Seven importers reported using long-term contracts averaging two years. Most importers reported that their long-term contracts allowed for price renegotiations, fixed both price and quantity, and did not have a meet-or-release provision.

Sales terms and discounts

Seven of nine U.S. producers reported that they typically quote prices on an f.o.b. basis, while *** most importers reported that they typically quote prices on a delivered basis.[41] A plurality of U.S. producers (6 of 11) and importers (23 of 50) do not offer any type of discount. However, five U.S. producers and 20 importers reported offering quantity-based discounts and two U.S. producers and nine importers offer volume discounts. In addition, one importer offers seasonal promotions, one importer *** offers discounts at the retail or promotional level, and one importer offers different discounts for dealers, distributors, and master distributors. [42] Typical sales terms for most responding producers and importers is net 30 days; however, many firms noted that payment terms varied depending on customers' credit and purchase volume.

PRICE DATA

The Commission requested U.S. producers and importers to provide quarterly data for the total quantity and f.o.b. value of the following CSPV products shipped to unrelated U.S. customers during 2012-16.

Product 1.-- Monocrystalline cells with an efficiency between 17.0% and 22.0%.

Product 2.-- 60 cell Multicrystalline silicon module, with a peak power wattage between 240w to 290w, inclusive, P-max or Wp.

Product 3.-- 60 cell Monocrystalline silicon module, with a peak power wattage between 250w to 300w, inclusive, P-max or Wp.

Product 4.— 72 cell Multicrystalline silicon module, with a peak power wattage between 290w to 340w, inclusive, P-max or Wp.

Product 5.— 72 cell Monocrystalline silicon module, with a peak power wattage between 300w to 350w, inclusive, P-max or Wp.

[41] ***.
[42] ***.

Two U.S. producers and 31 importers provided usable pricing data for sales of the requested products, although not all firms reported pricing for all products for all quarters.[43] [44] Pricing data reported by these firms accounted for approximately 83.3 percent of U.S. producers' U.S. shipments of CSPV products and 74.1 percent of U.S. importers' U.S. shipments of CSPV products in 2016.[45] [46]

The pricing product definitions consisted of a monocrystalline cell with an efficiency range of 5 percent, and four modules, each with peak power range of 50 watts. U.S. producers and importers reported their commercial shipment volumes for these pricing products, broken into narrower efficiency and wattage ranges. As shown in table V-11, U.S. producers and importers generally reported sales of CSPV cells and modules within similar efficiency and wattage ranges.[47]

Table V-11
CSPV products: Sales of U.S. produced and imported cells and modules, by wattage ranges, 2012-16

*   *   *   *   *   *   *

U.S. producers' price data volumes for sales of monocrystalline modules *** accounted for the *** of reported price data. Importers reported price data primarily for sales of multicrystalline modules, with products 2 and 4 accounting for the majority of price data volumes of foreign-origin product. Both U.S. producers and importers reported *** quantities of sales of monocrystalline cells (product 1), accounting for *** of domestic price data and in 2016 and *** of importers' price data in 2015.

Price data for products 1-5 are presented in tables V-12 to V-16 and figures V-8 to V-12. Prices are reported by import source in Appendix G.

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[43] Per-unit pricing data are calculated from total quantity and total value data provided by U.S. producers and importers. The precision and variation of these figures may be affected by rounding, limited quantities, and producer or importer estimates.

[44] Price data were requested by the origin of the cell. U.S. module assemblers that used imported cells were requested to report their price data in the importer questionnaire.

[45] U.S. importer *** revised its pricing data on August 31, 2016. These revisions changed the prices and quantities for product 1. See email from *** and *** revised importer questionnaire response, section III-2.

[46] Products 2-5 overlap with the pricing products 1-8 from the previous AD/CVD investigations. The wider wattage ranges in products 2-5 encompass the shifts to higher wattage modules during the five-year period of investigation. Table V-11 provides a breakout of the reported price data by narrower wattage ranges. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan*, Invs. Nos. 701-TA-511 and 731-TA-1246-1247 (Final) USITC Publication 4519 February 2015 at p. V-5.

[47] For product 5, U.S. producers' reported price data were split between the two wattage categories, while importers' reported price data fell in the lower wattage category in 2015.

Table V-12
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarters, 2012-16

* * * * * * *

Table V-13
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2,[1] by quarters, 2012-16

Period	U.S.-origin		Foreign-origin	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2012: Jan.-Mar.	***	***	1,059	84,005
Apr.-June	***	***	910	151,062
July-Sept.	***	***	837	193,745
Oct.-Dec.	***	***	805	188,753
2013: Jan.-Mar.	***	***	723	178,906
Apr.-June	***	***	713	240,438
July-Sept.	***	***	726	338,025
Oct.-Dec.	***	***	738	259,915
2014: Jan.-Mar.	***	***	735	216,823
Apr.-June	***	***	728	287,980
July-Sept.	***	***	751	289,276
Oct.-Dec.	---	***	735	367,474
2015: Jan.-Mar.	---	***	713	333,306
Apr.-June	---	***	692	494,227
July-Sept.	---	***	674	482,561
Oct.-Dec.	***	***	667	517,662
2016: Jan.-Mar.	---	***	641	360,330
Apr.-June	---	***	632	330,869
July-Sept.	---	***	592	335,198
Oct.-Dec.	---	***	535	265,793

[1] Product 2: 60 cell Multicrystalline silicon module, with a peak power wattage between 240w to 290w, inclusive, P-max or Wp.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-14
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarters, 2012-16

* * * * * * *

Table V-15
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4,[1] by quarters, 2012-16

Period	U.S.-origin		Foreign-origin	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2012:				
Jan.-Mar.	--	0	869	67,598
Apr.-June	--	0	***	***
July-Sept.	--	0	749	92,542
Oct.-Dec.	--	0	716	85,968
2013:				
Jan.-Mar.	--	0	***	***
Apr.-June	--	0	706	244,778
July-Sept.	--	0	697	329,372
Oct.-Dec.	--	0	690	323,929
2014:				
Jan.-Mar.	--	0	683	413,580
Apr.-June	--	0	687	666,572
July-Sept.	--	0	721	469,675
Oct.-Dec.	--	0	713	408,065
2015:				
Jan.-Mar.	--	0	716	310,628
Apr.-June	--	0	682	675,210
July-Sept.	--	0	652	1,221,632
Oct.-Dec.	--	0	641	1,763,922
2016:				
Jan.-Mar.	--	0	626	1,820,336
Apr.-June	--	0	623	2,130,333
July-Sept.	--	0	605	1,880,659
Oct.-Dec.	--	0	472	1,253,620

[1] Product 4: 72 cell Multicrystalline silicon module, with a peak power wattage between 290w to 340w, inclusive, P-max or Wp.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-16
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarters, 2012-16

* * * * * * *

Figure V-8
CSPV products: Weighted-average prices and quantities of domestic and imported product 1, by quarters, 2012-16

* * * * * * *

Figure V-9
CSPV products: Weighted-average prices and quantities of domestic and imported product 2, by quarters, 2012-16

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Figure V-10
CSPV products: Weighted-average prices and quantities of domestic and imported product 3, by quarters, 2012-16

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Figure V-11
CSPV products: Weighted-average prices and quantities of domestic and imported product 4, by quarters, 2012-16

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Figure V-12
CSPV products: Weighted-average prices and quantities of domestic and imported product 5, by quarters, 2012-16

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Aggregate pricing trends

Prices for all five price products decreased during 2012-16. As shown in table V-17, price decreases of U.S.-origin CSPV products ranged from 48.5 to 73.2 percent during 2012-16 while price decreases of foreign-origin CSPV products ranged from 45.7 to 51.0 percent.

Table V-17
CSPV products: Summary of weighted-average f.o.b. prices for products 1-5 from the United States and from other countries

Item	Number of quarters	Low price (dollars per kilowatt)	High price (dollars per kilowatt)	Change in price over period[1] (percent)
Product 1:				
U.S.-origin	17	***	***	***
Foreign-origin	1	***	***	***
Product 2:				
U.S.-origin	12	***	***	***
Foreign-origin	20	535	1,059	(49.4)
Product 3:				
U.S.-origin	20	***	***	***
Foreign-origin	20	***	***	***
Product 4:				
U.S.-origin	---	--	--	--
Foreign-origin	20	472	869	(45.7)
Product 5:				
U.S.-origin	20	***	***	***
Foreign-origin	19	***	***	***

[1] Percentage change from the first quarter to the last quarter, if available.

Note.—No domestic data were reported for product 4.

Source: Compiled from data submitted in response to Commission questionnaires.

Price comparisons

Prices for foreign-origin CSPV products were lower than prices of U.S.-origin CSPV products in 33 of 52 instances (***) and higher in 19 instances (***) (table V-18).[48]

[48] On an annual basis, prices for foreign-origin CSPV products were lower than prices of U.S.-origin CSPV products in 10 of 12 instances and higher in 2 instances during 2012, lower in 6 of 11 instances and higher in 5 instances during 2013, lower in 6 instances of 11 instances and higher in 5 instances during 2014, lower in 6 of 10 instances and higher in 4 instances during 2015, and lower in 5 of 8 instances and higher in 3 instances during 2016.

Table V-18
CSPV products: Summary of price comparisons, January 2012-December 2016

Products	Total number of comparisons	Foreign-origin lower than U.S.-origin		Foreign-origin higher than U.S. origin	
		Number of quarters	Quantity[1] (kilowatts)	Number of quarters	Quantity[1] (kilowatts)
Product 1	1	***	***	***	***
Product 2	12	***	***	***	***
Product 3	20	***	***	***	***
Product 4	---	---	---	---	---
Product 5	19	***	***	***	***
Total	52	33	***	19	***

[1] These data include only quarters in which there is a comparison between the U.S. and foreign-origin product.

Note.—No domestic data were reported for product 4.

Source**:** Compiled from data submitted in response to Commission questionnaires.

