United States International Trade Commission

Environmental and Related Services

Investigation No. 332-533
USITC Publication 4389
March 2013

U.S. International Trade Commission

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Abstract

Environmental and Related Services provides estimates of the U.S. and global markets for, and discusses barriers to, trade and investment in three core environmental services industries—water and wastewater services, solid and hazardous waste services, and remediation services. The report also examines the critical role of several related services.

Global demand for environmental services has grown in recent years. In 2010, global sectoral revenues exceeded $500 billion, with the United States accounting for nearly 40 percent of the global market. Water and wastewater services represented the largest share of global sectoral revenues (49 percent), followed by solid and hazardous waste services (32 percent).

Trade in environmental services occurs chiefly through foreign direct investment. Foreign affiliates of environmental services firms may build water infrastructure, landfill solid waste, remediate polluted sites, and more. Such activities rely on related services—e.g., in engineering, construction, and consulting. Although few trade barriers specifically target environmental services, measures that affect all service industries (e.g., restricting commercial presence) or related services (e.g., not recognizing foreign licenses) may restrict trade in environmental services. Nonetheless, trade negotiations in the environmental services sector tend to overlook measures that affect related-service providers.

Using statistical analysis, the Commission estimates how liberalizing trade in related services might affect sales by foreign affiliates of core environmental services firms. The results of the analysis suggest that the effects would be positive and significant. However, this conclusion would be strengthened by the availability of more robust data on the sector.

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Acronyms

ACE	architecture, construction, and engineering
APEC	Asia-Pacific Economic Cooperation
ARRA	American Recovery and Reinvestment Act
BEA	(U.S. Department of Commerce) Bureau of Economic Analysis
BOO	build-own-operate
BOT	build-operate-transfer
BOTT	build-operate-train-transfer
BRIC	Brazil, Russia, India, and China
CAFTA–DR	Dominican Republic-Central America-United States Free Trade Agreement
CCAFS	Cape Canaveral Air Force Station
CMS	community water system
CPC	(United Nations) Central Product Classification code
DFBOT	design-finance-build-operate-transfer
EBI	Environmental Business International
EDA	(U.S. Department of Commerce) Economic Development Administration
EIA	environmental impact assessment
ENT	economic needs test
EPA	(U.S.) Environmental Protection Agency
EU	European Union
FDI	foreign direct investment
FIFA	Fédération Internationale de Football Association
GATS	General Agreement on Trade in Services
GDP	gross domestic product
GFPR	guaranteed fixed-price remediation (contract)
HS	Harmonized System (international tariff code)
IT	information technology
LRR	Land Remediation Relief (program)
MNC	multinational corporation
NAFTA	North American Free Trade Agreement
NAICS	North American Industrial Classification System
NACE	Nomenclature générale des activités économiques dans les Communautés Européennes (General Industrial Classification for Economic Activities within the European Communities)
NASA	National Aeronautics and Space Administration
NMR	non-manufacturing regulation (also known as indicator of sectoral regulation)
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least squares
O&M	operation and maintenance
PSP	private sector participation
RACER	Revitalizing Auto Communities Environmental Response (Trust)
R&D	research and development
RMB	renminbi (Chinese currency)
STRI	Services Trade Restrictiveness Index
TPP	Trans-Pacific Partnership
USAID	United States Agency for International Development
USITC	United States International Trade Commission
USTR	United States Trade Representative
VAT	value-added tax
WTO	World Trade Organization

Executive Summary

Overview

Environmental services are an important and growing sector of the global economy and of global services trade. This report, requested by the United States Trade Representative (the USTR), estimates the size of the U.S. and global markets for environmental services; estimates the value of trade in the sector; and identifies measures impeding environmental services trade as well as the potential impact of removing these barriers. The report focuses on three core environmental services industries: the water and wastewater services industry, the solid and hazardous waste services industry, and the remediation services industry. The report also examines trade barriers affecting providers of related services, including architecture and engineering services, management consulting services, and related scientific and technical consulting services, among others. While related services are often critical to the provision of the core services mentioned above, the former have not been systematically incorporated into trade negotiations on environmental services.

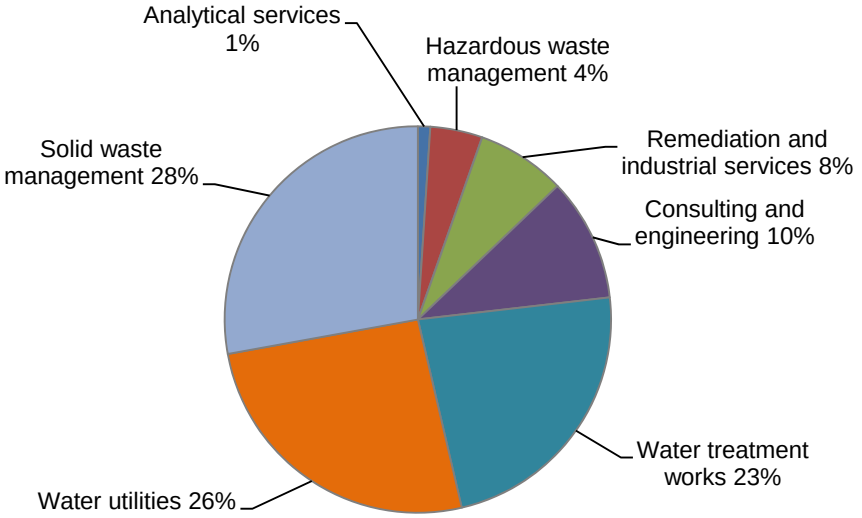
The report suggests a number of conclusions. First, few trade barriers pertain specifically to environmental services providers; as a result, the most substantial obstacles to trade in environmental services are measures affecting related services (such as licensing requirements for foreign architects and engineers) and "horizontal" measures that apply broadly to foreign investment in a particular market (such as foreign equity limitations). Second, the removal of barriers to trade in certain related services (including architecture, construction, engineering, electricity, and transportation) may have a positive effect on sales by environmental services firms' foreign affiliates. Third, while environmental services markets have grown in recent years due to factors such as population growth, increasing economic activity, regulation, and rising environmental awareness, trade continues to account for a very small share of these markets. In fact, many of the large water and wastewater firms that have had a significant international presence have reduced their overseas activities in recent years to focus on core markets. Finally—and perhaps most importantly—the scarcity of data on trade and market trends in the environmental services sector remains a primary obstacle to further analysis of environmental services liberalization. The lack of data is exacerbated by the absence of a widely accepted definition of "environmental services" among trading partners. An international effort to improve data collection and adopt a cohesive definition of environmental services would facilitate future analyses of this sector.

Key Findings

Market Size and Leading Suppliers

In 2010, the value of the global environmental services market reached $505.5 billion, an increase of 13 percent from 2005. Water and wastewater services[1] represented the largest share of global environmental service revenues in 2010 (49 percent), followed by solid and hazardous waste services (32 percent). By comparison, remediation services accounted for only 8 percent of global environmental services revenues (figure ES.1).

FIGURE ES.1 Global environmental services revenue reached nearly $506 billion in 2010



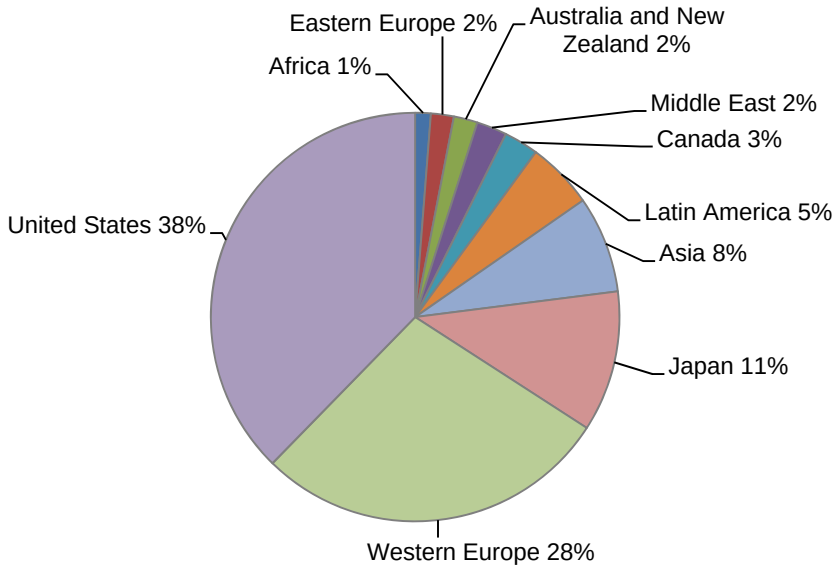
Total = $505.5 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

Overall, developed countries account for the vast majority of global revenues in the environmental services sector. In 2010, the United States accounted for 38 percent of the environmental services market, followed by Western Europe (28 percent) and Japan (11 percent). By comparison, Africa represented only 1 percent of the global market for environmental services (figure ES.2).

[1] Revenue numbers for water and wastewater services include revenue for "water utilities" and "water treatment works."

FIGURE ES.2 The United States had the largest share of the global environmental services market in 2010



Total = $505.5 billion

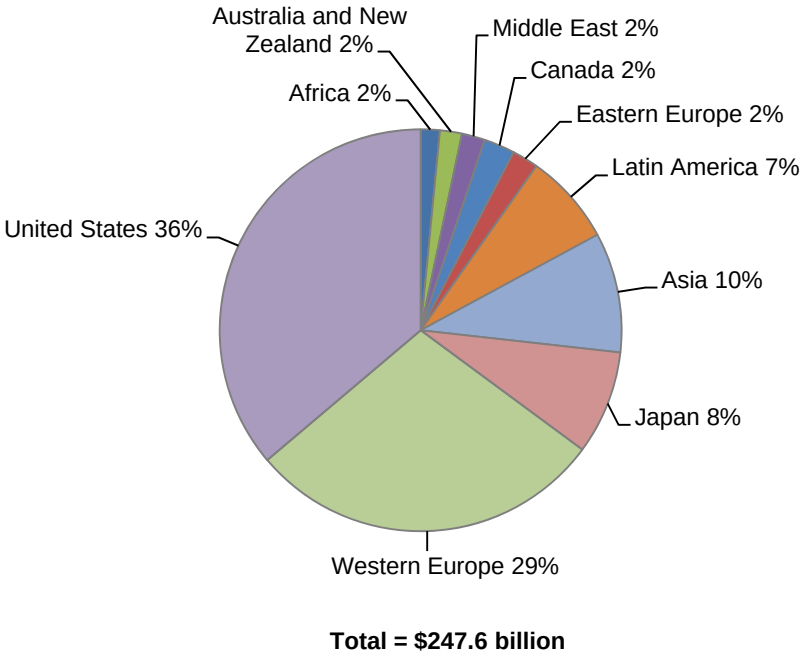
Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

Water and Wastewater Services

The global water market was valued at $247.6 billion in 2010 (figure ES.3). Overall, the market grew by approximately 5.5 percent in 2010, slightly faster than the 4.5 percent compound annual growth rate (CAGR) recorded during 2005–09. In 2010, the United States was the largest market for water and wastewater services, accounting for 36 percent of global revenues, followed by Western Europe and Asia, which accounted for 29 percent and 10 percent of the global market, respectively (figure ES.3).

In 2011, the two largest water companies, measured by annual revenues, were French firms Veolia Environnement ($45.2 billion) and Suez Environnement ($18.1 billion). Other large water companies measured by revenues included Companhia de Saneamento Básico do Estado de São Paulo (Brazil, $6 billion); Hera S.p.A (Italy, $5.9 billion); Iride S.p.A. (Italy, $4.8 billion); Tokyo Metropolitan Waterworks Bureau (Japan, $4.2 billion); Hong Kong and China Gas Company Ltd. (China, $2.9 billion); American Water Works Company (United States, $2.7 billion); and Sydney Water Corporation (Australia, $2.4 billion).

FIGURE ES.3 Wastewater treatment works and water utilities: The United States had the largest share of global revenue in 2010



Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

Solid and Hazardous Waste Services

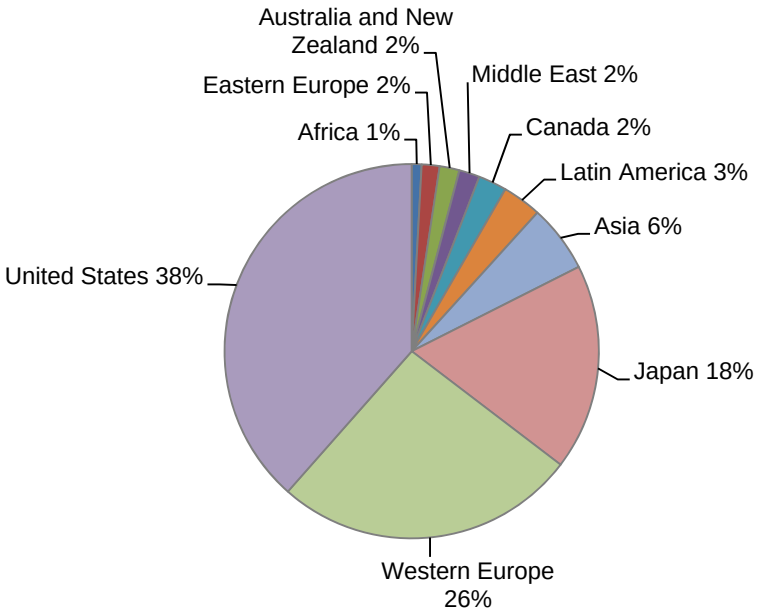
Between 2000 and 2009, global industry revenues grew from $155.4 billion to $162.9 billion. Developed countries account for the vast majority of revenues earned by the global solid and hazardous waste services industry. The United States accounted for 38 percent of global industry revenues in 2010, followed by Western Europe (26 percent) and Japan (18 percent) (figure ES.4).

The largest global suppliers of solid and hazardous waste services include Waste Management Inc. (United States); Republic Services, Inc. (United States); Veolia Environnement (France); Suez Environnement (France); Remondis AG & Co. KG (Germany); Dowa Eco-System Co., Ltd. (Japan); Daiseki Co., Ltd. (Japan); and JFE Kankyo Corporation (Japan).

Remediation Services

Revenues in the global remediation services market reached $37.7 billion in 2010. Overall, the global market declined by 2.6 percent in 2010, compared to a 3.8 percent CAGR recorded during 2000–2009. In 2010, the United States was the largest market for remediation services, accounting for 33 percent of global revenues, followed by Western Europe (24 percent) and Japan (13 percent) (figure ES.5).

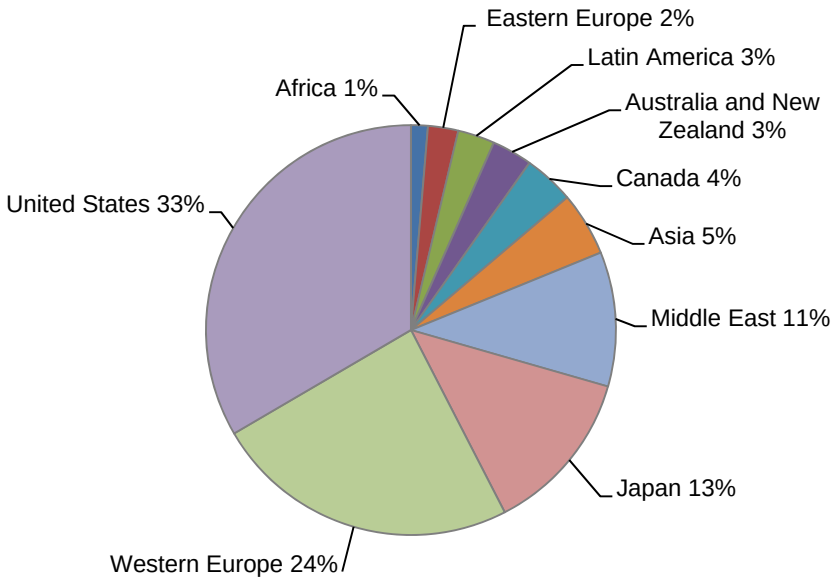
FIGURE ES.4 Solid and hazardous waste services: The United States and Western Europe had the largest shares of global revenue in 2010



Total = $162.9 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

FIGURE ES.5 Remediation and industrial services: The United States and Western Europe had the largest shares of global revenue in 2010



Total = $37.7 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

Note: Figures may not total 100 percent due to rounding.

Leading firms in the remediation services sector are nearly all U.S.-based, with multinational operations; in most cases, their core business is construction or engineering (table ES.1).

TABLE ES.1 Top global environmental firms by type of work, by revenue, 2012

	Country	Revenue (million $)
Construction, contracting, and/or remediation		
Bechtel Corp.	U.S.	1,635.3
Fluor Corp.	U.S.	902.5
The Shaw Group Inc.	U.S.	881.0
Layne Christensen Inc.	U.S.	638.7
The Walsh Group Ltd.	U.S.	571.5
Engineering and/or design		
CH2M Hill Ltd.	U.S.	1,493.0
MWH Global	U.S.	985.5
Bechtel Corp.	U.S.	804.7
AECOM Technology Corp.	U.S.	729.9
URS Corp.	U.S.	616.4
Consulting and/or studies		
Tetra Tech, Inc.	U.S.	1,503.5
CH2M Hill Ltd.	U.S.	1,480.7
URS Corp.	U.S.	1,271.3
Environmental Resources Management, Inc. (ERM)	U.S./UK	547.8
Golder Associates	U.S.	471.8

Source: ENR, "The Top 200 Environmental Firms," August 13, 2012.

Note: Since the largest environmental firms (e.g., construction, engineering, etc.) characterize remediation services as a sub-business, it is difficult to capture a single comprehensive list of the largest "remediation" firms.

Key Supply and Demand Factors

Water and Wastewater Services

In many countries, local government-owned and -operated utilities supply water and wastewater services in a variety of markets, ranging from small rural towns to major metropolitan areas. The participation of private companies in water and wastewater services supply is limited and is often the result of local utilities outsourcing certain discrete functions to private-sector firms. Overall, water and wastewater services supply is highly fragmented, with small utilities granted monopoly rights by the government to supply services in designated areas.

The main consumers of water and wastewater services are households, businesses, and agriculture. In most countries, the public sector accounts for only a small share of water consumption.

Growth in the demand for water is generally consistent with overall population growth, although cyclical factors like economic output and weather conditions can result in demand fluctuations. The demand for wastewater services is largely derived from water consumption patterns, so it too is influenced by changes in population growth, economic activity, and weather. The demand for wastewater services is also driven by federal, state, and local government regulations that require the treatment of wastewater for environmental and health reasons.

Solid and Hazardous Waste Services

Regulation is the principal factor affecting the solid and hazardous waste services industry's ability to supply waste management services to customers. Waste management firms must comply with extensive environmental, health, safety, and transportation regulations at the federal, state, and local levels. Several other factors also may have an impact on the ability of waste management firms to compete in the market—for example, high capital costs associated with the development and operation of landfills, and the predominance of public sector participation in many segments of the industry. In addition, new entrants into the market may be stymied by the prevalence of annual or multiyear contracts between consumers and existing waste management service providers.

The demand for solid and hazardous waste services is driven principally by economic development, population growth, and increased environmental awareness. Greater affluence and higher levels of consumption enjoyed by increasing numbers of people lead to increased waste generation rates and, thus, greater demand for waste management services. Regulations mandating the collection and treatment of solid and hazardous waste also spur demand for waste treatment services in many countries. Further, within the past decade, both the United States and the European Union have adopted regulations requiring a reduction in the amount of waste going into landfills, thereby increasing the demand for recycling and composting services in those countries.

Remediation Services

The supply of remediation services is largely driven by environmental regulation. For many countries, protecting the environment and human health from exposure to contaminated air, soil, surface water, and groundwater is a high priority. Governments and private firms have sought to reduce damage to the environment by adopting more environmentally friendly practices. The supply of remediation services may also be affected by a private firm's willingness to take on the financial risks of competing for large (usually government) contracts.

Government spending is an important demand driver for remediation services. For example, many government regulations require the allocation of government funds for the cleanup and remediation (or the closure and care) of certain public or heavily polluted sites. In addition to government spending, economic development (public and private), population growth, and the occurrence of natural or manmade disasters spur demand for remediation services.

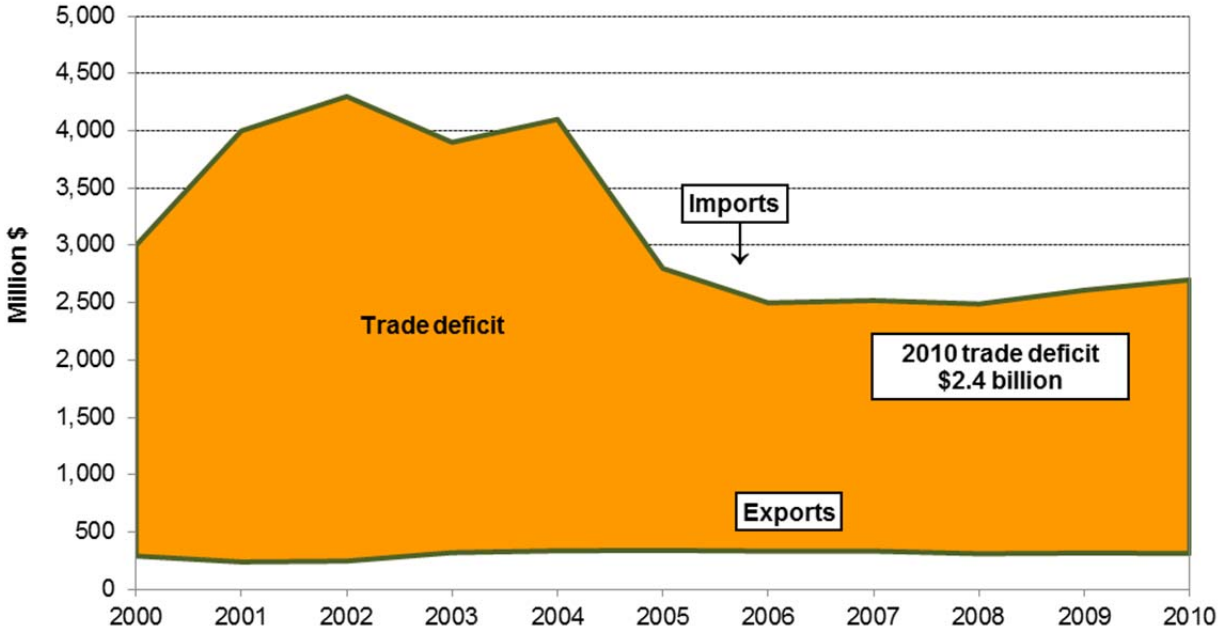
Estimates of Trade and Investment

Water and Wastewater Services

Firms participate in international trade in water services primarily by setting up a commercial presence in another country. Most commonly, a water services company from one country acquires an ownership stake in a water utility in another country, making the utility its affiliate. A water company may also establish offices in another country, either to manage and operate water facilities or provide water consulting services.

Between 2005 and 2009, both U.S. exports and imports of water services declined by slightly less than 2 percent annually, resulting in an annual trade deficit that gradually fell from $2.5 billion to $2.3 billion. In 2010, while U.S. exports of water services continued to decline, falling by 0.8 percent to $314 million, imports rose by 3.4 percent to $2.7 billion, increasing the U.S. trade deficit slightly to about $2.4 billion (figure ES.6). Global trade in water services increased during the 1990s, but many international companies have since reduced their overseas operations in order to focus on a handful of high-potential foreign markets.

FIGURE ES.6 Water treatment works and water utilties: U.S. cross-border trade resulted in a U.S. trade deficit each year during 2000–2010



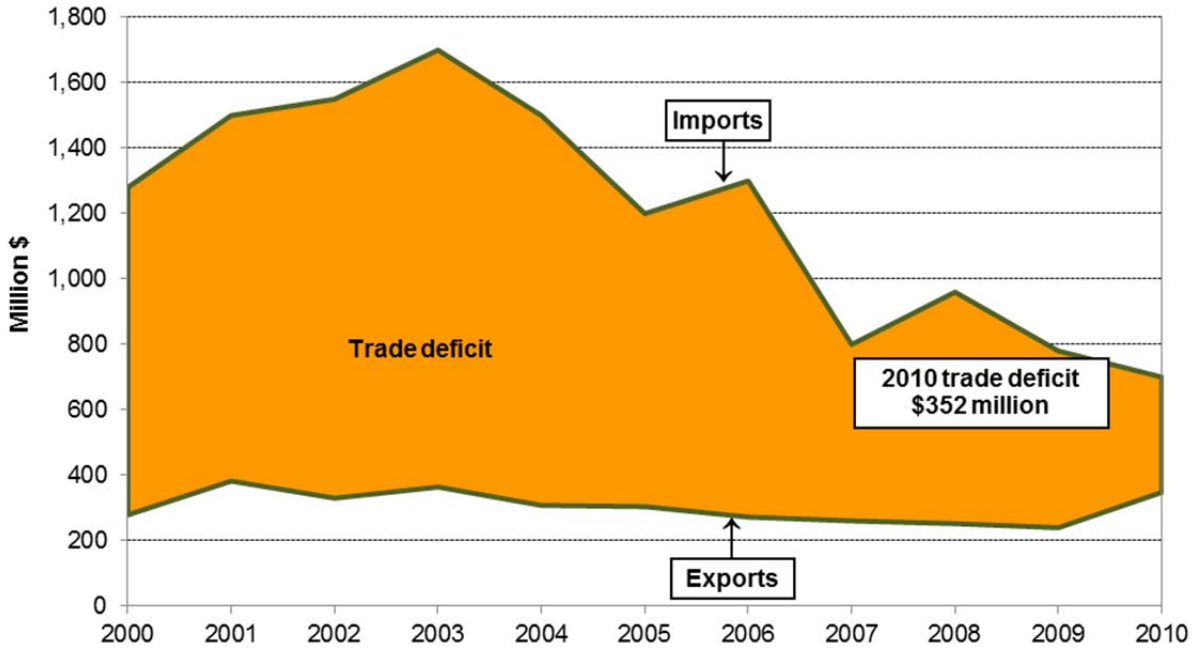
Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

Solid and Hazardous Waste Services

International trade in solid and hazardous waste services consists of cross-border trade (such as when a landfill in one country collects fees to dispose of waste imported from another country) and sales by foreign affiliates of solid and hazardous waste services firms (such as when a firm establishes a waste treatment facility in a foreign market in order to provide services to customers in that location). Although global data classified by mode of supply are not available, the vast majority of this trade likely occurs through foreign affiliates, as the high cost of shipping low-valued, bulky waste tends to limit cross-border trade.

The United States ran a persistent trade deficit in solid and hazardous waste services since 2000, although the deficit narrowed significantly between 2003 and 2010 (figure ES.7). During the period, U.S. exports of solid and hazardous services were flat, while U.S. imports increased between 2000 and 2003 and then declined thereafter to 2010.

FIGURE ES.7 Solid and hazardous waste services: The U.S. trade deficit decreased to its lowest level of the period in 2010



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

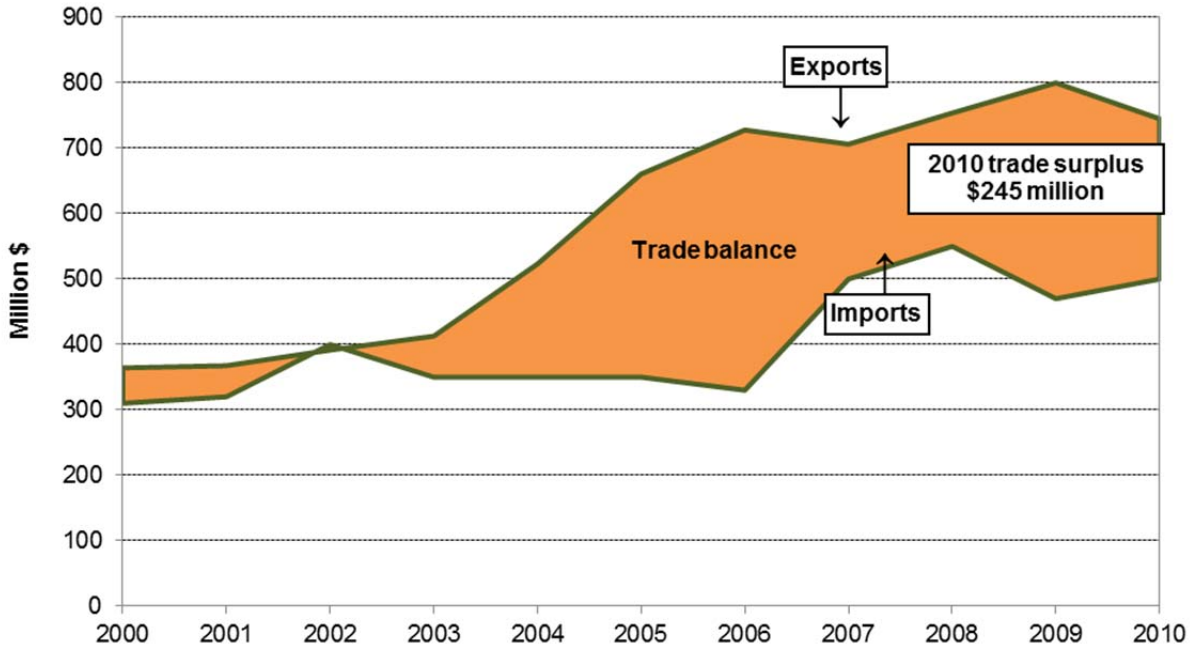
Remediation Services

Trade in remediation services is relatively small. The majority of international trade in remediation services occurs during the initial assessment and planning phase of a remediation project when, for example, soil samples from a polluted site are tested and analyzed, and plans for cleanup of the site are established. In most cases, suppliers of these so-called "front-end" remediation services travel abroad to supply such services, whereas site construction and other "back-end" services are often subcontracted to local firms. In 2010, U.S. exports of remediation services reached about $745 million, and imports totaled $500 million, for a trade surplus of $245 million (figure ES.8).