Published price data

U.S. prices of modules can vary widely based on order volume, country of origin, and individual firm. However, average prices of cells and modules in the U.S. market have declined during 2012-16 (figure V-13). According to industry reports, prices for both cells and modules declined steeply in 2012 and then began to increase through the fourth quarter of 2013.[49] Prices continued to increase through 2014, which industry reports indicated was driven primarily by the AD/CVD duties imposed on Taiwanese and Chinese cells and modules. By the first quarter of 2016, prices of both cells and modules began to fall.[50] [51] Overall, cell and module prices fell by 60.4 percent and 58.5 percent, respectively, from 2012 to 2016.[52]

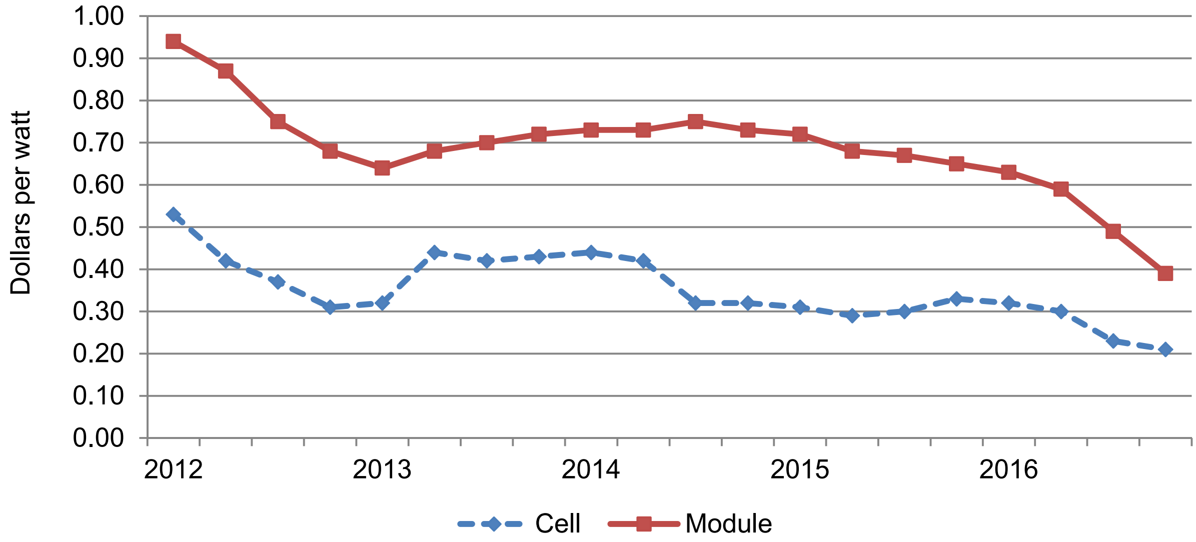
[49] GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2013 Year in Review, Executive Summary*, 2014, p. 18. In December 2012, AD/CVD duties were imposed on certain CSPV products from China, and in February 2015, AD duties were imposed on certain CSPV products from Taiwan, and AD/CVD duties were imposed on certain CSPV products from China.

[50] Prices of cells and modules declined by 34.4 percent and 38.1 percent, respectively, from the first quarter of 2016 to the fourth quarter of 2016.

[51] SolarWorld argues that global overcapacity of cells and modules led to a decline in global prices in 2016. SolarWorld's posthearing brief, exh. 1, pp. 30, 35-41.

[52] GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review, Executive Summary*, 2017, p. 16.

Figure V-13
U.S. cell and module prices, quarterly, 2012-16



Source: GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2012-2016 Year in Review*, Executive Summaries.

Lost sales and lost revenue

Of the 12 responding U.S. producers, eight reported that they had to reduce prices and three reported that they had to roll back announced price increases in order to avoid losing sales to competitors selling imported CSPV products since 2012. Three of these U.S. producers estimated that the revenue lost totaled approximately $140 million since 2012. Seven U.S. producers reported that they had lost sales of CSPV products to imported product since 2012. Four U.S. producers estimated that the total sales lost were approximately 950,000 kilowatts since 2012.[53]

As noted in *Part I*, the Commission received purchaser questionnaire responses from 106 purchasers. Responding purchasers reported that more than 90 percent of their purchases were foreign-origin CSPV cells and CSPV modules during 2012-16 (table V-19). Purchasers reported purchasing fewer CSPV cells and more CSPV modules on both an actual basis and as a share of total CSPV products (cells and modules) from 2012 to 2016. Reported purchases of CSPV cells from all sources, as a share of total CSPV products (cells and modules), decreased by 15.9 percentage points in 2012 to 4.2 percent in 2016, while reported purchases of CSPV modules from all sources, as a share of total CSPV products, increased by 15.9 percentage points to 95.8 percent from 2012 to 2016. Purchases of domestically produced modules, as a share of total CSPV products, increased by 0.3 percentage points to 4.6 percent while purchases of foreign-origin CSPV modules, as a share of total CSPV products, increased by 15.6 percentage points to 91.2 percent from 2012 to 2016.

[53] *** did not provide a quantity estimate but estimated that its lost sales totaled $148.7 million.

Table V-19
CSPV products: Purchasers' purchases by type, 2012-16

Item	Calendar year				
	2012	2013	2014	2015	2016
	Quantity (kilowatts)				
CSPV cells-- U.S.-origin	17,715	1,300	1,400	1,800	2,444
Foreign-origin	396,140	608,146	735,410	1,419,711	332,322
All origins	413,855	609,446	736,810	1,421,511	334,766
CSPV modules-- U.S.-origin	89,198	83,474	173,404	356,602	366,900
Foreign-origin	1,559,728	2,468,507	4,031,170	6,889,503	7,303,322
All origins	1,648,926	2,551,981	4,204,574	7,246,105	7,670,222
CSPV product (cells and modules)-- U.S.-origin	106,913	84,774	174,804	358,402	369,344
Foreign-origin	1,955,868	3,076,653	4,766,580	8,309,214	7,635,644
All origins	2,062,781	3,161,427	4,941,384	8,667,616	8,004,988
	Share of quantity (percent)				
CSPV cells-- U.S.-origin	0.9	0.0	0.0	0.0	0.0
Foreign-origin	19.2	19.2	14.9	16.4	4.2
All origins	20.1	19.3	14.9	16.4	4.2
CSPV modules-- U.S.-origin	4.3	2.6	3.5	4.1	4.6
Foreign-origin	75.6	78.1	81.6	79.5	91.2
All origins	79.9	80.7	85.1	83.6	95.8
CSPV products (cells and modules)-- U.S.-origin	5.2	2.7	3.5	4.1	4.6
Foreign-origin	94.8	97.3	96.5	95.9	95.4
All origins	100.0	100.0	100.0	100.0	100.0

Source: Compiled from data submitted in response to Commission questionnaires.

The majority of purchasers reported increasing purchases of domestic CSPV modules, in actual kilowatts; however, the share of domestic CSPV module purchases remained relatively unchanged, increasing from 4.3 percent of total purchases of CSPV products in 2012 to 4.6 percent in 2016. Less than one-third of purchasers both decreased their purchases of domestically produced CSPV modules and increased their foreign-origin CSPV modules, either by actual kilowatts or as a share of total purchases from 2012 to 2016 (table V-20). No purchaser reported simultaneously decreasing purchases of domestically produced CSPV cells and increasing purchases of foreign-origin CSPV cells from 2012 to 2016.

Table V-20
CSPV products: Number of changes in firm-level share of purchases of U.S.-origin and foreign-origin CSPV products since 2012

Item	Decreased US-origin	Increased foreign-origin	Both decreased U.S.-origin and increased foreign-origin
	Number of firms		
CSPV cells.-- Absolute values (in kilowatts)	1	6	0
Relative values (percentage points)	1	4	0
CSPV modules.-- Absolute values (in kilowatts)	19	75	19
Relative values (percentage points)	27	48	27
CSPV products (cells and modules).-- Absolute values (in kilowatts)	20	79	19
Relative values (percentage points)	28	50	27

Source: Compiled from data submitted in response to Commission questionnaires.

Of the 104 responding purchasers, 91 reported that, since 2012, they had purchased imported CSPV products instead of U.S.-produced product. Seventy-three of these purchasers reported that import prices were lower than U.S.-produced product, and 33 of these purchasers reported that price was a primary reason for the decision to purchase imported product rather than U.S.-produced CSPV products. Thirty-one purchasers estimated the quantity of imported CSPV products purchased instead of domestic CSPV products; quantities ranged from 54 kW to 1.7 million kW, totaling 3.4 million kW. Fifty-three of 86 purchasers indicated that price was not a primary reason for purchasing imported product rather than the domestic product. These purchasers identified financial strength/bankability, customer service, product range (technology and efficiencies), quality, product availability, warranty backstop protection, and delivery time as non-price reasons for purchasing imported rather than U.S.-produced CSPV products.

Of the 103 responding purchasers, 38 reported that U.S. producers had reduced prices of CSPV products in order to compete with lower-priced imports (44 purchasers reported that they did not know). The reported estimated price reduction ranged from 3 to 70 percent, averaging 31 percent. In describing the price reductions, purchasers indicated that domestic prices have fallen throughout the period of investigation, with several purchasers noting steeper price reductions in 2016.

OTHER DYNAMICS IN THE U.S. MARKET

Incentive programs and regulations

Changes in the availability and scope of Federal, state, and local government incentives and regulations continue to affect demand for CSPV products. Various mechanisms were created to help solar electricity reach price parity with traditional energy sources, thereby stimulating demand for solar-generated electricity. These mechanisms include fiscal incentives and regulatory measures. These fiscal incentives and regulatory measures benefit system owners, and typically are not directed at any particular domestic or foreign manufacturer of CSPV products.

There are a wide array of fiscal incentives that are designed to lower the cost of solar project development, including various tax credits, revenues from the sale of solar renewable energy certificates (SRECs), cash grants in lieu of credit, accelerated depreciation, and loan guarantees (table V-21). Tax credits are the most common form of Federal fiscal incentive; several types of tax credits, which have been modified and extended at various times, have affected the timing of the development of solar projects. However, these incentives were designed to decline over time, as the cost to generate solar-powered electricity declined.[54]

[54] *Certain Crystalline Silicon Photovoltaic Products from China*, Inv. Nos. 701-TA-481 and 731-TA-1190 (Final), USITC Publication 4360, November 2012, pp. 22-24.