Barriers to Trade and Investment

Barriers to trade and investment in environmental services primarily include (1) general restrictions on foreign investment and other factors affecting the investment climate, such as screening and ownership limitations that may apply to all or several services industries, and (2) restrictions on trade and investment in related services that are crucial to the provision of environmental services. As most international trade in environmental services occurs through commercial presence in foreign markets, measures that restrict foreign investment or the operations of foreign affiliates are most significant. Other general restrictions that affect environmental service providers include lack of regulatory transparency, local-content requirements, and restrictions on the legal form a foreign-affiliated business may take. Barriers specific to related service providers, such as certification and licensing requirements for architects and engineers, may also have a

FIGURE ES.8 Remediation and industrial services: U.S. cross-border trade has resulted in a U.S. trade surplus during 2003–10



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

discernible impact on the ability of environmental firms to supply services in foreign markets.

The results of a statistical analysis show that reducing certain regulations, including so-called "behind-the-border" measures that affect both domestic and foreign service providers (e.g., burdensome licensing requirements), is associated with increasing sales by environmental services firms operating abroad.

CHAPTER 1
Introduction

The environmental services industries covered in this report—water and wastewater services, solid and hazardous waste services, and remediation services—account for a substantial share of the overall environmental sector. Globally, the United States is the largest producer and exporter of environmental services, with Western Europe not far behind. Although trade in environmental services has expanded in recent years, it is constrained by measures in importing countries that affect the core services mentioned above, as well as by measures affecting "related" services (for example, testing, consulting, and engineering services). Going forward, prospects for expanding trade and investment in environmental services will largely hinge on the extent to which measures that affect trade in both core and related services are lessened or removed.

Objective

On July 30, 2012, the United States International Trade Commission (USITC or Commission) received a letter from the United States Trade Representative (the USTR) (see appendix A) requesting that the Commission conduct a fact-finding investigation under section 332(g) of the Tariff Act of 1930 (19 U.S.C. § 1332(g)) regarding trade and market trends in the environmental services sector.[1] The USTR requested that the Commission provide a report on environmental and related services that, to the extent practicable, (1) estimates the size of the U.S. and global markets for environmental and related services, including water and wastewater services, solid and hazardous waste services, and remediation services, identifying top suppliers and markets, investigating factors affecting supply and demand, and highlighting recent market developments in such services; (2) estimates the value of trade and investment in such services, identifying key export and import markets and recent trends in trade; and (3) identifies barriers to trade and investment in environmental services segments, discussing recent efforts towards, and the potential impact of, trade liberalization. The request letter notes that demand for environmental services has risen since the Commission's 2004 reports on environmental services, and that factors such as new technologies, tightening government budgets, and an emphasis on sustainability have altered the delivery of such services.[2] The Commission initiated the current investigation on August 21, 2012.

Scope of Industry

There is no widely accepted definition of environmental services. However, the request letter specifically mentions three segments of the environmental services industry that the report should examine: water and wastewater services, solid and hazardous waste

[1] In its letter to the Commission, the USTR also requested that the Commission conduct a factfinding investigation on renewable energy and related service to be delivered 11 months after the date of the request.

[2] For example, see USITC, *Solid and Hazardous Waste Services*, April 2004, and *Remediation and Nature and Landscape Protection Services*, October 2004.

services, and remediation services. All three segments encompass a varied and complex set of services and service providers to carry out their tasks.

Water and wastewater services are generally considered to include (1) the collection, treatment, and supply of water to residential, business, and government consumers, and (2) the collection, treatment, and disposal of wastewater. Firms in the water supply services industry operate systems including pumping stations, aqueducts, and distribution mains, as well as water treatment plants for residential, agricultural, and/or industrial uses. Most water supply facilities in the United States are operated by local governments, but a number of private firms also participate in this market segment.[3] Firms in the wastewater services industry operate sewage systems and sewage treatment facilities, and dispose of treated waste from sewage and industrial sources. In instances where wastewater services are provided by a private firm, the same firm will often provide both water and wastewater services.[4]

Solid and hazardous waste management services include the collection, treatment, and disposal of solid and hazardous (including medical) waste. Firms in this industry may provide a number of services, such as the collection of household, industrial, and hazardous solid waste; the operation of landfills, incinerators, and recycling centers; and the removal of debris. Local governments collect about one-fourth of solid nonhazardous waste in the United States, but this share has declined in recent years as services are increasingly outsourced to private firms.[5]

Remediation services include activities intrinsically linked to the treatment, removal, and disposal of contaminated soil and water. Firms in this sector provide a wide range of services, such as asbestos abatement and removal, lead paint abatement and removal, cleanup of oil and other spills, removal of contaminated soil, and treatment of contaminated groundwater. In the United States, the remediation services industry was largely an outgrowth of environmental regulation in the 1970s and 1980s that required the cleanup of polluted sites.[6]

Related Services

Often, providing an environmental service will require the use of one or more services that are not classified as core environmental services (box 1.1). Such related services may include architecture and engineering services, management consulting services, and related scientific and technical consulting services, among others.[7]

[3] IBISWorld, Water Supply and Irrigation Systems, June 2012, 3.
[4] Industry representative, email to Commission staff, November 26, 2012.
[5] IBISWorld, Waste Collection Services in the U.S., April 2012, 5.
[6] IBISWorld, Remediation and Environmental Cleanup Services, April 2012, 4.
[7] UN, Department of International and Social Affairs, "Provisional Central Product Classification," 1991, 2–3. While core environmental services are classified under the UN's Provisional Central Product Classification (CPC) code 94, architecture services and engineering services are classified under CPC 8671 and 8672, respectively; management consulting services, CPC 865; and related scientific and consulting services, CPC 8675.

BOX 1.1 Classification of environmental services in the CPC and NAICS

For the purposes of trade negotiations under the World Trade Organization (WTO) and data collection efforts by statistical agencies, environmental services are often identified under the United Nations (UN) Central Product Classification system (CPC) or the North American Industrial Classification System (NAICS). Core environmental services are categorized differently in these two classification systems. For instance, under the CPC, water distribution is classified in section 1, "ores and minerals"; and wastewater treatment is classified in section 9, "community, social, and personal services." NAICS classifies both water distribution and wastewater treatment under code 221, "utilities." Further, NAICS classifies the administration of publicly provided water distribution and wastewater systems under code 9241, "administration of environmental quality programs."

Neither the CPC nor the NAICS classify the full range of related environmental services within an environmental services category. For instance, construction of a new wastewater treatment facility might require an environmental impact assessment. The environmental impact assessment would likely involve related environmental services such as technical testing and analysis services, among others. Technical testing and analysis services are classified separately from environmental services in both the CPC (8676) and the NAICS (541380).

Classification of core and related services in the CPC and NAICS

Service	CPC	NAICS
Core services		
Water	18 (water)	221310 (water supply and irrigation systems)
Wastewater	94010 (sewage services)	221320 (sewage treatment facilities)
Solid/hazardous waste collection/ disposal	94020 (refuse collection and disposal services)	562111 (solid waste collection) 562112 (hazardous waste collection) 562211 (hazardous waste treatment and disposal) 562212 (solid waste landfill)
Remediation	94090 (other environmental protection services)	562910 (remediation services)
Related services		
Environmental consulting	86721 (advisory and consultative engineering services)	541620 (environmental consulting services)
Scientific testing	8676 (technical testing and analysis services)	541380 (testing laboratories)
Urban planning	86741 (urban planning services)	925120 (administration of urban planning and community and rural development)
Landscape architecture	86742 (landscape architectural services)	541320 (landscape architectural services)
Engineering	8672 (engineering services)	541330 (engineering services)
Architecture	8671 (architectural services)	541310 (architectural services)
Design	86724 (engineering design services for the construction of civil engineering works)	541420 (industrial design services)
General management	86601 (project management services other than for construction)	541611 (administrative management and general management consulting services)
Construction	86501 (general management consulting services)	236210 (industrial building construction)
Administration	Not available	9241 (administration of environmental quality programs)

Source: UN Department of International and Social Affairs, "Provisional Central Product Classification," 1991, 2–3; U.S. Census Bureau, North American Industrial Classification System, 2012, http://www.census.gov/eos/www/naics/.

Related environmental services likely account for a significant share of the revenue generated within the environmental services sector.[8] For example, recent construction of a solid waste disposal facility in Kuala Lumpur, Malaysia, involved an analysis of the

[8] According to Environmental Business International (EBI), consulting and engineering services accounted for 12.5 percent the value of services in the environmental sector (not including water utilities) in 2010. The value of other related services, such as design, architectural, and testing services with an environmental end use, is not included within the EBI definition and is not known.

waste stream; a determination of the most efficient number, design, and location of transfer stations; and preparation of environmental impact statements—all before the actual operation of the facility even began.[9]

Approach and Data Constraints

In responding to the USTR's request, the Commission gathered information from a variety of industry and public sources. Data on the size of the U.S. and global markets for environmental services, and on trade and investment in those services, have been largely drawn from data reported by Environmental Business International (EBI), augmented with sector-specific data where available. Other data sources include ENR (formerly Engineering News-Record), Standard & Poor's, and ORBIS. Statistical analysis performed for chapter 2 of this report relied on data from Eurostat, the World Bank, and the Organisation for Economic Co-operation and Development (OECD). The report also incorporates qualitative information gathered from secondary sources such as trade and industry journals, as well as from interviews with U.S. and foreign industry representatives and regulatory officials. The interviews were conducted both in person (during factfinding fieldwork) and over the telephone. Other sources of information included academic papers, business and industry publications, and publications by the World Trade Organization (WTO).

There is a significant lack of data on trade and market trends in environmental services, hindering deeper analysis of the sector. EBI is one of the few sources of data on revenues, employment, and trade in environmental services and, as such, is widely cited in discussions of industry trends. However, EBI's data on revenues are available for only a few countries and world regions, and its data on employment and trade are available only for the United States. Other data on environmental services also suffer from statistical deficiencies. For example, Eurostat data cover only certain member countries of the European Union (EU), ENR indicators are heavily weighted toward construction activities and firms, and Bureau of Economic Analysis (BEA) data on affiliate sales of waste management and remediation services are largely unavailable to the public. Similarly, although the World Bank, the OECD, and the Commission are currently developing databases on nontariff measures affecting service industries, none of these databases includes information specific to environmental services. In-depth analysis would require more complete and detailed data than those currently available. Such data could be compiled through a survey of firms known to be principal providers of the subject services.

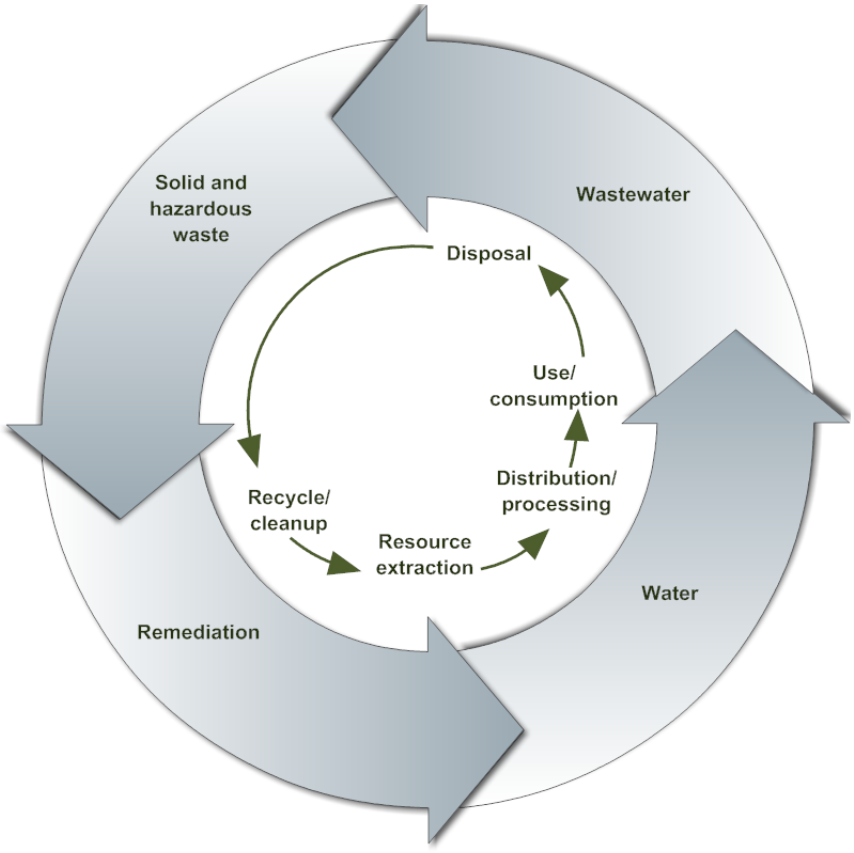
Analysis of this sector is further complicated by the fact that many environmental services are provided by firms that primarily identify themselves as members of other industry sectors. The environmental services provided by such firms are often incidental to their participation in construction, design, or other projects that happen to have an environmental component, and they therefore may not be able to report discrete information on environmentally related activities. Further, the lack of a widely accepted definition of environmental services may create inconsistencies in the discrete data and other information that do exist on the environmental services sector. Information on the sector frequently must be pieced together from a wide variety of industry sources, making it difficult to construct a comprehensive picture of the industry.

[9] CH2M Hill, "Solid Waste System and Transfer Station Plan," 2012.

Demand for Environmental Services

Demand for environmental services changes as a market develops—from an emphasis on basic services that have an immediate impact on human health to a wider focus on more sophisticated services with a longer-term impact on well-being. The first environmental service demanded in a developing economy is typically water distribution.[10] Clean water is necessary both for human health and for a number of production processes. Following clean water, wastewater collection and disposal of waste products are often the next priorities, since they also affect both health and efficient production. Site contamination typically has a less immediate impact on populations and production, so demand for remediation services is highest in developed countries that already address higher-priority environmental issues. Nonetheless, the three environmental service industries covered in this report are interrelated, and can be thought of as spanning a life cycle that includes activities such as resource extraction (i.e., for water) to recycling and cleanup (figure 1.1).