Table V-21
CSPV products: Selected U.S. fiscal incentives to promote solar energy

Type of incentive	Description	Expiration Date
Production Tax Credit (PTC)	Encourages solar energy production by providing a 10-year production-based tax credit equal to 2.3¢/kWh.	Project must have been under construction by end of 2013.
Investment Tax Credit (ITC)	A 30 percent tax credit on capital expenditures for new solar PV system on residential commercial properties, and utility-scale systems.	Project must be commissioned by end of 2019 for 30 percent tax credit; 26 percent tax credit in 2020, 22 percent in 2021 and after 2021 residential drops to zero while commercial and utility drop to a permanent 10 percent. Projects commenced before December 31, 2021 may still qualify for ITC if they are placed in service before December 31, 2023.
Cash grant program (Treasury 1603 program)	Cash grant equal to up to 30 percent of eligible capital expenditures in lieu of the ITC for commercial solar projects.	Project must be under construction by the end of 2011 and completed by the end of 2016.
Loan guarantee program (DOE 1705 loan program)	Authorized $16 billion in loan guarantees, mostly for wind and solar generation projects.	Must have begun construction before September 30, 2011.
Manufacturing tax credit (MTC)	Allocated $2.3 billion in investment tax credits up to 30 percent of investment in manufacturing facilities of clean energy products.	Project must have been commissioned before February 17, 2013.

Source: *Renewable Energy and Related Services: Recent Developments*, USITC Publication 4421, August 2013, pp. 2-11-12; and SEIA, "Solar Investment Tax Credit," http://www.seia.org/policy/finance-tax/solar-investment-tax-credit, retrieved July 2017.

Recently, the Public Utility Regulatory Policies Act of 1978 (PURPA) has emerged as a significant driver of utility-scale solar installations in certain states.[55] This regulation requires utilities to purchase electricity from qualifying facilities (renewable projects that meet size requirements) at the utility's avoided cost.[56] The declining cost of solar generated electricity has led to the development of more utility-scale solar under PURPA in a number of states such as North Carolina and Utah.[57] In many other states, however, PURPA has not been a significant driver of solar installations since states set certain criteria related to PURPA (which can make solar projects more or less attractive) and the "Energy Policy Act of 2005 allowed states with competitive electricity markets to opt out of PURPA."[58]

One widespread state regulatory measure is the renewable portfolio standards ("RPSs").[59] RPSs primarily affect demand for renewable energy, including solar electricity, by mandating its use and thereby increasing the demand for CSPV products. In the United States, 29 states plus the District of Columbia had RPS policies in place in 2016. Of these, 18 states plus the District of Columbia had RPS policies with a solar or distributed generation carve out (share of the RPS that must be supplied by these sources).[60] Several of these states with RPSs also set

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[55] GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, p.12; EIA Website, https://www.eia.gov/todayinenergy/detail.php?id=27632, retrieved July 27, 2017; Smith, Colin, "What Drives Utility Solar Growth in a Post-ITC-Extension World?" Greentech Media, March 24, 2016, https://www.greentechmedia.com/articles/read/What-Drives-Utility-Solar-Growth-in-a-Post-ITC-Extension-World.

[56] "Avoided cost is the cost a utility would incur if it chose to either provide the energy itself (by building new capacity) or to purchase the energy from nonqualifying facilities." EIA Website, https://www.eia.gov/todayinenergy/detail.php?id=27632, retrieved July 27, 2017; Federal Energy Regulatory Commission (FERC) Website, https://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp, retrieved July 27, 2017.

[57] EIA Website, https://www.eia.gov/todayinenergy/detail.php?id=27632, retrieved July 27, 2017; Smith, Colin, "What Drives Utility Solar Growth in a Post-ITC-Extension World?" Greentech Media, March 24, 2016, https://www.greentechmedia.com/articles/read/What-Drives-Utility-Solar-Growth-in-a-Post-ITC-Extension-World; Warren, Chris, "Once an Obscure Law, PURPA Now Drives Utility-Scale Solar. Regulatory Conflict Quickly Followed," Greentech Media, February 23, 2017, https://www.greentechmedia.com/articles/read/purpa-is-causing-conflict-in-montana.

[58] EIA Website, https://www.eia.gov/todayinenergy/detail.php?id=27632, retrieved July 27, 2017; Smith, Colin, "What Drives Utility Solar Growth in a Post-ITC-Extension World?" Greentech Media, March 24, 2016, https://www.greentechmedia.com/articles/read/What-Drives-Utility-Solar-Growth-in-a-Post-ITC-Extension-World; Warren, Chris, "Once an Obscure Law, PURPA Now Drives Utility-Scale Solar. Regulatory Conflict Quickly Followed," Greentech Media, February 23, 2017, https://www.greentechmedia.com/articles/read/purpa-is-causing-conflict-in-montana.

[59] An RPS is a regulatory mandate that requires entities that supply electricity, such as utility companies, to generate or buy a portion of their retail electricity sales from renewable energy sources, including solar.

[60] An additional three states have credit multipliers, which award additional credit for certain types of renewable energy. Barbose, Galen, *U.S. Renewables Portfolio Standards: 2016 Annual Status Report*, April 2016, pp. 5–6, https://emp.lbl.gov/sites/all/files/lbnl-1005057.pdf. In 2011, California increased its RPS goals to 20 percent by the end of 2013, 25 percent by the end of 2016, and 33 percent by the end of

up a market for tradeable certificates.[61] During 2012–16, a majority of utility-scale solar additions were for entities (such as utilities) and markets with RPS requirements.[62] By 2016, many utilities had met interim or final renewable energy mandates and 64 percent of utility PV projects in development were driven by non-RPS mechanisms.[63] At the same time, however, seven states increased their RPS requirements in 2016.[64]

States and utilities have implemented a number of programs to encourage the installation of solar, including rebates and feed-in-tariffs ("FITs").[65] In renewable energy rebate programs (such as the California Solar Initiative), customers that install PV systems receive a refund to cover a portion of the cost of the system installation.[66] FITs primarily affect the supply of solar energy by paying a solar electricity generator a known rate for electricity fed into the grid. In the United States, six states have FITs in place (California, Hawaii, Maine, Oregon, Vermont, and Washington). These payments are generally awarded as long-term contracts set over a period of 15 to 20 years.[67]

2020. In October 2015, California increased its renewable energy mandate to 50 percent of all electricity supplied by retail sellers and publicly owned utilities. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan,* Invs. Nos. 701-TA-511 and 731-TA-1246-1247 (Final) USITC Publication 4519 February 2015. p. II-25; California Energy Commission Website, http://www.energy.ca.gov/portfolio/, retrieved July 27, 2017.

[61] A SREC is created for each megawatt-hour of electricity generated from solar energy systems. A large customer or retailer of electricity required to meet renewable energy targets can purchase a certificate in lieu of deploying MWh of its own. Renewable energy generators can also sell certificates to entities covered by RPS. "SREC" markets have emerged in the United States, with New Jersey as the largest market. Prices of tradable certificates can be volatile. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan,* Invs. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Publication 4519 February 2015. p. II-25.

[62] Lawrence Berkeley National Laboratory defines RPS capacity additions as "capacity contracted to entities subject to an RPS or sold on a merchant basis into regional RPS markets." Barbose, Galen, *U.S. Renewables Portfolio Standards: 2017 Annual Status Report*, July 2017, pp. 17-18, https://emp.lbl.gov/sites/default/files/2017_annual_rps_summary_report.pdf.

[63] According to industry reports, 64 percent of utility PV projects in development are driven by non-RPS mechanisms. GTM Research and the Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight: 2016 Year in Review*, Executive Summary, 2017, p. 12.

[64] Barbose, Galen, *U.S. Renewables Portfolio Standards: 2017 Annual Status Report*, July 2017, p. 10.

[65] A FIT offers a guarantee of payments to solar electricity developers for the electricity they produce. Payments are based on a certain price per kilowatt-hour (kWh) at which electricity is purchased, typically as part of a long-term agreement set over a period of 15-20 years.

[66] NREL Website, http://www.nrel.gov/tech_deployment/state_local_governments/basics_rebates.html, retrieved July 27, 2017; Go Solar California Website, http://www.gosolarcalifornia.ca.gov/about/csi.php, retrieved July 27, 2017.

[67] National Renewable Energy Laboratory (NREL), "Feed-In-Tariffs," http://www.nrel.gov/tech_deployment/state_local_governments/basics_tariffs.html, retrieved July 17, 2017.

Net metering allows residential and commercial customers that generate their own electricity from solar to receive credit for excess electricity fed into the grid.[68] In some states, utilities may offer net metering programs voluntarily or as a result of regulatory decisions. Differences between states' legislation and implementation mean that the benefits of net metering can vary widely for solar customers in different areas of the United States. There were more than 43 states, the District of Columbia and four territories with some form of net energy metering legislation or regulation in process in 2013.[69] However, since then, Hawaii, Arizona, Maine, and Indiana have begun to phase out their net metering incentives.[70] Utility companies, that are forced to credit customers for the solar electricity they generate but do not use, have lobbied against these net metering state incentives. From utilities' perspective, net metering reduces the number of ratepayers that are needed to cover the large costs of traditional power generation and maintenance of the grid.[71]

Firms were asked how the level or availability of federal, state, and local government incentives have changed since 2012. Most U.S. producers, importers, and purchasers indicated that the level or availability of Federal incentive programs has not changed since January 1, 2012 (table V-22). Most firms noted that the Investment Tax Credit, which had been set to expire in 2016, was extended to 2023, while the Treasury 1603 cash grant expired in 2016.[72]

[68] Residential and commercial customers can use this credit to offset the cost of grid electricity used when their CSPV system does not generate enough electricity to cover their needs.

[69] SEIA, "Net Metering," http://www.seia.org/policy/distributed-solar/net-metering.

[70] As of July 2017, 38 states, the District of Columbia, and three territories have mandatory net metering rules in place. Database of State Incentives for Renewables & Efficiency (DSIRE), Net Metering, July 2017, http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2017/07/DSIRE_Net_Metering_July2017.pdf. National Conference of State Legislatures, "State Net Metering," November 3, 2016, http://www.ncsl.org/research/energy/net-metering-policy-overview-and-state-legislative-updates.aspx, retrieved July 19, 2017.

[71] New York Times, "Rooftop Solar Dims Under Pressure from Utility Lobbyists," July 8, 2017, https://www.nytimes.com/2017/07/08/climate/rooftop-solar-panels-tax-credits-utility-companies-lobbying.html?mcubz=0&_r=0.

[72] Legislation extending the Solar Investment Tax Credit was signed on December 18, 2015. Projects eligible under the Treasury cash grant program 1603 were required to begin construction by the end of 2011 and finish by 2016. The grants were available for commercial solar projects.

Table V-22
CSPV products: Firms' responses regarding the level or availability of federal, state, and local government incentives for CSPV products since 2012

Item	Increase	No change	Decrease	Fluctuated
Federal government incentives				
U.S. producers	1	7	2	0
Importers	7	28	6	6
Purchasers	9	61	19	9
State and local government incentives				
U.S. producers	3	0	4	3
Importers	15	7	13	13
Purchasers	22	10	50	19

Source: Compiled from data submitted in response to Commission questionnaires

Firms' responses varied regarding how the level or availability of state and local incentives has changed since 2012. U.S. producer *** noted that FITs or similar incentives vary widely by state. U.S. producer *** reported that state incentives in some solar markets, such as California, New Jersey, Nevada, and Hawaii have decreased, while incentives in other markets, such as Massachusetts, North Carolina, and South Carolina, have increased. Of the firms that indicated a decline in state and local incentives, most attributed the decrease to changes in net metering policies.

Firms were asked how the changes in the level of federal, state, and local government incentives have affected the demand for CSPV products since 2012 (table V-23). For federal incentives, most firms reported that changes to federal incentives have not changed the demand for CSPV products. Most firms that indicated an increase in demand of CSPV products was due to the level of federal incentives noted the extension of the ITC. For state and local incentives, a plurality of U.S. producers, importers, and purchasers reported an increase in the demand for CSPV products due to the availability of state and local incentives. U.S. producers, importers, and purchasers most often described state RPS mandates as a mechanism that increased demand for CSPV product installations.

Table V-23
CSPV products: Firms' responses regarding how changes in the availability of government incentives have affected the demand for CSPV products since 2012

Item	Increase	No change	Decrease	Fluctuated
Federal government incentives				
U.S. producers	3	5	1	1
Importers	17	19	2	9
Purchasers	33	49	9	11
State and local government incentives				
U.S. producers	4	3	1	3
Importers	18	8	8	13
Purchasers	38	24	21	22

Source: Compiled from data submitted in response to Commission questionnaires

Firms were asked how changes in the availability of government incentives have affected the price of solar generated electricity since 2012 (table V-24). Most firms responded that availability of government incentives had led to a decrease in the price of solar generated electricity. Several firms attributed the decline in the price of solar generated electricity to the increase in supply of solar generated electricity in the marketplace.

Table V-24
CSPV products: Firms' responses regarding how changes in the availability of government incentives have affected the price of solar generated electricity since 2012

Item	Increase	No change	Decrease	Fluctuated
U.S. producers	0	3	6	1
Importers	2	10	27	8
Purchasers	4	23	56	11

Source: Compiled from data submitted in response to Commission questionnaires

Firms were asked how changes in the price of solar generated electricity have affected the price of CSPV products since 2012. Most U.S. producers (7 of 10), importers (24 of 44), and purchasers (53 of 95) reported that changes in the price of solar generated electricity did not affect the prices of CSPV products. Several firms, however, reported that the price of CSPV modules is a large factor in the price of solar electricity; and therefore, declining CSPV module prices translate directly into less expensive solar generated electricity.

Other sources of electricity

The demand for CSPV products is derived from the demand for solar electricity. However, purchasers can use energy and electricity from a wide variety of sources, ranging from traditional fossil fuels to various forms of renewable energy (including wind, solar, geothermal, and biomass). Electricity providers using renewable energy sources seek to achieve "grid parity" with other sources of electricity.[73] Levelized cost of electricity ("LCOE") represents the per-kilowatt hour cost of building and operating a generating plant over an assumed financial life.[74] The availability of both state and federal tax credits can also impact the calculation of LCOE.

[73] Grid parity is the price at which the levelized cost of electricity generated from renewable sources is competitive with the cost of conventional energy from the grid.

[74] Key inputs to calculating LCOE include capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type. However, plant owners or investors who finance plants may also value portfolio diversification due to the uncertainty of future fuel prices and future policies. U.S. Energy Information Administration (EIA), "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2017," April 2017, https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

LCOE varies by region, time of day, and availability of other electricity sources.[75] During periods of non-peak electricity demand in the United States, only lowest-cost generators would be able to sell electricity to the grid, whereas during periods of peak electricity demand, even generators with somewhat higher costs may be able to sell electricity into the transmission or distribution grid. For peak periods, natural-gas generated electricity generally sets the levelized cost of electricity that CSPV and other renewable systems must seek to meet, especially for sales to the utility segment.[76]

The levelized cost of electricity, by energy source, can vary widely. According ***, combined-cycle natural gas had the lowest LCOE in 2016, followed by onshore wind and coal (figure V-14).[77] *** LCOE estimate for combined-cycle natural gas was $***, $*** for onshore wind, and $*** for coal.[78] It estimated that the LCOE of PV solar in the United States was $*** and $***.[79] However, the LCOE of solar varied widely by state. In California, the state with the largest PV installations (by MW), the LCOE of PV solar ***. ***.[80]

Figure V-14
Estimated U.S. levelized cost of electricity ranges for selected technologies, dollars per MWh, 2016

*   *   *   *   *   *   *

[75] *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan,* Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final) USITC Publication 4519, February 2015, p. II-21.

[76] *Certain Crystalline Silicon Photovoltaic Products from China*, Inv. Nos. 701-TA-481 and 731-TA-1190 (Final), USITC Publication 4360, November 2012, pp. 21-22.

[77] ***.

[78] The LCOE of coal has been increasing. According to EIA, regulators and the investment community have continued to push energy companies to invest in technologies that have low to no carbon dioxide emissions. Major investments in power plants with a relatively higher rate of carbon dioxide emissions are considered a financial risk. U.S. Energy Information Administration (EIA), "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2017," April 2017, https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

[79] ***.

[80] ***. ***.

The EIA estimated the average LCOE for new plants entering service in 2019 (table V-25). When tax credits were included, new onshore wind installations had the lowest estimated LCOE, at $34.50/MWh. For new combined-cycle natural gas plants, the estimated LCOE ranged from $45.2/MWh to $49.3/MWh. The estimated LCOE of new solar PV installations was estimated to be $53.10/MWh when tax credits are included and $70.10/MWh unsubsidized.

Table V-25
Estimated U.S. capacity-weighted average LCOE for plants entering service in 2019[1]

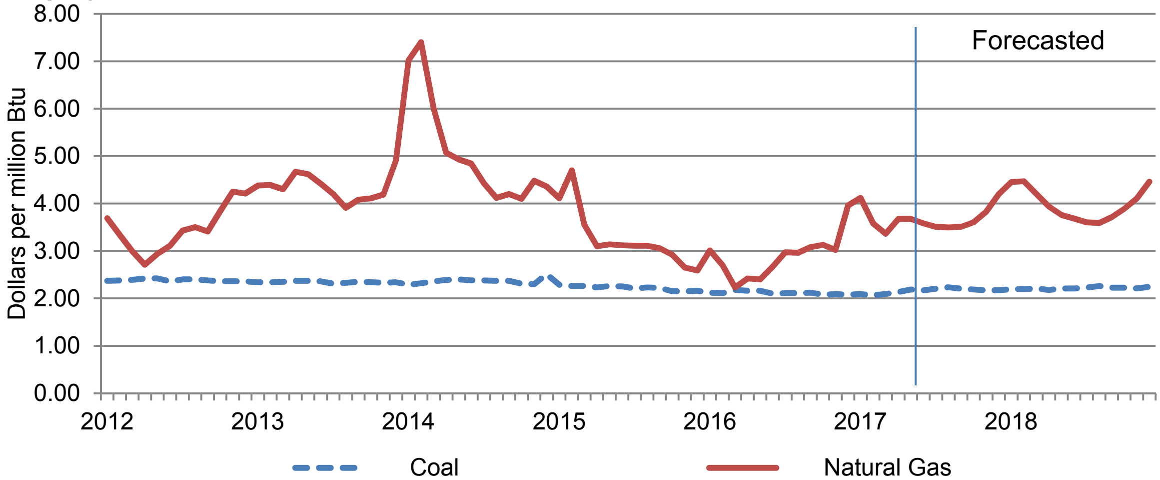
	Total System LCOE	**Total LCOE including Tax Credits[2]**
	(2016 $/MWh)	
Natural Gas-fired:		
Conventional combined cycle	49.30	49.30
Advanced combined cycle	45.20	45.20
Conventional combustion Turbine	92.70	92.70
Advanced combustion turbine	78.30	78.30
Wind-onshore	52.40	34.50
Solar PV	70.10	53.10
Solar thermal	158.90	122.10

[1] The capacity-weighted average is the average levelized cost per technology, weighted by the new capacity coming online in each region. The capacity additions for each region are based on additions in 2017-2019.
[2] Levelized cost with tax credits reflects tax credits available for plants entering service in 2019. Not all technologies have tax credits available.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2017, January 2017, DOE/EIA-0383 (2017).

As shown in figure V-15, the general trend of the price of coal used for electricity generation has remained relatively unchanged since 2012 and is forecasted to stay stable through 2018. The price of natural gas used for electricity generation increased in the latter half of 2012 and 2013, peaking in February 2014 and then declined to its lowest level in March 2016. Since then, the price of natural gas has risen, and is projected to continue to increase.

Figure V-15
Average cost of coal and natural gas for electricity generation, monthly, January 2012-May 2017 and projected June 2017-December 2018



Source: "Short-Term Energy Outlook, January 2014- U.S. Energy Prices Table 2," U.S. Energy Information Administration, and "Short-Term Energy Outlook, June 2017- U.S. Energy Prices Table 2," U.S. Energy Information Administration, accessed August 30, 2017.

Firms were asked how changes in the price of U.S. conventional energy have affected demand for CSPV products, by sector, since 2012 (table V-26). Firms' responses were varied and did not differ between the three market sectors. Firms that reported that changes in the price of U.S. conventional energy have increased demand cited the positive relationship between electricity rates and the demand for PV systems and modules.

Table V-26
CSPV products: Firms' responses regarding how changes in the price of U.S. conventional energy have affected demand for CSPV products, by sector, since 2012

Item	Increase	No change	Decrease	Fluctuate
Residential sector				
U.S. producers	1	4	1	4
Importers	12	10	4	14
Purchasers	35	15	7	13
Commercial sector				
U.S. producers	2	3	1	3
Importers	11	9	4	14
Purchasers	38	16	12	13
Utility sector				
U.S. producers	3	3	1	2
Importers	12	9	4	13
Purchasers	34	13	10	13

Source: Compiled from data submitted in response to Commission questionnaires.

Most U.S. producers reported that changes in the price of U.S. conventional energy have not affected the price of solar generated electricity since 2012 (table V-27).[81] However, a plurality of importers and purchasers reported that changes in the price of U.S. conventional energy has decreased the price of solar generated electricity. U.S. producers reported that the decrease in the price of solar generated electricity has been driven by CSPV market competition and not by falling prices of conventional energy. Furthermore, several importers and purchasers stated that there is no correlation between conventional energy prices and prices of solar generated electricity.