FIGURE 1.1 The environmental services life cycle, which consists of interrelated industries, runs from resource extraction to recycling and cleanup



Source: USITC.

[10] Industry representatives, e-mails to USITC staff, November 9, 2012, and November 26, 2012.

In recent years, the demand for core and related environmental services has risen in both developed and developing countries. Developed countries' demand for environmental services has been stimulated by growing affluence, on the one hand, and a strengthening environmental awareness on the other. Developing countries' demand has been spurred largely by population growth and increased industrial activity. In addition, increasing environmental regulation in most countries has significantly expanded global demand for core and related environmental services.[11]

The Market for Environmental Services

The Global Market

Already large at the beginning of this century, the global market for environmental services has continued to expand. Total revenues in the global environmental services market rose by about 41 percent between 2000 and 2010, to $505.5 billion (figure 1.2).[12] The solid and hazardous waste services industry accounted for the largest share of industry revenues ($163.0 billion) in 2010, followed by water utilities ($130.3 billion) and water treatment works ($117.2 billion). Environmental consulting and engineering services experienced the fastest growth in revenues during this period, which increased by 73 percent to $52.2 billion.[13]

Developed countries account for the vast majority of global revenues in the environmental services sector. The largest market for environmental services is the United States, which accounted for 38 percent of global environmental services revenues in 2010. Western Europe accounted for 28 percent of the global market, and Japan for 11 percent. By contrast, Africa accounted for only 1 percent of the global market for environmental services (figure 1.3).

The U.S. Market

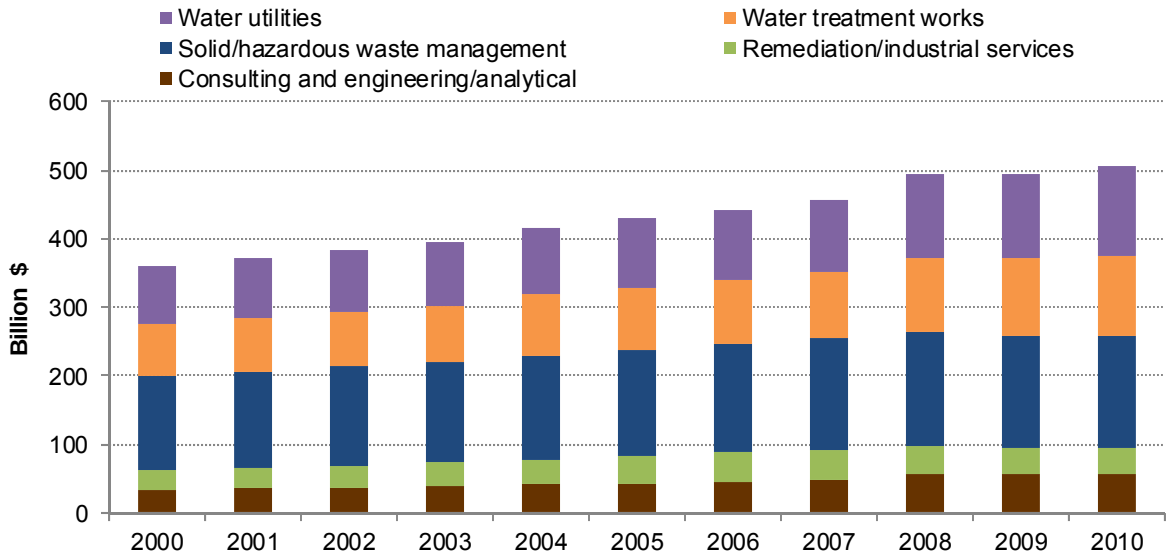
The United States is a large and rapidly growing market for environmental services. In 2010, U.S. environmental services industries generated revenues of $190.5 billion (figure 1.4). Water and wastewater services accounted for the largest share of U.S. revenues (46 percent), followed by solid and hazardous waste management services (33 percent) and consulting and engineering services (14 percent). In line with global trends, U.S. environmental services revenues grew by about 41 percent overall, with water and wastewater services recording the highest revenue growth during the 2000–2010 period.

[11] Environmental regulations that focus on minimizing environmental damage or pollution often require related environmental services, but not core services. For instance, while a regulation under the U.S. Environmental Protection Agency (EPA) that limits discharges of pollutants from aquaculture facilities may require facilities to use consulting and testing services, it may not necessarily stimulate demand for core remediation services.

[12] For the purposes of this report, total environmental services revenues are the sum of the revenues reported by solid and hazardous waste management, water and wastewater management, remediation and industrial services, environmental consulting and engineering services, and analytical testing services. Water utilities are included as part of the water/wastewater management industry. Data on revenue are from EBI.

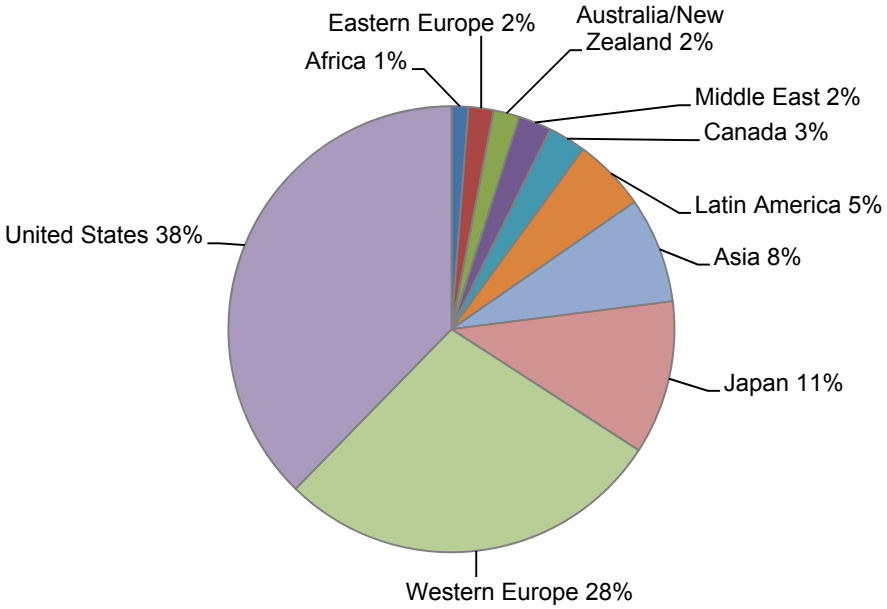
[13] EBI, Global Environmental Market Data Pack, 2011.

FIGURE 1.2 Global environmental services revenues: Water related and environmental consulting services showed steady increases during 2000–2010



Source: Environmental Business International, "The Global Environmental Market by Segment." *Environmental Business Journal*, various issues (2002–12).

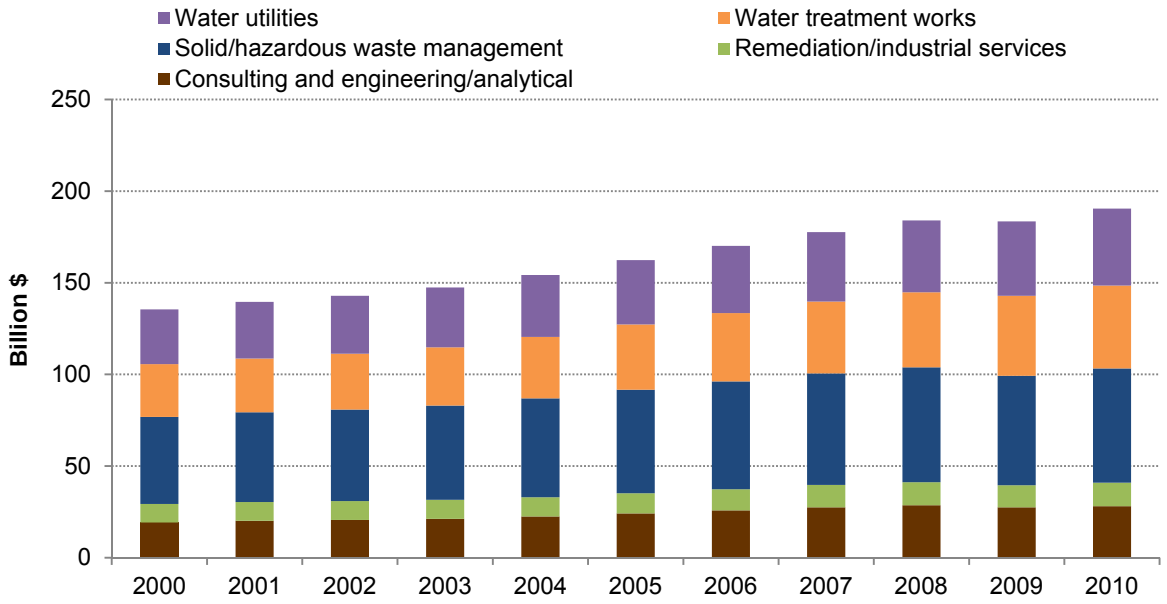
FIGURE 1.3 The United States had the largest share of the global environmental services market in 2010



Total = $505.5 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

FIGURE 1.4 U.S. environmental services revenues: Water related and environmental consulting services increased the most during 2000–2010



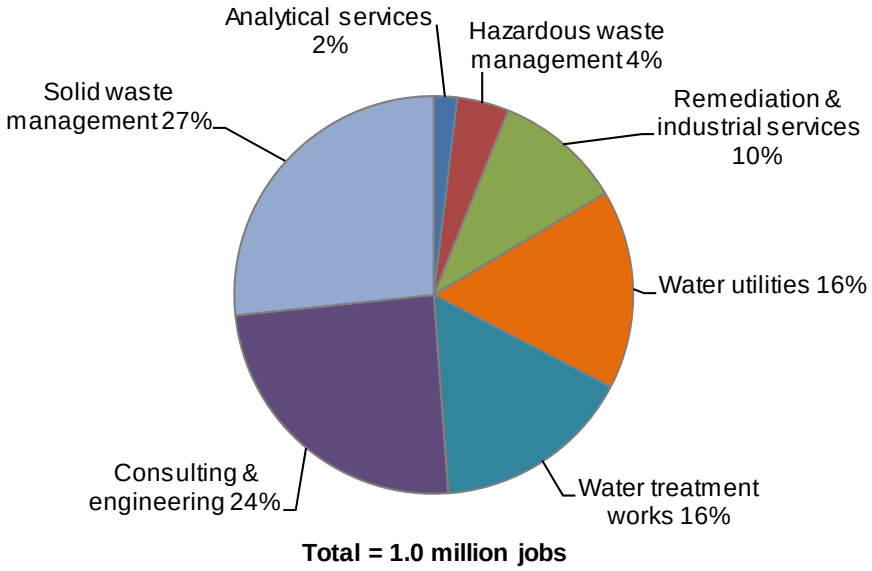
Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

Total U.S. employment in the environmental services industry increased by about 27 percent during 2000–2010, to slightly more than one million workers (figure 1.5). In 2011, the solid waste management and the consulting and engineering industries accounted for more than one-half of U.S. environmental services employment, with 278,000 workers and 255,800 workers, respectively. During 2000–2010, the most rapid growth in U.S. employment was in wastewater treatment services (42 percent). The only core environmental services segment to experience a decrease in employment during 2000–2010 was the hazardous waste management segment, which fell by 3 percent over the period.

Trade in Environmental Services

Trade in environmental services occurs either through cross-border channels (such as online monitoring of water treatment processes across a national border) or through the operation of foreign affiliates (such as when a U.S. firm establishes a foreign subsidiary that supplies environmental services to the local population). Discrete data on cross-border trade and affiliate sales in the environmental services industry are unavailable (box 1.2). However, it is likely that the vast majority of such transactions take place through foreign affiliates, as the provision of many environmental services involves operating facilities (such as wastewater treatment plants or landfills) or being physically near to customers (such as waste collection).

FIGURE 1.5 Solid waste management services accounted for the largest share of U.S. environmental services employment in 2010



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

Note: Figures may not total 100 percent due to rounding. It is unclear to what extent "related" services are accounted for in EBI data.

BOX 1.2 How environmental services are traded

The General Agreement on Trade in Services (GATS) defines four modes of services supply. Mode 1 is defined as cross-border supply; mode 2, consumption abroad; mode 3, commercial presence; and mode 4, the presence of natural persons. Environmental services may be supplied through each of these four modalities, although supplying through modes 1 and 3 is most prevalent. For example, the design of a wastewater treatment facility by a U.S.-based engineering firm for a client located in Canada would be an example of mode 1. If the U.S. firm were to establish a subsidiary in Canada to provide design services to local clients, this would be an example of mode 3 (commercial presence).

Modes 1, 2, and some instances of mode 4 are forms of cross-border trade, and transactions that occur via these modes are counted in cross-border trade data. By contrast, transactions that occur via mode 3 and some transactions via mode 4 take place through foreign affiliates and are therefore counted as affiliate sales.

Mode of supply		Example
Mode 1	Cross-border supply: the provider is not present in the country in which the service is provided	A U.S. firm performs online monitoring of water treatment processes, or provides services such as design and consulting for an entity located in Canada.
Mode 2	Consumption abroad: individuals travel to a foreign market where the service is provided	U.S. employees go to Canada for training on measuring levels of pollution in groundwater.
Mode 3	Commercial presence: service provider establishes a subsidiary in the host country	U.S. engineering firm establishes a subsidiary in Canada to provide design and consulting services to local clients.
Mode 4	Presence of natural persons: an individual travels abroad to provide services in host market or to work as an intra-corporate transferee under mode 3 (commercial presence)	A U.S. environmental consultant travels to Canada to perform an initial assessment of a remediation site.

Source: Compiled by the USITC.

Global Trade

Global trade (imports plus exports) within the environmental sector was estimated at $130.6 billion in 2009 (the latest year for which data are available). The largest markets, in terms of both imports and exports, were the United States and Western Europe. In these two markets, as well as in Australia, Japan, and New Zealand, exports of environmental goods and services exceeded imports.[14] In comparison, Africa reported environmental imports in 2009 that were approximately 17 times the value of its exports.[15]

U.S. Trade

Official data on U.S. trade in environmental services are unavailable;[16] however, as noted earlier, EBI publishes a limited amount of data on such trade. These data suggest that U.S. exports of environmental services in 2010 (the latest year for which data are available) totaled $5.7 billion, while imports totaled $5.8 billion, yielding a small trade deficit of $8.9 million (figure 1.6).[17] Among environmental services segments, trade in environmental consulting and engineering yielded the largest trade surplus in 2010 ($2.4 billion), while trade in the water utilities segment yielded the largest trade deficit ($1.5 billion). According to EBI data, trade accounts for a very small share of the environmental services produced and consumed in the United States. In 2010, U.S. exports and imports of environmental services together accounted for 3.0 percent each of environmental services produced and consumed in the country. During 2000–2010, U.S. environmental services exports grew at a cumulative annual rate of 6.0 percent.

Barriers to Trade

Growing demand for environmental services has expanded opportunities for trade in these services. However, certain factors have hampered this expansion, including both barriers to entry and regulatory burdens on businesses once they are in operation. Barriers to trade encountered by foreign environmental services firms are generally broad in scope and may, for instance, include those pertaining to commercial establishment (e.g., requirements for joint ventures with local or state-owned entities); limitations on the temporary stay of technical and managerial personnel from abroad; local-content requirements, including requirements to hire nationals of the host country; and limitations on legal form. Other, less direct impediments to trade in environmental services can include nontransparent and often burdensome rules and regulations concerning services provision by foreign firms, including onerous or opaque licensing requirements on related service providers.[18]

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[14] Global environmental sector trade data reflects trade in both goods and services. EBI, the source of the data, does not separate trade numbers for goods and services in its country-level breakouts, except for the United States. Trade in Western Europe includes trade between countries in the region. For example, an export from Germany to Italy would be counted as both an export and an import.

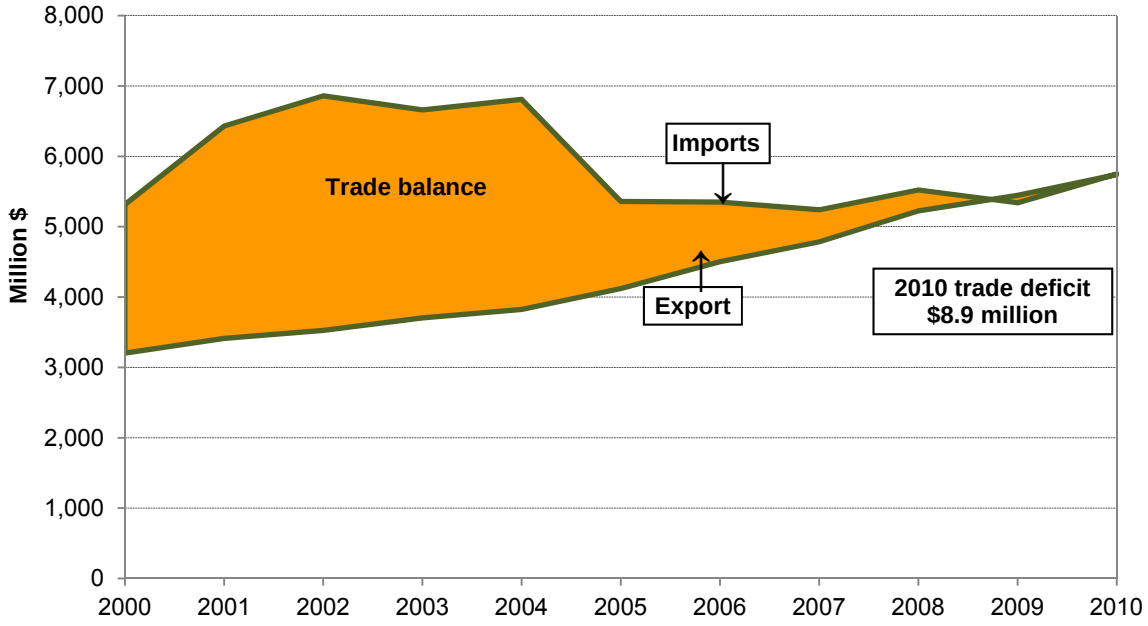
[15] EBI, Global Environmental Market Data Pack, 2011. EBI data reflect both cross-border trade and the repatriated profits of foreign affiliates.

[16] The Bureau of Economic Analysis (BEA) at the U.S. Department of Commerce collects data on trade in goods and services. However, BEA data on affiliate sales of solid and hazardous waste services and remediation services are largely unavailable to the public to avoid disclosing confidential information on individual firms.

[17] These data reflect trade in solid and hazardous waste management; remediation and industrial services; water treatment and water utilities; environmental consulting and engineering services; and analytical services.

[18] Industry representative, e-mail to USITC staff, November 26, 2012. Restrictions on trade in environmental goods may also effectively limit trade in environmental services.

FIGURE 1.6 U.S. environmental services trade: 2009 was the only year in which the United States posted a cross-border trade surplus for the 2000–2010 period



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

Suppliers of related environmental services also face substantial trade impediments. For instance, foreign architects and engineers are often subject to strict licensing and certification requirements which vary by country and may be time-consuming and costly to meet.[19] However, trade restrictions that affect related services have not been systematically addressed in environmental services negotiations.[20]

Such barriers may be addressed through bilateral or multilateral negotiations. Bilateral agreements in which the United States is a partner have addressed some regulations affecting environmental services, such as those governing professional licensing and establishment of a commercial presence, but have not comprehensively addressed trade in the environmental services sector.[21] By contrast, comprehensively reducing or ending

[19] Although licensing and certification requirements are intended to correct for information asymmetries between service providers and consumers, such requirements may serve as a barrier to trade—for example, when they are applied to foreign service suppliers in a discriminatory way.

[20] Some WTO members, including the United States and the European Union (EU), have proposed creating a "cluster" or list of related services that are necessary for the provision of core environmental services. Under such an approach, members offer concessions on core environmental services that also apply to related services, such as engineering, when the related service has an environmental end use. WTO, Council for Trade in Services, "Communication from the European Communities," December 22, 2000; WTO, Council for Trade in Services, "Communication from Australia, the European Communities, Japan," February 11, 2005.

[21] Although the U.S.-Chile Free Trade Agreement (FTA) does not comprehensively address trade in environmental services, the FTA includes several provisions that apply to all service providers. These provisions include, for example, commitments towards national treatment and most-favored nation (MFN) treatment of each country's service providers; a prohibition on requiring service providers to establish a commercial presence in order to supply services cross-border; and requirements that both parties to the agreement endeavor to assure that regulations dealing with services are based on objective criteria and are not more burdensome than necessary.

barriers that affect environmental services trade is an ongoing aim of multilateral negotiations within the WTO. Specifically, the Doha Ministerial Declaration states that "With a view to enhancing the mutual supportiveness of trade and environment, we agree to negotiations, without prejudging their outcome, on the reduction or, as appropriate, elimination of tariff and nontariff barriers to environmental goods and services."[22]

Organization of the Report

Following the brief introduction to trade in environmental and related services in this chapter, chapter 2 presents information on measures affecting trade in both core and related environmental services and uses statistical analysis to examine the potential impact of trade liberalization in the sector. Chapters 3, 4, and 5 present estimates of the size of the U.S. and global markets for the water/wastewater, solid and hazardous waste, and remediation services industries, respectively. Each chapter will also describe the types of services provided within the subject industry segment, examine factors affecting supply and demand, and discuss recent trends. To the extent feasible, chapters 3 through 5 will also provide an overview of cross-border trade and foreign investment in each of these three environmental services industries, and profile key suppliers and country markets.

[22] WTO Ministerial Declaration, November 20, 2001, paragraph 31.

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CHAPTER 2
Measures Affecting Environmental Services Trade in Key Markets

This chapter identifies barriers to trade and investment in core environmental services, including barriers that pertain specifically to environmental service providers; restrictions on related services that are vital to providing environmental services (e.g., architecture, engineering, and construction); and "horizontal" measures that have a particularly significant impact on environmental services supply, such as those that pertain to a country's general investment regime. The chapter also provides a brief overview of recent efforts to liberalize environmental services trade, including proposals made by WTO members within the General Agreement on Trade in Services (GATS) negotiations that highlight classification issues and barriers in related-service sectors. The chapter concludes by summarizing the findings of an econometric model used to assess the impact that restrictions on related services have on sales of core environmental services by foreign affiliates. The principal finding of this model is that impediments to trade in certain related environmental services (specifically, architecture, engineering, electricity, and road transport services) have a statistically significant and negative effect on trade in certain core environmental services (including water supply, sewage, waste management, and remediation services).

Barriers to Trade and Investment in Environmental Services

Restrictions Specific to Environmental Services

Commercial Presence Restrictions

Environmental services can be traded both through cross-border channels and by establishing a commercial presence, with the latter accounting for a vast majority of such trade.[1] Environmental services firms establish operations in foreign markets in various ways. For example, one representative of a U.S. environmental services firm with a significant international presence reports that the company's international growth has been fueled equally though organic growth (e.g., through internally generated new projects or expansion) and acquisitive growth.[2] Another industry representative reports that firms usually expand abroad through projects which allow them to establish

[1] Gelosso Grosso, "Managing Request-Offer Negotiations under the GATS," February 2005, 10, 29; UNEP, ITC, ICTSD, "Trade and Environment Briefings," June 2012, 3.

[2] Industry representative, interview by USITC staff, Los Angeles, CA, October 30, 2012. For example, in a Middle Eastern country where the representative's firm did not have a local presence, it began working on projects with oil and gas industry clients; once it started working in the country it set up and registered as a company there. By contrast, the firm's expansion in India and Africa has been through acquisitions, motivated by demand growth in these markets, which will likely continue.

partnerships with local firms or form client relationships with resident multinational corporations (MNCs) as a way to continue to provide services in the market and potentially establish a presence.[3] Cross-border trade occurs less frequently in the environmental services sector, though in the past 20 years, the information technology (IT) revolution has made it possible to provide certain services, such as architectural design or project management and consulting, through cross-border channels.[4]

As environmental services are exported primarily through commercial presence, and as foreign investment is generally necessary to set up, maintain, and expand a foreign presence, measures that restrict foreign investment or the operations of foreign affiliates can have a serious impact. These measures include, among others, investment screening processes, restrictions on forms of establishment, and restrictions on the nationality of managers or directors.[5] The country-specific schedules of commitments appended to the GATS include foreign equity limits and screening requirements specific to environmental services.[6] For example, China's GATS schedule requires foreign environmental services suppliers in that country to set up joint ventures with Chinese firms (a restriction on legal form). In Korea, there is a quota on the number of foreign sewage service suppliers that may enter the market, and foreign investment in refuse services is subject to an economic needs test.[7]

However, while commercial presence restrictions may impede trade, they are not common in GATS commitments on core environmental services. Moreover, restrictions found in the schedules often do not reflect actual practice, making certain markets appear closed when they are actually quite open.[8] A review of environmental services offers submitted as part of the WTO's Doha Round negotiations and bilateral and regional trade agreements suggests that liberalization may have occurred, or that market conditions may be less restrictive than indicated in countries' GATS commitments (box 2.1).

Further, studies examining barriers in services sectors find fewer barriers to investment in environmental services than in other sectors. For example, a 2000 study of barriers to foreign direct investment (FDI) across several service sectors in certain APEC countries found that environmental services was among the least restricted sectors.[9] A more recently constructed database, covering restrictions on FDI in 50 developing countries across several industries, also revealed that restrictions on commercial presence in environmental services were low relative to other industries (figure 2.1).[10]

[3] Industry representative, interview by USITC staff, San Diego, CA, October 31, 2012.

[4] Ibid.

[5] Gelosso Grosso, "Managing Request-Offer Negotiations under the GATS," February 2005, 31.

[6] For a list of country-specific commitments, see appendix table C.1.

[7] WTO, "Economic Needs Test," 2001, 3–4. Economic needs tests (ENTs) are not defined in the GATS, nor does the term have a well-defined meaning in economic literature. ENTs usually make market access conditional on the result of an examination of industry, market, and labor conditions, often without clarifying the criteria used in the test, leaving trade officials with broad discretion. More information on China, Korea, and other countries can be found in box 2.1.

[8] UNCTAD, "Measuring Restrictions on FDI in Services," 2006. A comparison of restrictiveness scores across services sectors (using GATS as a supplemental source) with GATS schedules alone shows that GATS underestimates openness to foreign direct investment (FDI) in services.

[9] Holmes and Hardin, "Assessing Barriers to Services Sector Investment," 2000, 62–65. Results are shown for select APEC countries.

[10] UNCTAD, "Measuring Restrictions on FDI in Services," 2006. See figure 2.1 above for a list of service sectors included in the study; see page 6 (table 4) of article for country coverage. Data referred to 2004 or latest available year. Restrictions ranged from 0 (completely open to FDI) to 1 (completely closed to FDI), and the average for environmental services was 0.16.

BOX 2.1 Barriers in specific markets

A comparison of GATS commitments with offers made during the Doha Round of negotiations indicates that the offers, if agreed, would codify a more liberal regime for trade in environmental services. Although these offers have no legal standing, they likely reflect current practice because changing national laws can be difficult.

For example, among other proposed revisions,[a] Norway offered to open sectors that had been reserved for monopolies (waste management services) or government-owned monopolies (services to reduce exhaust gas);[b] Japan offered to end limitations on licenses given to certain refuse disposal providers;[c] and Korea offered to end its quotas on the number of sewage service suppliers, as well as its requirements for economic needs tests for providers of refuse disposal and for environmental testing and assessment services.[d] Further, some countries that had not initially made environmental service commitments, such as New Zealand and Pakistan, offered to undertake commitments in the sector.[e]

Regional and bilateral trade agreements also reflect more environmental services liberalization than do GATS commitments, particularly when agreements use a "negative list" approach.[f] In negative-list agreements, sectors are presumed open in the absence of explicit exclusions, while in positive-list agreements, sectors are presumed closed unless explicitly listed as open. Hence regional and bilateral trade agreements that apply a negative-list approach typically have wider sectoral coverage than positive-list agreements. For example, the United States' GATS commitments apply only to environmental services contracted by private industry. This provision is not included in the Dominican Republic-Central America-United States Free Trade Agreement (CAFTA-DR)[g] or other U.S. free trade agreements (FTAs), and as a result, all environmental services are left unrestricted. [h]

Further, both positive- and negative-list regional and bilateral trade agreements tend to liberalize mode 3 environmental services more than countries' GATS commitments do. For example, despite GATS bindings that require foreign companies to enter China's market via joint ventures, some of China's FTA agreements allow wholly owned foreign enterprises in certain categories of environmental services.[i]

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[a] This paragraph describes some offers made concerning environmental services during the Doha Round and is not an inventory of all offers. See Mitchell and Rae, "Evaluation of Commitments and Offers of Liberalisation," 2009.

[b] WTO, "Norway: Revised Offer," 2005, 24–25.