Table V-27
CSPV products: Firms' responses regarding how changes in the price of U.S. conventional energy have affected the price of solar generated electricity since 2012

Item	Increase	No change	Decrease	Fluctuate
U.S. producers	0	6	1	2
Importers	0	13	14	13
Purchasers	4	29	44	13

Source: Compiled from data submitted in response to Commission questionnaires

[81] SolarWorld argues that there is no correlation between the price of conventional energy and the price of CSPV products, noting that U.S. solar prices declined by approximately 60 percent during 2012-16 while natural gas prices increased from 2012 through the first quarter of 2014 and increased in the second half of 2016. SolarWorld's posthearing brief, p. 19 and exh. 1, pp. 29-30.

APPENDIX A

FEDERAL REGISTER NOTICES

The Commission makes available notices relevant to its investigations and reviews on its website, www.usitc.gov. In addition, the following tabulation presents *Federal Register* notices issued by the Commission during the current proceeding.

Citation	Title	Link
82 FR 25331 June 1, 2017	*Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled Into Other Products); Institution and Scheduling of Safeguard Investigation and Determination That the Investigation Is Extraordinarily Complicated*	https://www.gpo.gov/fdsys/pkg/FR-2017-06-01/pdf/2017-11013.pdf
82 FR 33927 July 21, 2017	*Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled Into Other Products); Institution and scheduling of safeguard investigation and determination that the investigation is extraordinarily complicated, amendment*	https://www.gpo.gov/fdsys/pkg/FR-2017-07-21/pdf/2017-15355.pdf
82 FR 37900 August 14, 2017	*Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled Into Other Products) Determination Not To Close Any Portion of the Commission's Hearing on Injury Issues*	https://www.gpo.gov/fdsys/pkg/FR-2017-08-14/pdf/2017-17081.pdf

APPENDIX B

LIST OF HEARING WITNESSES

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject:	Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products)
Inv. No.:	TA-201-75
Date and Time:	August 15, 2017 - 9:30 a.m.

Sessions were held in connection with this investigation in the Main Hearing Room (room 101), 500 E Street, SW, Washington, DC.

STATE GOVERNMENT WITNESSES:

The Honorable Paul Gazelka, State Senator, Minnesota State Senate

The Honorable David Tomassoni, State Senator, Minnesota State Senate

The Honorable Jason Saine, State Representative, North Carolina House of Representatives

The Honorable Bucky Johnson, Mayor of the City of Norcross, Georgia

The Honorable Lauren McDonald, Commissioner, Georgia Public Service Commission

The Honorable Luke Clippinger, Delegate, Maryland House of Delegates

Al Christopher, Director, Division of Energy, Virginia Department of Mines, Minerals and Energy

EMBASSY WITNESSES:

Embassy of the Republic of Korea
Washington, DC

The Honorable Chang K. Kim, Minister Counsellor for Trade, Industry & Energy

Embassy of the Republic of Indonesia
Washington, DC

Reza Pahlevi Chairul, Commercial Attaché

Delegation of the European Union to the United States of America
Washington, DC

Sibylle Zitko, Senior Legal Advisor

Embassy of Brazil
Washington, DC

Reynaldo Linhares Colares, Second Secretary

Embassy of Mexico
Washington, DC

Aristeo Lopez, Legal Adviser in the Commercial and NAFTA Office of the Secretariat of Economy

Embassy of Canada
Washington, DC

Carrie Goodge O'Brien, Counsellor (Trade Policy)

Taipei Economic and Cultural Representative Office
Washington, DC

Chien Chi Chao, Economic Officer

OPENING REMARKS

Petitioners (**Matthew J. McConkey**, Mayer Brown LLP)
Respondents (**Matthew R. Nicely**, Hughes Hubbard & Reed LLP)

IN SUPPORT OF THE PETITION:

Mayer Brown LLP
Washington, DC
on behalf of

Suniva Inc.

Matt Card, Executive Vice President of Commercial Operations, Suniva Inc.

Dave McCarty, Chief Operating Officer, Itek Energy

Steve Shea, Consultant, Formerly Vice President at Beamreach Solar

Warren Payne, Sr., International Trade Advisor, Mayer Brown LLP

Andrew Szamosszegi, Principal, Capital Trade Inc.

Seth Kaplan, President, International Economic Research LLC

Matthew J. McConkey)
) – OF COUNSEL
Margaret Sales)

Wiley Rein LLP
Washington, DC
on behalf of

SolarWorld Americas, Inc. ("SolarWorld")

Juergen Stein, Chief Executive Officer, SolarWorld

Shane Messer, Vice President of Sales and Marketing, SolarWorld

Edward Harner, Chief Operating Officer, Green Solar Technologies

Timothy C. Brightbill)
Usha Neelakantan) – OF COUNSEL
Tessa V. Capeloto)

<u>NON-PARTIES IN SUPPORT OF THE PETITION:</u>

FisherBroyles,LLP
Washington, DC
<u>on behalf of</u>

SKC, Inc.

Emmarine Byerson, Senior Accounting & Risk Manager

Aiden Oh, Business Manager

Philip Gallas) – OF COUNSEL

Stion Corporation
Hattiesburg, MS

Frank Yang, Vice President of Business Development & Marketing

<u>IN OPPOSITION TO THE PETITION:</u>

Hughes Hubbard & Reed LLP
Washington, DC
<u>on behalf of</u>

The Solar Energy Industries Association ("SEIA") and its member company SunPower Corporation

Thomas Werner, President and CEO, SunPower Corp.

Ed Fenster, Co-Founder and Executive Chairman, Sunrun Inc.

Dan Shugar, Founder and CEO, NEXTracker

Craig Cornelius, Senior Vice President, Renewables, NRG Energy Inc.

Bastel Wardak, President, California Solar Systems, Inc.

Thomas J. Prusa, Professor and Chair, Department of Economics, Rutgers University

Amy Grace, Head of North America Research, Bloomberg New Energy Finance

<u>IN OPPOSITION TO THE PETITION (continued):</u>

James P. Dougan, Vice President, Economic Consulting Services, LLC

Jennifer Lutz, Senior Economist, Economic Consulting Services, LLC

Emma K. Peterson, Economist, Economic Consulting Services, LLC

Matthew R. Nicely)
) – OF COUNSEL
Julia K. Eppard)

Baker & McKenzie LLP
Washington, DC
<u>on behalf of</u>

Depcom Power Inc. ("Depcom")

James Lamon, Chief Executive Officer, Depcom

Kevin M. O'Brien) – OF COUNSEL

Curtis, Mallet-Prevost, Colt & Mosle LLP
Washington, DC
<u>on behalf of</u>

Korea Photovoltaic Industry Association
Hanwha Q Cells Korea Corporation
LG Electronics, Inc.
Hyundai Heavy Industries Green Energy Co., Ltd.
(collectively, "KOPIA")

Aaron Hall President, Borrego Solar

Stephen Hahm, VP of Energy Business, LG Electronics USA

Kevin Kim, Head of Solar Business, LG Electronics USA

Dave Byrne, Senior Sales Manager of Solar Business, LG Electronics USA

Bo Gyung Kim-Lauren, Senior Counsel, LG Electronics USA

<u>IN OPPOSITION TO THE PETITION (continued):</u>

Edward Balistreri, Associate Professor, Department of Economics,
Iowa State University

Daniel L. Porter	)
	) – OF COUNSEL
James P. Durling	)

Akin Gump Strauss Hauer & Feld LLP
Washington, DC
<u>on behalf of</u>

China Chamber of Commerce for Import and Export of Machinery and
Electronic Products, Solar Energy and Photovoltaic Products Branch ("CCCME")

Spencer S. Griffith) – OF COUNSEL

Appleton Luff Pte. Ltd.
Washington, DC
<u>on behalf of</u>

REC Solar Pte. Ltd ("REC Solar")
REC Americas, LLC (collectively, "REC")

Steven M. O'Neil, Chief Executive Officer, REC Solar

Edmund W. Sim	)
	) – OF COUNSEL
Kelley A. Slater	)

Arent Fox LLP
Washington, DC
<u>on behalf of</u>

Hanwha Q Cells America Inc. ("Hanwha")

Sunghoon Kim, Senior Director of Sales Planning, Hanwha

Andres Munro, General Counsel, Hanwha

Sam Yoon, Sales Planning Manager, Hanwha

John N. Gurley	)
	) – OF COUNSEL
Nancy A. Noonan	)

IN OPPOSITION TO THE PETITION (continued):

Vinson & Elkins LLP
Washington, DC
on behalf of

SunPower Corporation ("SunPower")

Thomas Werner, President and Chief Executive Officer, SunPower

Daniel J. Gerkin) – OF COUNSEL

Hogan Lovells US LLP
Washington, DC
on behalf of

Canadian Solar Inc.
Silfab Solar, Inc.
Heliene Inc. (collectively, the "Canadian Industry")

Vincent Ambrose, General Manager for North America, Canadian Solar Inc.

Paolo Maccario, General Manager and Chief Operating Officer, Silfab Solar Inc.

Martin Pochtaruk, President, Heliene Inc.