[c] WTO, "Japan: Revised Offer," 2005, 59–60.

[d] WTO, "Republic of Korea: Revised Offer on Services," 2005, 43–44.

[e] WTO, "New Zealand: Revised Conditional Offer," 2005, 31–32; WTO, "Pakistan: Conditional Initial Offer on Services," 2005, 23–24.

[f] Mitchell and Rae, "Evaluation of Commitments and Offers of Liberalisation," 2009, 23–24.

[g] CAFTA-DR's final text is available at http://www.ustr.gov/trade-agreements/free-trade-agreements/cafta-dr-dominican-republic-central-america-fta/final-text (accessed December 5, 2012).

[h] The North American Free Trade Agreement (NAFTA) and the U.S.-Australia, U.S.-Bahrain, U.S.-Chile, U.S.-Morocco, U.S.-Oman, U.S.-Singapore, and U.S.-Peru FTAs all remove the GATS restriction as well; see Mitchell and Rae, "Evaluation of Commitments and Offers of Liberalisation," 2009, 27.

[i] WTO, "Trade Policy Review: China," 234, 166–67.

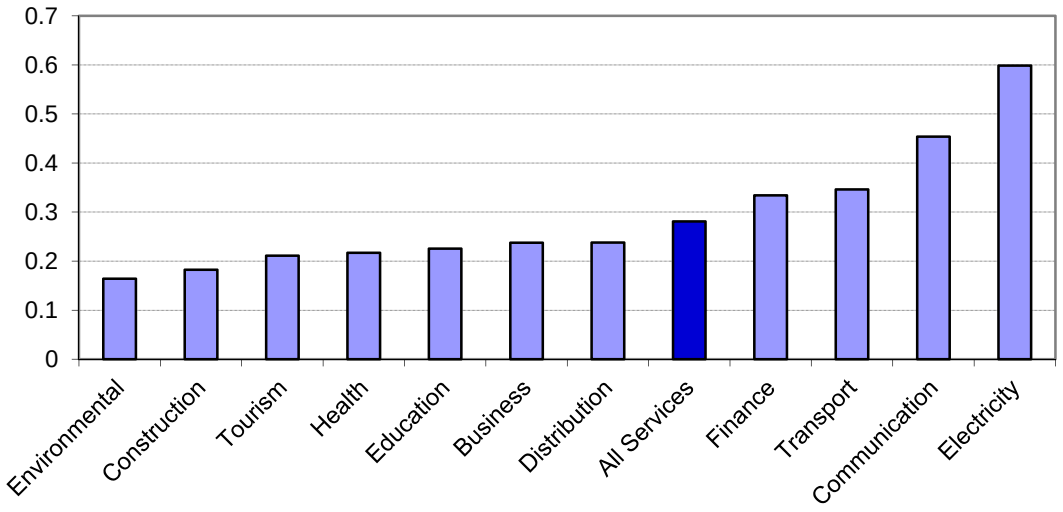
Measures Affecting Competition

Public-sector provision of environmental services limits competition and opportunities for private sector participation in the sector. Historically, infrastructure services (including water distribution, sewage, and solid and hazardous waste management) have often been publicly provided.[11] Government involvement in these industry segments is reflected in several countries' GATS schedules. For example, Vietnam's[12] schedule indicates that four of the discrete environmental services activities for which it has

[11] For further discussion of private vs. public sector participation in these industries, see chapter 3, "Water and Wastewater Services," and chapter 4, "Solid and Hazardous Waste Services."

[12] Vietnam is a relatively new member of the WTO, having joined in 2007. This suggests that their GATS commitments may reflect de facto practices.

FIGURE 2.1 FDI restrictiveness score for environmental services is low relative to other services sectors, 2004[a]



Source: UNCTAD, "Measuring Restrictions on FDI in Services," 2006.

[a]Aggregated data published in 2006 referred to 2004 or latest available year.

scheduled commitments may be subject to public monopolies and thus excluded from the agreement (see appendix table C.1).[13]

Most countries have private sector competition in some segments of solid waste management services (such as waste collection) and increased opportunities for private sector competition in sewage treatment services.[14] However, the benefits of increased competition depend on the strength of a country's regulatory environment.[15] To promote effective competition, governments may, among other things, choose to regulate prices, require equal access to essential infrastructure services, issue standards, establish regulatory agencies (including competition authorities), and ensure regulatory transparency.[16] Conversely, the absence or weak/inconsistent enforcement of such regulations may hinder trade.[17]

[13] See Geloso Grosso, "Regulatory Principles for Environmental Services," 2007, 16–22, for a discussion of the GATS and environmental services, including information on horizontal commitments affecting environmental services.

[14] Gelosso Grosso, "Managing Request-offer Negotiations under the GATS," February 2005, 18. See Geloso Grosso, "Regulatory Principles for Environmental Services," 2007, 3, for a discussion of water services.

[15] UNEP, ITC, ICTSD, "Trade and Environment Briefings," June 2012, 3.

[16] Gelosso Grosso, "Managing Request-offer Negotiations under the GATS," February 2005, 20–21; Geloso Grosso, "Regulatory Principles for Environmental Services," 2007, 5–12. As discussed in the following section, price controls imposed on suppliers of architectural and engineering services may serve as a barrier to trade. Such controls (i.e., setting mandatory minimum or maximum fees) may also impede competition (see OECD, "Services Trade Restrictiveness Index (STRI)," June 6–7, 2012, 15). However, regulation of prices may be necessary for certain capital-intensive environmental network services where private sector participation may actually increase fees for the services supplied by the government. Government regulation can ensure fair prices to consumers while balancing the interests of investors (see Gelosso Grosso, "Managing Request-offer Negotiations under the GATS," February 2005, 20).

[17] Gelosso Grosso, "Managing Request-offer Negotiations under the GATS," February 2005, 33; EBI and Nathan Associates, "Thailand," August 2012, 7, 9, 28; EBI and Nathan Associates, "Chile," 2011, 10, 39; EBI, "Malaysia," 2010, 6–7, 29–30; EBI, "Vietnam," November 2011, 4–5.

Related Services

To provide core environmental services, a number of ancillary services are needed. At the front end, services such as consulting, testing, and analysis are required to judge the feasibility of a project or estimate potential environmental damage. At the back end, a wide variety of services such as architecture, construction, and engineering (ACE), designing, planning, and permitting are necessary to design and build infrastructure, and operation, management, and maintenance services are needed to monitor and maintain the project.[18]

Barriers to trade in these vital related services may impact trade and investment in core environmental services.[19] In contrast to the few restrictions on core environmental services, restrictions on related environmental services are numerous. Among members of the Organisation for Economic Co-operation and Development (OECD), for instance, impediments to trade in construction services include restrictions on foreign ownership and market entry.[20] Restrictions on the movement of people (such as employee quotas and labor market tests)[21] are also particularly prevalent in the labor-intensive construction sector. Procurement and permitting measures, including local-content requirements, may discriminate in favor of local suppliers. Further, regulatory opacity and the cost of complying with regulations in multiple markets can impede trade in construction services.[22]

Labor market tests and quotas may limit the number of foreign engineers and architects that can be active in a particular market, and such measures are most prevalent among OECD members.[23] In addition, licensing requirements, nonrecognition of professional qualifications, restrictions on advertising (for architects), and limitations on the use of professional titles by foreign-licensed professionals are significant impediments.[24] Sector-specific price controls also serve as barriers to trade.

[18] Industry representative, interview by USITC staff, San Diego, CA, October 31, 2012. U.S. competitive advantages lie in providing services such as feasibility studies used to prepare bids for U.S. Agency for International Development (USAID) or World Bank contracts.

[19] Industry representatives state that having to fulfill formal administrative requirements (such as licensing) before supplying certain services can be both time-consuming and costly. However, representatives also indicate that while complicated, such requirements are not difficult, and that there are ways of overcoming these barriers, such as through private-public or local partnerships. Industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012; industry representative, interview by USITC staff, Los Angeles, CA, October 30, 2012; industry representative, interview by USITC staff, San Diego, CA, October 31, 2012.

[20] OECD, "Services Trade Restrictiveness Index (STRI)," June 6–7, 2012. These restrictions include investment screening, limitations on board members and managers, restrictions on acquiring land, and equity restrictions on publicly owned firms; see pages 22–23 of the OECD study.

[21] WTO, "Communication from Canada," 2005, 2. Labor market tests are similar to economic needs tests in that they are ill-defined and afford trade officials considerable discretion. They generally assess whether foreign workers would compete with or displace domestic workers.

[22] Industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012. Industry representatives also report there are required training levels and health and safety measures in this industry, which are more a global tendency than a local requirement.

[23] OECD, "Services Trade Restrictiveness Index (STRI)," June 6–7, 2012, 24–28.

[24] Limited licensing systems exist in almost half of OECD countries; other requirements may include minimum years of practice, or exams to recognize foreign qualifications or degrees. Related discriminatory regulations not common among OECD countries include limits on foreign firm names.

Restrictions on road freight transportation, which impact transportation of goods (including waste) over land, may also affect environmental services providers.[25] The OECD identifies several restrictions on commercial presence in this sector, including investment limitations, local establishment requirements, prohibitions on cabotage or triangular traffic,[26] and controls over certain routes and transportation of certain goods. Licensing/permitting road freight may be limited by quotas or conditioned on economic needs tests. Other measures may include discriminatory public procurement and taxation, laws or regulations that differ from common international standards, competition and price restrictions, and lengthy customs procedures.[27]

Barriers to the foreign provision of several other related services—including technical testing and analysis, maintenance and repair, operation and management, and rail transport, among others—may also impact environmental services providers. For further information, box C.1 (appendix C) provides an overview of two indices that measure restrictions to foreign investment and competition in some of the related services industries discussed above.

Horizontal Measures

Investment Measures

There are a number of measures that may apply to all investment—including investment in environmental services—in a given country. These horizontal policies, primarily affecting a firm's ability to establish a commercial presence and the presence of natural persons, tend to be more significant than those that specifically apply to environmental services. For example, the results of a database analysis (mentioned earlier) of services investment barriers indicate that horizontal measures were more widespread than barriers specific to environmental services.[28] Similarly, responses to a survey on barriers to environmental services trade by 13 countries belonging to the Asia-Pacific Economic Cooperation (APEC) largely either indicated the absence of environmental-specific commercial presence restrictions or referenced horizontal investment policies in their respective economies. Common restrictions affecting the movement of natural persons (visa restrictions, professional qualification exams, and labor permits) were reported as well.[29]

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[25] OECD, "Transport and Courier Services," June 18, 2012, 25–32. Also included are restrictions on passenger transport, air transport, maritime transport, rail transport, and courier services. Trade in road freight "takes place either through transport between two different countries (mode 1), or through the establishment abroad to provide domestic road transport (mode 3 and accompanying mode 4)." Ibid., 25.

[26] Cabotage is defined as "transport between two points in the same country, including by operators who are not established in the country within which the transport operation take place," while triangular traffic is "traffic between a point in the territory of the other party and a point in the territory of a third state, provided that the journey includes the country of establishment of the hauler." Ibid., 27.

[27] For a fuller list of measures included in the STRI for road freight, see ibid., 31–32.

[28] UNCTAD, "Measuring Restrictions on FDI in Services," 2006. Horizontal measures tended to drive up the restrictiveness scores of countries that scored above the average of 0.16 in environmental services. See pages 3–4 for more information and weighting of the measures. The index is constructed by focusing on five areas of possible barriers: (1) restrictions on foreign ownership (usually applicable to a particular industry); (2) investment screening (such as economic needs test requirements for investment, which typically apply horizontally across sectors); (3) operational restrictions applied to management and board of directors (such as nationality or residency requirements); (4) restrictions on the movement of people; and (5) performance requirements (such as local employment requirements). Stephen Golub, in an email to USITC staff, November 16, 2012, indicated that equity limits are sector-specific and other measures are usually horizontal.

[29] APEC, "Survey on APEC Trade Liberalization in Environmental Services," 2010, 27–34.

Horizontal commercial presence restrictions, such as provisions requiring the screening of foreign investments, bans or limits on foreign ownership, or performance requirements, may hinder environmental services trade and investment. For example, environmental services industry representatives report that host countries increasingly require foreign service providers to use domestically sourced or manufactured inputs or to employ domestic personnel.[30] Restrictions on natural persons, which may include requirements for obtaining work permits, nationality or residency requirements for certain categories of personnel, and limitations on the temporary stay of foreign workers (including intracorporate transferees), among others, may also negatively affect trade and investment.[31] For example, in China, the ability of foreign firms to employ expatriate personnel is restricted by an economic needs test.[32]

Financial Risk and Additional Barriers

Industry representatives cite financial risks as a key barrier to providing services in foreign markets.[33] These risks are of particular importance to core environmental service providers, who often must make significant infrastructure investments in order to supply services[34] (particularly solid and hazardous waste and water services). A foreign firm must have the financial resources and procurement capabilities to carry out projects and to manage the financial risks associated with participating in such projects.[35]

Besides financial risks, competition in many developing markets is impeded by a lack of strong regulatory standards, low interest and institutional demand, difficulty in acquiring financing, and lack of infrastructure and other mechanisms to keep projects going.[36] For example, in certain Asia-Pacific countries, municipal projects are affected by a lack of funding, as water rates do not sufficiently meet the costs of building, maintaining, and operating water infrastructure essential for clean water and sanitation.[37]

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[30] Industry representative, interview by USITC staff, Los Angeles, CA, October 30, 2012. These local-content requirements are magnified by value-added taxes (VATs) on foreign professional services, which vary across countries. EBI, "Ex-Im Bank Sees Only Growth Ahead," 2012, 41. See EBI, "Development of Resources Drives Growth," 2012, 8, for a discussion on the necessity of hiring local labor when operating globally; for a discussion on the challenge of finding locally qualified personnel, see pages 7–8 and 12.

[31] Gelosso Grosso, "Managing Request-offer Negotiations under the GATS," February 2005, 29, 32. Gelosso Grosso discusses the importance of mode 4 provisions as they relate to traditional infrastructure services (i.e., water and waste treatment services) and non-infrastructure environmental services and related services (i.e., air pollution control and environmental consulting).

[32] EIU, "Country Commerce Guide: China," 2012, 59 discusses exceptions to the licensing system for foreign employment in China.

[33] Industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012; industry representative, interview by USITC staff, San Diego, CA, October 31, 2012.

[34] EBI, "Development of Resources Drives Growth in Global Environmental Market," 2012, 8.

[35] According to industry representatives, for a variety of reasons, corruption and lack of transparency are also compelling problems when operating in foreign markets (industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012; industry representative, interview by USITC staff, Los Angeles, CA, October 30, 2012). Corruption has also been associated with weak enforcement of environmental laws and regulations (see EBI and Nathan Associates, "Thailand," August 2012, 11).

[36] Industry representative, interview by USITC staff, San Diego, CA, October 31, 2012.

[37] EBI, "Acquatech, Xylem See Emerging Economies," 2012, 39. In these countries, multilateral and other lending institutions have become key providers of financing for water infrastructure projects. See EBI, "Vietnam," November 2011, 6, for a discussion of Vietnam, where a majority of environmental infrastructure development has been funded by bilateral overseas development assistance and subsidized loans from multilateral lending agencies. One industry representative indicated that in some countries, spending on one type of infrastructure can crowd out spending on other critical environmental infrastructure; the representative asserted that this is happening in Brazil, where all infrastructure funds are going towards the Olympics preparations. Industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012.

As a result, despite significant potential, U.S. industry representatives report that that it will be a while before certain emerging markets demand a large volume of technically sophisticated environmental services.[38]

Finally, given the importance of the public sector as a provider and consumer of environmental services**,** government procurement barriers may impact the ability of foreign firms to compete abroad outside their home countries. For example, industry representatives report that it can be difficult for foreign firms to compete effectively when bidding against government-subsidized competitors.[39] Additionally, opaque government procurement procedures, local-content requirements, residency requirements, and other conditions attached to procurement may make it harder for foreign environmental service suppliers to compete in foreign markets.[40] For example, industry representatives report that in order to compete for procurement contracts in certain countries, firms have been required to demonstrate that they have a certain number of years of experience in providing the subject service.[41]

Recent Efforts to Liberalize Environmental Services Trade

As stated above and in box 2.1, the environmental services offers that have been submitted as part of the WTO negotiations, as well as related provisions in many bilateral and regional trade agreements, suggest that a number of countries have liberalized barriers to environmental services trade or have more open markets in this sector than is implied by their initial GATS commitments. This section provides an overview of environmental services proposals made by WTO members for the current round of GATS negotiations. This section also includes a summary of other multilateral and regional negotiations that may have an impact on trade in environmental services.

Proposals: Classification Issues and the Importance of Related Services

WTO members' proposals show broad support for the ideas that certain related services are essential to providing core environmental services, and that meaningful liberalization of environmental services must include liberalization of related services. These proposals, which were submitted beginning in 1999, have focused on two issues: the classification of environmental services—including defining a set of related[42] services—and the elimination of barriers to both core environmental and related services. Several

[38] Industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012.
[39] Ibid.
[40] Gelosso Grosso, "Managing Request-offer Negotiations under the GATS," February 2005, 33.
[41] Industry representative, interview by USITC staff, Los Angeles, CA, October 30, 2012.
[42] Several proposals use the term "cluster services" when referring to services that are related to environmental services.

negotiating proposals discussed in the following paragraph[43] have laid out alternative classifications, reportedly for two reasons: activities classified elsewhere in the CPC (Central Product Classification), such as construction and engineering, are intrinsic to the provision of many environmental services; and more generally, the current classification does not reflect the way environmental services have evolved since the establishment of the GATS. Several of the proposals state that updating the classification would better represent the sector by adding service areas which have gained prominence, either because technological changes have made trade feasible or because new regulations have driven up demand.

A communication from the EU cited problems with the current classification of environmental services in the WTO and suggested that commitments should be scheduled according to an alternate classification.[44] Among other things,[45] the proposal suggested that while related services should be negotiated separately from environmental services, environmental services and related services negotiators should communicate to ensure that certain goals are reached. The related services specifically mentioned in the EU paper include business services; R&D; consulting, contracting and engineering; construction; distribution; transport; and others.[46] Communications from the United States and Canada supported the idea of defining a set of related services that are important to the provision of environmental services and supported liberalization in both core and related sectors.[47] Switzerland also advocated further liberalization in core and

[43] WTO, Council for Trade in Services, "Communication from Australia," October 1, 2001; WTO, Council for Trade in Services, "Communication from Australia, the European Communities, Japan," February 11, 2005; WTO, Council for Trade in Services, "Communication from Canada," March 14, 2001; WTO, Council for Trade in Services, "Communication from Colombia," November 21, 2001; WTO, Council for Trade in Services, "Communication from the European Communities," December 22, 2000; WTO, Committee on Specific Commitments, "Communication from the European Communities," September 28, 1999; WTO, Council for Trade in Services, "Communication from Switzerland," May 4, 2000; WTO, Council for Trade in Services, "Communication from the United States," December 18, 2000.

[44] WTO, Council for Trade in Services, "Communication from the European Communities," December 22, 2000, 2; WTO, Committee on Specific Commitments, "Communication from the European Communities," September 28, 1999, 2. Problems cited include the narrow focus on "end-of-pipe" services and the failure to consider the growing importance of pollution prevention and other services, as well as services such as engineering and design that are used to provide environmental services. See ICTSD, "Environmental Goods and Services Negotiations," June, 2005, 8–9, for a discussion of the issue of including water services within the environmental services classification. See Kirkpatrick, "Trade in Environmental Services," 2006, 6–10, for a comparison of environmental services classifications.

[45] WTO, Council for Trade in Services, "Communication from the European Communities," December 22, 2000, 2–3. The proposal preserved "core" environmental services and classified them into seven subsectors. The communication discussed the importance of liberalizing modes 1, 2, and 3 and proposed holding further discussion on how to facilitate mode 4. The following environmental services barriers were listed: "monopolies and exclusive providers issues, restrictions on legal forms of doing business, equity limitations, restrictions on foreign investment, unspecified licensing and approval requirements, unspecified economic needs tests, residency and nationality requirements, restrictions to the movement of key personnel etc." Horizontal commitments that affect the provision of environmental services were also mentioned: "unspecified approval requirements, unspecified economic needs tests, certain limitations on the purchase or rental of real estate, restrictions on equity holdings, residency requirements, certain tax and subsidy measures."

[46] WTO, Council for Trade in Services, "Communication from the European Communities," December 22, 2000, 2. See pages 6–10 for a chart detailing the activities covered under each sector, along with examples.

[47] WTO, Council for Trade in Services, "Communication from the United States," December 18, 2000, 2; WTO, Council for Trade in Services, "Communication from Canada," March 14, 2001. The U.S. and Canadian proposals mention additional related services, including technical testing and analysis and scientific and technical consulting, as well as advertising and other professional services.

related environmental services,[48] and a 2006 communication from several members reiterated the importance of liberalizing both core and related services.[49]

Doha Round negotiations are ongoing, but there have been few developments specific to environmental services in recent years. However, several proposed and recently completed bilateral, regional, and multilateral trade agreements suggest that there is continued interest in, and progress on, environmental services trade liberalization. For example, the United States and 10 other Asia-Pacific countries[50] are currently negotiating a Trans-Pacific Partnership (TPP) Agreement, and efforts to develop text on trade-related environmental issues have included discussions on environmental goods and services.[51] In addition, the United States and 20 of its trading partners plan to address barriers to services trade by initiating negotiations on a new trade agreement on services in early 2013.[52] Although specific negotiating goals for environmental services have not been publicized, both environmental and related service industries would likely fall within the scope of the agreement as part of the overall services sector.

The Potential Impact on Environmental Services of a Reduction in Related-Services Barriers

Anecdotal evidence suggests that open markets spur environmental services exports and the development of competitive environmental services sectors. However, there has been no quantitative analysis examining how reforms of any type (either reforms specific to core environmental services or reforms in crucial related services) impact the environmental services sector.[53] This section presents an overview of a gravity model that

[48] WTO, Council for Trade in Services, "Communication from Switzerland," May 4, 2000, 2. Switzerland proposed an environmental service classification like that proposed by the EU. Two other WTO Council for Trade in Services communications—"Communication from Australia," October 1, 2001, and "Communication from Colombia," November 21, 2001—proposed adopting or working from the classification proposed by the EU and supported further liberalization in environmental services. Colombia's communication proposed adding a few specific categories to the EU's proposed classification.

[49] WTO, Council for Trade in Services, "Communication from Australia, the European Communities, Japan," February 11, 2005. In 2006, Australia, Canada, the European Communities, Japan, Korea, Norway, Switzerland, Taiwan, and the United States circulated a collective request calling for liberalization of environmental services and related services across all modes of supply and all subsectors in the UN CPC classification (with flexibility on the classification of the subheadings). This communication is summarized in Permanent Delegation of the EC, "Plurilateral Request Environmental Services" (accessed December 6, 2012).

[50] As of December 2012, countries participating in the TPP negotiations include Australia, Brunei Darussalam, Canada, Chile, Malaysia, Mexico, New Zealand, Peru, Singapore, the United States, and Vietnam. USTR, "TPP Chief Negotiators Pleased," December 11, 2012 (accessed January 16, 2013).

[51] USTR, "Outlines of the Trans-Pacific Partnership Agreement," November 12, 2011.

[52] USTR, "U.S. Trade Representative Ron Kirk Notifies Congress," January 15, 2013.

[53] Several studies examine the impact of reform on other service sectors. A few examples of these sector-specific studies include Arnold et al., "Services Reform and Manufacturing Performance," September 2010; Arnold et al., "Does Services Liberalization Benefit Manufacturing Firms?" January 2007; Fink et al., "An Assessment of Telecommunications Reform in Developing Countries," 2003; Herfindahl and Brown, "WTO Negotiations in Financial Services," 2007; Kalirajan, "Restrictions on Trade in Distribution Services," 2000; Nguyen-Hong, "Restrictions on Trade in Professional Services," 2000; OECD, "Methodology for Deriving the STRI," 2009; Reisman and Vu, "Nontariff Measures in the Global Retailing Industry," 2012.

estimates the impact of "behind the border" barriers in related services on foreign affiliates' sales of core environmental services, and a description of model results.[54]

This analysis focuses on related services for two reasons. First, while there are few explicit barriers to core environmental services trade, regulations in related services are more numerous. Second, related services represent a large share of the services provided by environmental firms. For example, EBI reports that consulting, engineering, and analytical services accounted for about 16 percent of global environmental services revenues in 2012.[55] The analysis is restricted to foreign affiliates, since most firms that provide environmental services in foreign markets do so by establishing a commercial presence abroad.

Related-Services Index and Foreign Affiliates' Sales of Environmental Services

The gravity model estimated for this study analyzes the impact that nondiscriminatory barriers in related services sectors might have on core environmental services. Nondiscriminatory barriers are those that are not aimed specifically at foreign entities. This study focuses on nondiscriminatory barriers because when providing environmental services in foreign markets, U.S. industry representatives have reported that they have used both foreign and local services and other inputs, and that the share of local content is sometimes very high. This being the case, the incidence of purely discriminatory regulations might not be as relevant as the general level of competition and productivity in any given local sector.[56] Moreover, as stated earlier, industry representatives cite threats to the ease of doing business in foreign markets (corruption, opacity, financial risk) as their primary concern when operating or deciding to operate abroad.[57] For the purposes of this estimation, the OECD's indicators of non-manufacturing regulation system (NMR) index (see appendix C, box C.1) in architectural, engineering, electricity, and road transport services is used to measure nondiscriminatory barriers in related services.[58] The NMR index captures nondiscriminatory provisions affecting entry and competition (price controls, restrictions on forms of doing business, public ownership, etc.), as well as the ease of doing business within each sector.[59]

[54] "Behind the border" barriers refer to measures that affect the ability to conduct business once operating in the country.

[55] EBI, "Development of Resources Drives Growth," 2012, 2. It is not clear which specific services are included in analytical services.

[56] As discussed above, the NMR index generally applies to all service providers (and not solely to foreign service providers); however, there is one question in the professional services index (which includes architectural and engineering) that is specific to foreign service providers.

[57] Industry representative, interview by USITC staff, Los Angeles, CA, October 29, 2012. For example, in some projects, such as U.S. federal construction projects overseas, the supply of labor is approximately 90 percent local, mostly because of the practicalities of construction-oriented projects but also because U.S. firms are often tasked with building local capacity. Another industry representative stated that how a foreign-owned business operates locally depends on why and how the company entered the market. For example, in a project carried out by a U.S. firm in Mexico City, the intention was to design the project and let the back end be handled locally. Industry representative, interview by USITC staff, San Diego, CA, October 31, 2012.

[58] The OECD refers to NMR as "indicators of sectoral regulation" or "non-manufacturing regulation system."

[59] For the set of host countries in the dataset, the correlation coefficient between the average of the NMR index across the four related services (which refers to 2007 and 2008) and the latest World Bank's Doing Business index (2012) was 0.71. World Bank, "Doing Business" (accessed December 7, 2012).

The estimation also employs data on foreign affiliate sales from Eurostat's Structural Business Statistics.[60] The data capture foreign affiliates' environmental services sales within European "host countries"[61] (where the foreign-owned affiliates are located) by firms in a select number of "source countries" (the countries that own the affiliates) (see appendix C, table C.4). The data illustrate that the share of foreign affiliate sales to total sales varies across countries and that most foreign affiliate sales within the countries listed are by affiliates based in other European countries. Total sales by environmental services firms located in the EU-27 (both domestic and foreign-owned) totaled €190 billion in 2009 (about $264 billion)[62] (column 1). Foreign affiliate sales as a percentage of total sales by environmental service affiliates ranged from 1.3 percent in Spain to over 30 percent in the United Kingdom and Romania and over 40 percent in the Czech Republic and Luxembourg (column 3). With the exception of Romania and the United Kingdom, most (over 80 percent) of foreign affiliate sales in individual European countries were by enterprises headquartered in other EU-27 members (column 5).[63]

The Model

Gravity models have been used to analyze trade flows between countries for decades,[64] with traditional empirical studies focusing on cross-border trade and more recent studies on FDI flows and foreign affiliate sales.[65] Gravity equations typically analyze trade between two countries as a function of several variables: the gross domestic products (GDPs) of an exporter or source country and of an importer or host country (which capture supply and demand factors); geographic distance between the two countries (which acts as a proxy for trade costs);[66] common language (or other variables which may facilitate trade); and a policy variable (which captures the impact of preferential trade agreements or barriers to trade).[67]

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[60] Eurostat, Structural Business Statistics, "Foreign Controlled EU Enterprises—Inward FATS" (accessed August 29, 2012); Eurostat, "Statistical Classification of Economic Activities in the European Community, Rev. 2 (2008)" (accessed December 10, 2012). The statistical classification of economic activities in the European Community categorizes environmental services in Section E of the *Nomenclature générale des activités économiques dans les Communautés Européennes* (General Industrial Classification for Economic Activities within the European Communities), or NACE, Revision 2: "Water Supply; Sewerage, Waste Management and Remediation Activities." The categories are water collection, treatment and supply (E36); sewerage (E37); waste collection, treatment and disposal activities, and materials recovery (E38); and remediation activities and other waste management services (E39).