Robert A. Rogowsky, Ph.D., Professor and Program Chair of Trade and Economic Diplomacy at the Monterey Institute of International Studies

Jonathan T. Stoel)
Craig A. Lewis)
) – OF COUNSEL
Michael Jacobsen)
Mary Van Houten)

Smirnow Law
Washington, DC
on behalf of

8minutenergy Renewables LLC ("8minutenergy")

Arthur Haubenstock, General Counsel *and* Vice President, Government & Regulatory, 8minutenergy

John P. Smirnow) – OF COUNSEL

GigaWatt, Inc.
Placentia, CA

Deep Patel, Founder *and* Chief Executive Officer

<u>NON-PARTIES IN OPPOSITION TO THE PETITION:</u>

PT. Sky Energy Indonesia
Indonesia

Jio Wu, Director of International Business Development

<u>REBUTTAL/CLOSING REMARKS:</u>

Petitioners (**Timothy C. Brightbill**, Wiley Rein LLP; **Matthew J. McConkey** of Mayer Brown LLP; *and* **Seth Kaplan**, International Economic Research LLC)
Respondents (**Matthew R. Nicely**, Hughes Hubbard & Reed LLP)

APPENDIX C

SUMMARY DATA

Table C-1a
CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. consumption quantity:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. consumption value:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. imports from:										
Canada:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
China:										
Quantity	326,846	82,264	1,263,270	3,311,513	2,720,193	732.3	(74.8)	1,435.6	162.1	(17.9)
Value	291,878	69,976	747,148	1,680,733	1,258,864	331.3	(76.0)	967.7	125.0	(25.1)
Unit value	$893	$851	$591	$508	$463	(48.2)	(4.7)	(30.5)	(14.2)	(8.8)
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Germany:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Indonesia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Japan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Korea:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Malaysia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Mexico:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Philippines:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Signapore:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Taiwan:										
Quantity	1,065,160	2,113,220	2,090,974	852,758	1,118,967	5.1	98.4	(1.1)	(59.2)	31.2
Value	743,337	1,349,271	1,274,305	467,820	606,449	(18.4)	81.5	(5.6)	(63.3)	29.6
Unit value	$698	$638	$609	$549	$542	(22.3)	(8.5)	(4.6)	(10.0)	(1.2)
Ending inventory quantity	128,249	116,508	200,189	170,345	91,083	(29.0)	(9.2)	71.8	(14.9)	(46.5)
Thailand:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Vietnam:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All other sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All import sources:										
Quantity	2,162,388	3,101,412	4,582,898	8,430,393	12,813,568	492.6	43.4	47.8	84.0	52.0
Value	1,904,664	2,214,457	3,014,861	4,967,865	7,060,489	270.7	16.3	36.1	64.8	42.1
Unit value	$881	$714	$658	$589	$551	(37.4)	(18.9)	(7.9)	(10.4)	(6.5)
Ending inventory quantity	303,409	327,638	560,211	1,107,536	1,238,641	308.2	8.0	71.0	97.7	11.8

Table continued on next page.

Table C-1a--Continued
CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location, 2012-16

(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. producers': (fn3)										
Average capacity quantity	***	***	***	***	***	***	***	***	***	***
Production quantity	***	***	***	***	***	***	***	***	***	***
Capacity utilization (fn1)	***	***	***	***	***	***	***	***	***	***
U.S. shipments (fn4):										
Quantity	***	***	***	***	***	***	***	***	***	***
Value (fn5)	***	***	***	***	***	***	***	***	***	***
Unit value (fn6)	***	***	***	***	***	***	***	***	***	***
Export shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Inventories/total shipments (fn1)	***	***	***	***	***	***	***	***	***	***
Production workers	***	***	***	***	***	***	***	***	***	***
Hours worked (1,000s)	***	***	***	***	***	***	***	***	***	***
Wages paid ($1,000)	***	***	***	***	***	***	***	***	***	***
Hourly wages (dollars)	***	***	***	***	***	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***	***	***	***	***	***
Unit labor costs	***	***	***	***	***	***	***	***	***	***
Net sales: (fn7)										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Cost of goods sold (COGS)	***	***	***	***	***	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***	***	***	***	***	***
SG&A expenses	***	***	***	***	***	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***	***	***	***	***	***
Net income or (loss)	***	***	***	***	***	***	***	***	***	***
Unit COGS	***	***	***	***	***	***	***	***	***	***
Unit SG&A expenses	***	***	***	***	***	***	***	***	***	***
Unit operating income or (loss)	***	***	***	***	***	***	***	***	***	***
Unit net income or (loss)	***	***	***	***	***	***	***	***	***	***
COGS/sales (fn1)	***	***	***	***	***	***	***	***	***	***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	***	***	***	***	***
Net income or (loss)/sales (fn1)	***	***	***	***	***	***	***	***	***	***

Notes:

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Undefined.
fn3.--Generally the data for U.S. producers in this table are limited to U.S.-origin cells and modules containing U.S.-origin cells.
fn4.--U.S. producers' U.S. shipments include U.S. producers' exports of cells that have been re-imported after being formed into modules and/or laminates in other countries.
fn5.--The value of U.S. producers' U.S. shipments includes value added to foreign-origin cells. See part IV for details.
fn6.--The average unit values of U.S. producers' U.S. shipments are calculated exclusive of the value added to foreign-origin cells. See part IV for details.
fn7.--Financial results in this table include derived module revenue and costs based on relative production using U.S.-origin cells plus the data from merchant market cell operations.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-1b
CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16

* * * * * * *

Table C-2
CSPV products: Summary data concerning the merchant U.S. market for cells, 2012-16

* * * * * * *

CSPV modules: Total market: COO Petition

Table C-3a
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. consumption quantity:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. consumption value:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. imports from:										
Canada:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
China:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Germany:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Indonesia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Japan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Korea:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Malaysia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Mexico:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Philippines:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Signapore:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Taiwan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Thailand:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Vietnam:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All other sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All import sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***

Table C-3a--Continued
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. producers': (fn3)										
Average capacity quantity	929,827	913,452	716,900	871,603	1,245,807	34.0	(1.8)	(21.5)	21.6	42.9
Production quantity	538,633	447,129	440,259	552,968	669,089	24.2	(17.0)	(1.5)	25.6	21.0
Capacity utilization (fn1)	57.9	48.9	61.4	63.4	53.7	(4.2)	(9.0)	12.5	2.0	(9.7)
U.S. shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Export shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Inventories/total shipments (fn1) (fn3)	***	***	***	***	***	***	***	***	***	***
Production workers	1,293	1,080	956	1,038	1,253	(3.1)	(16.5)	(11.5)	8.6	20.7
Hours worked (1,000s)	3,041	2,335	1,781	2,095	2,364	(22.3)	(23.2)	(23.7)	17.6	12.8
Wages paid ($1,000)	***	***	***	***	***	***	***	***	***	***
Hourly wages (dollars)	***	***	***	***	***	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***	***	***	***	***	***
Unit labor costs	***	***	***	***	***	***	***	***	***	***
Net sales:										
Quantity	581,762	464,771	472,355	527,683	623,846	7.2	(20.1)	1.6	11.7	18.2
Value	607,615	410,608	420,661	476,920	484,359	(20.3)	(32.4)	2.4	13.4	1.6
Unit value	$1,044	$883	$891	$904	$776	(25.7)	(15.4)	0.8	1.5	(14.1)
Cost of goods sold (COGS)	858,747	545,848	422,575	432,924	488,577	(43.1)	(36.4)	(22.6)	2.4	12.9
Gross profit or (loss)	(251,132)	(135,240)	(1,914)	43,996	(4,218)	(98.3)	(46.1)	(98.6)	[fn2]	[fn2]
SG&A expenses	125,946	68,803	56,642	54,526	210,773	67.4	(45.4)	(17.7)	(3.7)	286.6
Operating income or (loss)	(377,078)	(204,043)	(58,556)	(10,530)	(214,991)	(43.0)	(45.9)	(71.3)	(82.0)	1,941.7
Net income or (loss)	(551,170)	(217,135)	(54,504)	(21,071)	(224,873)	(59.2)	(60.6)	(74.9)	(61.3)	967.2
Unit COGS	$1,476	$1,174	$895	$820	$783	(46.9)	(20.4)	(23.8)	(8.3)	(4.5)
Unit SG&A expenses	$216	$148	$120	$103	$338	56.1	(31.6)	(19.0)	(13.8)	227.0
Unit operating income or (loss)	$(648)	$(439)	$(124)	$(20)	$(345)	(46.8)	(32.3)	(71.8)	(83.9)	1,627.0
Unit net income or (loss)	$(947)	$(467)	$(115)	$(40)	$(360)	(62.0)	(50.7)	(75.3)	(65.4)	802.7
COGS/sales (fn1)	141.3	132.9	100.5	90.8	100.9	(40.5)	(8.4)	(32.5)	(9.7)	10.1
Operating income or (loss)/sales (fn1)	(62.1)	(49.7)	(13.9)	(2.2)	(44.4)	17.7	12.4	35.8	11.7	(42.2)
Net income or (loss)/sales (fn1)	(90.7)	(52.9)	(13.0)	(4.4)	(46.4)	44.3	37.8	39.9	8.5	(42.0)

Notes:

Note.--Share and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Undefined.
fn3.--U.S. producers' data in this table includes modules assembled from U.S.-origin cells and from foreign-origin cells.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-3b
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. consumption quantity:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. consumption value:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. imports from:										
Canada:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
China:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Germany:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Indonesia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Japan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Korea:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Malaysia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Mexico:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Philippines:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Signapore:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Taiwan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Thailand:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Vietnam:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All other sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All import sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***

Table C-3b--Continued
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. producers': (fn3)										
Average capacity quantity	929,827	913,452	716,900	871,603	1,245,807	34.0	(1.8)	(21.5)	21.6	42.9
Production quantity	538,633	447,129	440,259	552,968	669,089	24.2	(17.0)	(1.5)	25.6	21.0
Capacity utilization (fn1)	57.9	48.9	61.4	63.4	53.7	(4.2)	(9.0)	12.5	2.0	(9.7)
U.S. shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Export shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Inventories/total shipments (fn1) (fn3)	***	***	***	***	***	***	***	***	***	***
Production workers	1,293	1,080	956	1,038	1,253	(3.1)	(16.5)	(11.5)	8.6	20.7
Hours worked (1,000s)	3,041	2,335	1,781	2,095	2,364	(22.3)	(23.2)	(23.7)	17.6	12.8
Wages paid ($1,000)	***	***	***	***	***	***	***	***	***	***
Hourly wages (dollars)	***	***	***	***	***	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***	***	***	***	***	***
Unit labor costs	***	***	***	***	***	***	***	***	***	***
Net sales:										
Quantity	581,762	464,771	472,355	527,683	623,846	7.2	(20.1)	1.6	11.7	18.2
Value	607,615	410,608	420,661	476,920	484,359	(20.3)	(32.4)	2.4	13.4	1.6
Unit value	$1,044	$883	$891	$904	$776	(25.7)	(15.4)	0.8	1.5	(14.1)
Cost of goods sold (COGS)	858,747	545,848	422,575	432,924	488,577	(43.1)	(36.4)	(22.6)	2.4	12.9
Gross profit or (loss)	(251,132)	(135,240)	(1,914)	43,996	(4,218)	(98.3)	(46.1)	(98.6)	[fn2]	[fn2]
SG&A expenses	125,946	68,803	56,642	54,526	210,773	67.4	(45.4)	(17.7)	(3.7)	286.6
Operating income or (loss)	(377,078)	(204,043)	(58,556)	(10,530)	(214,991)	(43.0)	(45.9)	(71.3)	(82.0)	1,941.7
Net income or (loss)	(551,170)	(217,135)	(54,504)	(21,071)	(224,873)	(59.2)	(60.6)	(74.9)	(61.3)	967.2
Unit COGS	$1,476	$1,174	$895	$820	$783	(46.9)	(20.4)	(23.8)	(8.3)	(4.5)
Unit SG&A expenses	$216	$148	$120	$103	$338	56.1	(31.6)	(19.0)	(13.8)	227.0
Unit operating income or (loss)	$(648)	$(439)	$(124)	$(20)	$(345)	(46.8)	(32.3)	(71.8)	(83.9)	1,627.0
Unit net income or (loss)	$(947)	$(467)	$(115)	$(40)	$(360)	(62.0)	(50.7)	(75.3)	(65.4)	802.7
COGS/sales (fn1)	141.3	132.9	100.5	90.8	100.9	(40.5)	(8.4)	(32.5)	(9.7)	10.1
Operating income or (loss)/sales (fn1)	(62.1)	(49.7)	(13.9)	(2.2)	(44.4)	17.7	12.4	35.8	11.7	(42.2)
Net income or (loss)/sales (fn1)	(90.7)	(52.9)	(13.0)	(4.4)	(46.4)	44.3	37.8	39.9	8.5	(42.0)

Notes:

Note.--Share and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Undefined.
fn3.--U.S. producers' data in this table includes modules assembled from U.S.-origin cells and from foreign-origin cells.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-4
CSPV products: Apparent consumption and market shares for by channel for modules, 2012-16

*   *   *   *   *   *   *

Table C-5
CSPV products: Apparent consumption and market shares by 60-cell vs 72-cell modules, 2012-16

*   *   *   *   *   *   *

Table C-6
CSPV products: Apparent consumption and market shares by mono- vs multi-crystaline cell modules 2012-16

*   *   *   *   *   *   *

Table C-7
CPSV products: U.S. imports, 2012-16

Source	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Argentina	54	27	---	---	---
Australia	1,671	426	613	407	150
Austria	744	402	---	---	44
Bangladesh	---	---	---	---	39
Belgium	1,039	84	48	57	17
Belize	---	---	---	25	---
Br Virgin Is	---	---	---	---	32
Cambodia	---	---	658	---	---
Canada	47,680	5,456	18,885	77,151	88,741
Chile	---	5	---	---	---
China	1,717,276	1,171,672	1,634,023	1,733,170	1,531,218
Colombia	---	---	---	---	3
Costa Rica	---	123	---	---	---
Cyprus	---	---	---	239	---
Czech Republic	10,234	2,901	408	---	---
Denmark	---	133	24	3	21
Dominican Rep	---	---	---	10	---
Estonia	---	---	---	7	---
Finland	10	11	---	132	---
France	88	249	160	855	15,578
Germany	201,046	38,842	123,447	409,272	163,827
Greece	---	52	---	---	---
Honduras	---	---	---	---	21
Hong Kong	2,942	7,287	2,365	140	1,930
Hungary	2	---	---	46	27
India	11,608	832	35,079	13,349	6,741
Indonesia	---	---	---	846	1,810
Ireland	---	---	10	21	---
Israel	100	21	35	49	17
Italy	110	231	731	982	1,797
Jamaica	4	---	---	---	---
Japan	172,700	22,569	52,337	115,484	113,732
Jordan	---	7	---	---	---
Korea	141,549	36,487	110,817	404,272	1,331,309
Latvia	---	---	---	---	5
Lithuania	112	239	127	38	69
Macao	6	---	---	---	---
Malaysia	1,512,045	1,251,732	896,650	1,315,635	2,530,531
Mauritius	---	---	---	---	2,087

Table continued next page.

Table C-7--*Continued*
CPSV products: U.S. imports, 2012-16

Source	Calendar year				
	2012	2013	2014	2015	2016
	Value (1,000 dollars)				
Mexico	482,440	439,440	506,212	911,979	854,638
Netherlands	294	22	---	512	2,033
New Zealand	53	---	5	9	---
Norway	5	39	71	77	---
Pakistan	---	---	---	55	---
Peru	---	---	---	---	36
Philippines	394,421	98,319	67,770	85,418	125,307
Poland	40	17	22	12	6,213
Portugal	65	---	232	451	3,997
Qatar	---	---	3	---	---
Romania	---	---	8	---	14
Saudi Arabia	6	---	---	---	---
Serbia	---	---	10	---	---
Singapore	70,135	48,983	57,592	426,532	360,180
Slovak Republic	3	---	---	5	6
South Africa	---	---	---	---	5,055
Spain	19,470	20,226	95	544	2,683
Sweden	14	110	196	---	3
Switzerland	104	11	16	51	---
Taiwan	424,075	573,146	761,855	342,446	269,860
Thailand	12	374	751	40,858	532,257
Turkey	95	108	7,111	24,408	4,622
United Arab Emirates	12	---	5	172	39
United Kingdom	495	369	1,002	690	387
Vietnam	940	158	7,408	176,289	529,803
Total U.S. imports	5,213,699	3,721,106	4,286,778	6,082,698	8,486,876

Table C-7--*Continued*
CPSV products: U.S. imports, 2012-16

Source	Calendar year				
	2012	2013	2014	2015	2016
	Share of value (percent)				
Argentina	0.0	0.0	---	---	---
Australia	0.0	0.0	0.0	0.0	0.0
Austria	0.0	0.0	---	---	0.0
Bangladesh	---	---	---	---	0.0
Belgium	0.0	0.0	0.0	0.0	0.0
Belize	---	---	---	0.0	---
Br Virgin Is	---	---	---	---	0.0
Cambodia	---	---	0.0	---	---
Canada	0.9	0.1	0.4	1.3	1.0
Chile	---	0.0	---	---	---
China	32.9	31.5	38.1	28.5	18.0
Colombia	---	---	---	---	0.0
Costa Rica	---	0.0	---	---	---
Cyprus	---	---	---	0.0	---
Czech Republic	0.2	0.1	0.0	---	---
Denmark	---	0.0	0.0	0.0	0.0
Dominican Rep	---	---	---	0.0	---
Estonia	---	---	---	0.0	---
Finland	0.0	0.0	---	0.0	---
France	0.0	0.0	0.0	0.0	0.2
Germany	3.9	1.0	2.9	6.7	1.9
Greece	---	0.0	---	---	---
Honduras	---	---	---	---	0.0
Hong Kong	0.1	0.2	0.1	0.0	0.0
Hungary	0.0	---	---	0.0	0.0
India	0.2	0.0	0.8	0.2	0.1
Indonesia	---	---	---	0.0	0.0
Ireland	---	---	0.0	0.0	---
Israel	0.0	0.0	0.0	0.0	0.0
Italy	0.0	0.0	0.0	0.0	0.0
Jamaica	0.0	---	---	---	---
Japan	3.3	0.6	1.2	1.9	1.3
Jordan	---	0.0	---	---	---
Korea	2.7	1.0	2.6	6.6	15.7
Latvia	---	---	---	---	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0
Macao	0.0	---	---	---	---
Malaysia	29.0	33.6	20.9	21.6	29.8
Mauritius	---	---	---	---	0.0

Table continued next page.

Table C-7--*Continued*
CPSV products: U.S. imports, 2012-16

Source	Calendar year				
	2012	2013	2014	2015	2016
	Share of value (percent)				
Mexico	9.3	11.8	11.8	15.0	10.1
Netherlands	0.0	0.0	---	0.0	0.0
New Zealand	0.0	---	0.0	0.0	---
Norway	0.0	0.0	0.0	0.0	---
Pakistan	---	---	---	0.0	---
Peru	---	---	---	---	0.0
Philippines	7.6	2.6	1.6	1.4	1.5
Poland	0.0	0.0	0.0	0.0	0.1
Portugal	0.0	---	0.0	0.0	0.0
Qatar	---	---	0.0	---	---
Romania	---	---	0.0	---	0.0
Saudi Arabia	0.0	---	---	---	---
Serbia	---	---	0.0	---	---
Singapore	1.3	1.3	1.3	7.0	4.2
Slovak Republic	0.0	---	---	0.0	0.0
South Africa	---	---	---	---	0.1
Spain	0.4	0.5	0.0	0.0	0.0
Sweden	0.0	0.0	0.0	---	0.0
Switzerland	0.0	0.0	0.0	0.0	---
Taiwan	8.1	15.4	17.8	5.6	3.2
Thailand	0.0	0.0	0.0	0.7	6.3
Turkey	0.0	0.0	0.2	0.4	0.1
United Arab Emirates	0.0	---	0.0	0.0	0.0
United Kingdom	0.0	0.0	0.0	0.0	0.0
Vietnam	0.0	0.0	0.2	2.9	6.2
Total U.S. imports	100.0	100.0	100.0	100.0	100.0

Note.—Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Official U.S. imports statistics using HTS statistical reporting numbers 8541.40.6020 and 8541.40.6030, accessed August 21, 2017.

APPENDIX D

COMPETITIVE EFFORTS AND PROPOSED ADJUSTMENTS

U.S. producers were asked whether their firm has undertaken or planned any efforts to compete more effectively in the U.S. market for CSPV cells (whether or not partially or fully assembled into other products) ("CSPV products") since 2012. The following five U.S. producers that together represented *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that they had not made any efforts to compete more effectively since 2012: ***. None of these firms manufactured CSPV cells in the United States during the period of investigation. The following eight U.S. producers that together represented *** percent of reported U.S. CSPV cell production and *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that they had made efforts to compete more effectively since 2012: ***. The aggregate reported expenditures involved in these U.S. producers' efforts to compete was $***. U.S. producers were further instructed to provide a description of (1) the efforts made since 2012 to compete more effectively, (2) the year in which the effort was made, (3) the expenditure involved, and (4) the specific competitive advantage sought or acquired. The responses of the U.S. producers to this request are presented in table D-1.

Table D-1
CSPV products: U.S. producers' efforts to compete more effectively in the U.S. market, by reporting firm, January 2012 – June 2017

* * * * * * *

U.S. producers were asked if they were to receive import relief as a result of this safeguard investigation, would the firm and/or its workers make adjustments in its operations producing CSPV products that would permit it to compete more effectively with imports of CSPV products. The following six U.S. producers that together represented *** percent of reported U.S. CSPV cell production and *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that they would not make any adjustments in their operations if they were to receive import relief: ***. The following seven U.S. producers that together represented *** percent of reported U.S. CSPV cell production and *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that if they were to receive import relief, they would make adjustments in their operations: ***. The aggregate reported anticipated expenditures involved were $***. U.S. producers were also instructed to describe (1) the specific adjustment actions that they would make during any period of relief that would permit them to compete more effectively with imports, (2) the anticipated expenditure involved, and (3) the specific competitive advantage expected to be gained by the adjustment. The firms were asked to include adjustment actions that were in addition to those that they would incur notwithstanding any relief under section 202 and which was described in the previous table above. The responses of the U.S. producers to this request are presented in table D-2.

Table D-2
CSPV products: U.S. producers' anticipated adjustments under safeguard import relief

* * * * * * *

APPENDIX E

Effects of imports on U.S. producers and related information by firm

Table E-1
CSPV products: Narrative relating to actual and anticipated negative effects of imports on investment and growth and development, since January 1, 2012

* * * * * *

Table E-2
CSPV products: U.S. producers' financial results on cells (commercial sales and transfers) by firm, 2012-16

* * * * * *

Table E-3
CSPV products: U.S. producers' financial results on modules by firm, 2012-16

* * * * * *

Table E-4
CSPV products: U.S. producers' capital expenditures, research and development (R&D) expenses, and investment in productive assets related to cells and modules by firm, 2012-16

* * * * * *

APPENDIX F

COMMENTS ON THE EFFECTS OF U.S. ORDERS ON CRYSTALLINE SILICON PHOTOVOLTAIC PRODUCTS

Ten of 13 responding U.S. producers that accounted for *** percent of U.S. production of CSPV cells and *** percent of U.S. production of CSPV modules during the period of investigation reported that their firm's operations concerning CSPV cells (whether or not partially or fully assembled into other products) ("CSPV products") had been injured by imports of CSPV products since January 1, 2012.[1] Explanations of their responses are presented in table F-1.

Table F-1
CSPV products: U.S. producers' injury from imports

* * * * * * *

U.S. producers were asked to rank any factors that are having an adverse impact on the operations of their firm producing CSPV products. Although U.S. producer responses were varied, the most often cited factor as being an extremely important cause of injury to U.S. producers was import competition, with nine firms ranking it a "5" and one firm ranking it a "4" on the scale (table F-2).

Table F-2
CSPV products: Ranking of the importance of factors causing injury as reported by U.S. producers, by factor

Factor	Number of firms reporting				
	Importance rank[1]				
	1	2	3	4	5
Import competition	---	---	---	1	8
Exchange rates	2	---	---	1	1
Domestic energy costs	3	---	1	1	---
Competition from other U.S. producers	3	3	2	---	---
Competition from any substitute products	---	1	1	---	1
Developments in technology	3	1	---	2	---
U.S. demand for CSPV cells	3	---	1	---	---
Inability to obtain adequate financing	1	2	---	1	2
Change in raw material costs	3	2	---	---	2
Labor problems or shortages	3	---	1	---	---
Production problems	1	1	---	---	---
Change in composition of U.S. industry	3	---	2	1	---
Grid parity with natural gas	4	---	---	1	---
Grid parity with out-of-scope thin-film solar products	1	1	---	---	---
Changes in government incentive programs	3	1	1	---	2
Other factors	---	---	---	1	---

[1] Importance of factor in causing injury on a scale of 1 to 5 (with 5 being an extremely important cause of injury). U.S. producers were instructed to leave blank or report a zero for "not applicable/ no opinion."

Source: Compiled from data submitted in response to Commission questionnaires.

[1] The three responding U.S. producers that indicated that their firm's operations concerning CSPV products had not been injured by imports of CSPV products since January 1, 2012 include***.

U.S. producers were also asked to describe the impact of imports of CSPV products on their U.S. operations producing CSPV products and to identify and describe any factors that are having an adverse impact on the operation of their firm. They were also asked to describe the role played by each factor that they identified. The responses of U.S. producers to this request are presented in table F-3.

Table F-3
CSPV products: U.S. producers' descriptions of factors that have adverse impact on firm

* * * * * * *

U.S. producers were asked to describe the significance, if any, of the existing U.S. antidumping and countervailing duty orders on imports of CSPV products from China and Taiwan on their firm's production, capacity, U.S. shipments, inventories, purchases, employment, revenues, costs, profits, cash flow, capital expenditures, research and development expenditures, and asset values. Responses to this request are presented in table F-4.

Table F-4
CSPV products: U.S. producers' descriptions of significance of existing U.S. antidumping and countervailing duty orders on imports of CSPV products from China and Taiwan

* * * * * * *

Thirty-four of 56 responding importers reported importing CSPV products prior to 2012. Importers were asked if their patterns of importing CSPV products had changed since the United States imposed antidumping and countervailing duty orders on imports from China and Taiwan. Importer responses were varied. Of the most cited responses, 17 importers indicated that they reduced their imports from China because of the orders, 16 importers indicated that they began importing from sources other than China and Taiwan, and 12 indicated that they discontinued imports from China because of the orders (table F-5). Ten importers indicated that their pattern of imports remained essentially unchanged.

Table F-5
CSPV products: Effect of AD/CVD order on U.S. importers' imports of CSPV cells and modules, by number of responding firms[1]

Item	Cells	Modules	Total responding firms
No, our pattern of imports is essentially unchanged.	4	6	10
Yes, we discontinued imports from China because of the orders.	3	9[2]	12[2]
Yes, we reduced imports from China because of the orders.	5	12	17
Yes, but changes in the pattern of our imports from China are for reasons other than the orders.	0	9[3]	9[3]
Yes, we discontinued imports from Taiwan because of the order.	4	3	7
Yes, we reduced imports from Taiwan because of the order.	4	4	8
Yes, but changes in the pattern of our imports from Taiwan are for reasons other than the order.	0	3	3
Yes, we began importing from sources other than China and Taiwan.	3	13	16
Yes, we increased imports from sources other than China and Taiwan.	3	6	9
Yes, but changes in the pattern of our imports from sources other than China and Taiwan are for reasons other than the orders.	1	7	8

[1] The sum of responses may not add up to the total number of responding firms as each firm was instructed to check all applicable effects on imports.
[2] Three of the reporting firms have a common corporate parent (i.e., ***).
[3] Two of the reporting firms have a common corporate parent (i.e., ***). In additional three of the reporting firms have a common corporate parent (i.e., ***).

Source: Compiled from data submitted in response to Commission questionnaires.

Importers were requested to provide an explanation when identifying an effect on their pattern of imports. Importers' responses are provided in table F-6.

Table F-6
CSPV products: U.S. importers' explanations on the effect of AD/CVD orders on their imports

*   *   *   *   *   *   *

Importers were asked to describe the significance, if any, of the existing U.S. antidumping and countervailing duty orders on imports of CSPV products from China and Taiwan on their firm's imports, U.S. shipments of imports, and inventories. Responses to this request are presented in table F-7.

Table F-7
CSPV products: U.S. importers' descriptions of significance of existing U.S. AD/CVD orders on imports of CSPV products from China and Taiwan

*   *   *   *   *   *   *

Seventy-eight of 106 responding purchasers reported purchasing CSPV products prior to 2012. Purchasers were asked if their purchase patterns of CSPV products had changed since the United States imposed antidumping and countervailing duty orders on imports from China and Taiwan. Purchaser responses were varied. Of the most cited responses, 38 purchasers indicated that their pattern of purchases remained essentially unchanged, 21 purchasers indicated that they began purchasing CSPV products from sources other than China and Taiwan, 16 purchasers indicated that they reduced their purchases of CSPV products from China, and 12 indicated that they changed their pattern of purchases of CSPV products from other sources for reasons other than the orders (table F-8).

Table F-8
CSPV products: Effect of U.S. AD/CVD order on U.S. purchasers' purchases of CSPV cells and modules, by number of responding firms[1]

Item	Cells	Modules	Total responding firms
No, pattern of purchasing is essentially unchanged.	4	37	38
Yes, discontinued purchases from China because of the orders.	4	10	12
Yes, reduced purchases from China because of the orders.	1	15	16
Yes, but changes in purchases from China are for reasons other than the orders.	0	9	9
Yes, discontinued purchases from Taiwan because of the order.	2	6	7
Yes, reduced purchases from Taiwan because of the order.	1	9	10
Yes, but changes in purchases from Taiwan are for reason other than the order.	0	6	6
Yes, began purchasing from sources other than China and Taiwan.	3	20	21
Yes, increased purchases from sources other than China and Taiwan.	0	9	9
Yes, but changes in purchases from sources other than China and Taiwan are for reasons other than the orders.	1	12	12

[1] The sum of responses may not add up to the total number of responding firms as each firm was instructed to check all applicable effects on purchases.

Source: Compiled from data submitted in response to Commission questionnaires.

Purchasers were requested to provide an explanation when identifying an effect on their pattern of purchases of CSPV products. Purchasers' responses are provided in table F-9.

Table F-9
CSPV products: U.S. purchasers' explanations on the effect of AD/CVD orders on their purchases of CSPV products

* * * * * * *

Foreign producers were asked to describe the significance, if any, of the existing U.S. antidumping and countervailing duty orders on CSPV products from China and Taiwan on their firm's production, capacity, U.S. exports, inventories, purchases, or other indicators. Responses to this request are presented in table F-10.

Table F-10
CSPV products: Foreign producers' descriptions of significance of existing U.S. AD/CVD orders on U.S. imports of CSPV products from China and Taiwan

*   *   *   *   *   *   *

APPENDIX G

PRICE DATA BY COUNTRY SOURCE

Thirty-one importers reported price data. Twenty importers provided price data for Taiwan, 13 for China, 11 for Korea, 11 for Malaysia, 9 for German, 9 for Vietnam, 6 for Thailand, 1 for Singapore, and 7 for all other sources (Netherlands, India, Japan, Portugal, and Turkey).[1] These price items and accompanying data are comparable to those presented in tables V-12 to V-16. Price and quantity data for individual country sources are shown in tables G-1 to G-5.

Table G-1
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1,[1] by quarters, 2012-16

* * * * * * *

Table G-2
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2,[1] by quarters, 2012-16

* * * * * * *

Table G-3
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3,[1] by quarters, 2012-16

* * * * * * *

Table G-4
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4,[1] by quarters, 2012-16

* * * * * * *

Table G-5
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5,[1] by quarters, 2012-16

* * * * * * *

[1] There are antidumping and countervailing duty orders in place on imports from China and Taiwan. Antidumping and countervailing duty orders associated with the *CSPV 1* investigations became effective December 7, 2012. Antidumping and countervailing duty orders associated with the *CSPV 2* investigations became effective February 18, 2015.