[61] Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom, as well as the EU-27 (all the countries on this list with the exception of Norway).

[62] IMF, International Financial Statistics, accessed October 16, 2012. The period average rate for euro-area currency per U.S. dollar was used to convert euros to dollars.

[63] The table also shows the share of total foreign affiliate sales to European countries originating from U.S.-, German-, Spanish-, French-, and UK-controlled foreign affiliates (columns 8–17). For example, 45 percent of foreign affiliate sales in the Czech Republic, 49 percent of those in Germany, and 70 percent of those in Italy originated from French-controlled affiliates in those countries (column 15).

[64] De Benedictis and Taglioni, "Chapter 4: The Gravity Model in International Trade," 2011.

[65] Brainard, "An Empirical Assessment of the Proximity-Concentration Trade-off," 1997; Bergstrand and Egger, "A Knowledge-and-Physical-Capital Model," 2007; Kleinert and Toubal, "Gravity for FDI," 2010. For recent USITC work in this area, see Fukui and Lakatos, "Liberalization of FDI in Retail Services," 2012; Reisman and Vu, "Nontariff Measures in the Global Retailing Industry," 2012.

[66] See De Benedictis and Taglioni, "Chapter 4: The Gravity Model in International Trade," 2011, 75–79, for a discussion on distance.

[67] A measure of multilateral resistance has more recently been incorporated to take into account the relative costs of trade (i.e., trade costs between country A and country B relative to their trade costs with all other countries). Anderson and Van Wincoop, "Gravity with Gravitas," 2003; Baier and Bergstrand, "*Bonus Vetus* OLS," 2009.

The empirical models estimated for this study are based on recent quantitative research assessing FDI stock or flows within a gravity framework.[68] The gravity model is estimated using Poisson regression analysis to reduce bias and correct for data imperfections.[69] As explained above, the focus is on sales by foreign affiliates in the environmental services industry. The explanatory variables discussed in the preceding paragraph are included in the analysis (see appendix D for a more detailed discussion regarding variables included in the model). The policy variable used in the analysis is the weighted sum of the indicators of NMR in host countries for the architecture, engineering, electricity, and road transport sectors.[70] The weights are based on the environmental services sector's total input requirements from each related-services sector.[71] The NMR measures the level of anticompetitive regulation and indicates the general ease of doing business in each sector. The higher the level of anticompetitive regulation or difficulty of doing business within a country, the less inward foreign affiliate sales are expected.

Data on the sales of foreign affiliates in the environmental services industry were taken from the Eurostat database described above.[72] The dataset covers the years 2008 and 2009 (the most recent data available) and consists of 1,140 source-country/host-country pairs.[73] See appendix tables D.1 and D.2 for a list of sources and other information.

Results

The principal finding of this model is that impediments to trade in related environmental services have a statistically significant and negative effect on trade in core environmental services. Table 2.1 summarizes the main result (for a fuller set of results, see appendix table D.5). More specifically, the model predicts that a decrease of one standard deviation (0.07) in the overall related-services index[74] (i.e., reducing barriers in the combination of architecture, engineering, electricity, and road transport services by a meaningful amount) is associated with an increase in affiliates' core environmental services sales of 2.4 times (or 137 percent) (see table 2.1).[75] For example, in 2009, total foreign affiliate sales in Italy were €660.5 million (about $917.6 million). If Italy's related-services NMR

[68] See appendix D for more information on the gravity model and variables estimated.

[69] See Santos Silva and Tenreyo, "The Log of Gravity," 2006.

[70] Models were estimated as well for each individual weighted related service. Estimations also included models where each related service sector was added simultaneously. These sectors were included in the NMR index and identified as important environmental service related sectors (see preceding section on related services mentioned in WTO negotiating proposals).

[71] The weights are derived from input-output tables and represent the total input requirements of the environmental services sector being studied. The input-output tables are drawn from the Eurostat EU-17 input-output tables. See appendix D for a description of the methodology used for deriving the regression weights. To calculate the related-services index, two steps are required: first, the weighted architecture and engineering indices are averaged (since they are aggregated together in the Eurostat input-output tables), and then the weighted electricity and road transport indices are summed to the average.

[72] Eurostat, Structural Business Statistics, "Foreign Controlled EU Enterprises—Inward FATS (fats)" (accessed August 29, 2012).

[73] Data for 2010 do not appear to be complete. There are 1,140 observations for the Poisson model (where the majority of observations contain sales valued at zero). As a robustness check, models were also estimated with ordinary least squares (OLS). When estimated with OLS, the dataset consists of 87 bilateral pairs (where foreign affiliate sales take positive, non-zero values).

[74] See appendix D, table D.3, for descriptive statistics on the related-services index.

[75] The model's predicted increase applies to cases where trade exists (i.e., where there is a foreign affiliate and foreign affiliate sales, the model predicts an increase of sales by 137 percent). The model does not yield a prediction of estimated impacts when there are zero foreign affiliate sales. Thus the model does not estimate a level of the NMR (or other independent variables) that would yield establishment of new foreign affiliates.

TABLE 2.1 Potential effect of reduction in related-services NMR index on foreign affiliate sales

Estimated coefficient of related-services NMR index	–12.506
Coefficient standard error	(1.62)
Mean of related-services NMR index	0.23
Standard deviation of related-services NMR index	0.07
Implied percent change in foreign affiliate sales of a decrease of one standard deviation in related-services NMR index	137%

Notes: The estimated coefficient is derived from table D.5, column 1. The implied percent change is calculated by taking the exponent of the product of the coefficient on the related-services NMR index (–12.506) and a decrease of one standard deviation (.07). The coefficient lies at the midpoint of the 95% confidence interval (which ranges from –15.674 to –9.338). The estimated impact thus ranges from a 90 percent change to a 194 percent change.

score were reduced by one standard deviation (from 0.26 to 0.19), foreign affiliate sales in Italy are estimated to increase to €1,563.1 million (about $2,171.4 million).[76]

Table 2.2 illustrates the potential effect of reducing related-services barriers on foreign affiliates' sales of environmental services in the set of host countries that scored above the mean level of restrictiveness in the NMR index. Nine countries in the sample scored above the mean level of restrictiveness (0.23). If all nine countries that scored above the mean were to reduce barriers to the mean, foreign affiliates' sales of core environmental services in those countries are estimated to increase by €3,533.4 million (about $4,907.5 million). That is, those sales are predicted to rise from €5,617.2 million to €9,150.6 million (about $7,801.7 million to $12,709.2 million).

It is possible to apply the method used in table 2.2 to approximate the estimated level of sales in a given host country by affiliates from certain source countries. For example, table 2.2 shows that total sales by foreign affiliates in France are estimated to increase by €1,713.6 million (about $2,380.5 million) to €3,508.7 million (about $4,874.3 million), and it is possible to calculate how much U.S. foreign affiliate sales in France are predicted to increase. As shown in appendix table C.4, in 2009, U.S. foreign affiliate sales in France were €26.1 million (about $36.3 million) (about 1.5 percent of all foreign affiliates sales in France). If France's related-services NMR index were reduced to the mean, U.S. foreign affiliate sales in France are estimated to increase to €51 million (about $70.8 million).[77]

Future research in this area would benefit from a better understanding of the way different types of barriers affect environmental services trade, investment, and foreign affiliate sales. For example, it would be useful to disentangle effects due to discriminatory barriers from those due to nondiscriminatory ones; to focus on an expanded set of related services; and to explore further the impact of restrictions affecting the ability of foreign entities to invest, as opposed to the "behind the border" measures.

[76] IMF, International Financial Statistics, accessed October 16, 2012. The period average rate for euro-area currency per U.S. dollar was used to convert euros to dollars. All conversions to dollars in this paragraph and next use the same exchange rate data source; sales figures in euros are used to calculate potential increases as estimated by the model, and those numbers are then converted to dollars.

[77] Since the model assumes all countries' foreign affiliates sales are equally affected by changes in the NMR index, the estimated increase for U.S. foreign affiliate sales in France rests on the assumption that sales of U.S. foreign affiliates increase at the average predicted rate.

TABLE 2.2 Potential effect of a reduction to mean level of related-services NMR index

Country	Revenues of environmental foreign affiliates, 2009 (million €)	Related-services NMR index	Reduction required to reach mean weighted NMR total score (0.23)	Predicted increase in foreign affiliate sales (million €)	Predicted level of foreign affiliate sales (million €)
Austria	220.7	0.25	0.02	79.8	300.5
Czech Republic	1,650.0	0.24	0.01	263.8	1,913.8
France	1,795.1	0.28	0.05	1,713.6	3,508.7
Italy	660.5	0.26	0.04	418.5	1,079.0
Hungary	315.3	0.26	0.03	157.0	472.3
Slovakia	141.8	0.31	0.08	246.8	388.6
Slovenia	47.2	0.32	0.09	103.1	150.3
Luxembourg	85.1	0.30	0.07	129.4	214.5
Poland	701.5	0.26	0.04	421.4	1,122.9
Total	5,617.2			3,533.4	9,150.6

Sources: Eurostat, Structural Business Statistics database, (accessed August 29, 2012) USITC staff calculations. Countries in the Poisson sample (1,140 observations) which had a score above the mean (of summed weighted related-services index) are included in the table, with the exception of Estonia (total foreign affiliate sales were missing). Index values in table are rounded, but calculations are done on whole values. Results are calculated using the estimated related-services coefficient from Table D.5, column (1). The predicted level of foreign affiliate sales, based on the minimum and maximum values of the coefficient in the 95% confidence interval, ranges from €8,056.9 million to €10,454.3 million.

On the latter point, unlike the results found with the "behind the border" NMR index, models that were estimated using the FDI Index (described in appendix C, box C.1) showed that the ability of foreigners to invest in related services had a less robust relationship with foreign affiliates' sales of environmental services (see appendix D and tables D.6 and D.7). Finally, more robust data, including data for more countries, would make it possible to estimate more precisely how removing different types of barriers in environmental and related services would impact this sector.

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CHAPTER 3
Water Services

Industry Characteristics

Description of Services and Overview of the Structure of the Industry

In this report, water services are defined to include activities related to the provision of water and wastewater services to residential and business customers (box 3.1). These activities include the collection, transportation, purification, and distribution of potable water; the collection, removal, treatment, and disposal of wastewater; and incidental services such as metering, billing, construction, design, maintenance and repair, testing, consulting, and facilities management.

BOX 3.1 Water and wastewater services

Water and wastewater services involve two distinct but related services. The provision of public water services entails extracting water from surface sources (lakes and streams) and groundwater sources; transporting it to water treatment facilities; and distributing the treated water through water pipes to residential, commercial, and industrial end users. By contrast, public wastewater, or sewage services, involves not only the collection of wastewater from sewage pipe systems but also multiple-step treatment processes. Primary treatment involves the use of large basins which physically separate solid wastes from wastewater, whereas secondary treatment involves the use of biological processes to remove organic waste. In some cases, wastewater is also subjected to a third step in which salts and other minerals are removed from the water. After meeting certain regulatory standards, treated water is released into lakes, rivers, streams, and groundwater sources.

Source: Standard & Poor's, *Environmental and Waste Management*, October 4, 2012, 40–41.

In many countries, the water industry is dominated by local government-owned and -operated utilities serving residential and geographic markets ranging from small rural towns to major metropolitan areas. Private water companies also tend to participate at the local utility level; they represent a small share of the global water services industry. These firms typically provide outsourced services to utilities or, in some cases, acquire a local utility. As a result, the structure of the water services industry in many countries tends to be highly fragmented, as the market is divided among many small utilities, each with monopoly rights to provide water and wastewater services in a designated service area. The number of service areas, and thus the number of utilities, can range from a few dozen in small developing countries to hundreds or thousands in large developed countries. Due to this fragmentation, in many countries there is relatively little competition at either the local or national levels. [1]

Private sector entry into the water services industry tends to be dominated by large, well-financed companies, due in large part to the capital-intensive nature of the industry. The

[1] Bueno, "Sewage Treatment Facilities in the U.S.," May 2012, 17; Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012, 20; MarketLine, "Global Water Utilities," July 2012, 19.

provision of water and wastewater services involves the construction of facilities including pipelines, pump stations, reservoirs, wells, and treatment facilities. Maintaining and operating such facilities also involves high operating expenditures. The capital necessary to build, operate, and maintain an effective water services infrastructure, which can run into tens or hundreds of millions of dollars, acts as a barrier to entry for all but the largest, best-financed companies.[2] Other barriers to entry include heavy government regulation[3] as well as high research and development costs related to improving water quality and meeting both social and environmental obligations.

Factors Affecting Supply and Demand for Water Services

The water services industry is highly regulated at both the national and local levels to ensure that water supply meets strict environmental and hygiene standards. In many countries, water treatment and supply regulations are developed by several ministries in conjunction with the legislature. Policy and regulatory functions include setting tariffs (prices for service) and approving tariff increases; setting, monitoring, and enforcing standards pertaining to environmental protection and service quality; and benchmarking utility performance, among others.[4]

The main consumers of water services are households, businesses, and agriculture. Household water usage is mainly driven by drinking, bathing, household cleaning, and garden irrigation. Commercial businesses, ranging from hotels to retail outlets to office buildings, use water for drinking, cleaning, and public restrooms. Industrial business users include firms that use water in manufacturing processes, typically as an input or coolant. The volume of water used in this subsegment varies greatly across industries, depending upon the manufacturing processes used as well as conservation and management efforts. Leading industrial users of water services include petroleum refineries and steel, chemical, and paper manufacturers. In most countries, the public sector accounts for only a small share of water consumption.[5] Similarly, in the wastewater subsegment, households, commercial, and industrial users consume the majority of services.[6]

Growth in the demand for water is generally consistent with overall population growth, although cyclical factors like economic output and weather conditions can result in demand fluctuations.[7] As the number of households increases, more water is consumed for drinking, bathing, and cleaning.[8] Similarly, as commercial and industrial activity rises, more water is used in the production of goods and services. Conversely, the demand for water drops when the economy slows and commercial and industrial activity declines. General climate conditions as well as fluctuations in the weather also have a discernible impact on the demand for water, with warm or dry weather typically requiring more water for cooling and irrigation. By contrast, cooler or wetter weather typically lowers demand for water.[9]

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[2] MarketLine, "Global Water Utilities," July 2012, 17.
[3] QFINANCE, "Water: Major Industry Trends," 2012, 1.
[4] MarketLine, "Global Water Utilities," July 2012, 16–17.
[5] Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012, 13–14.
[6] Bueno, "Sewage Treatment Facilities in the U.S.," May 2012, 13–14.
[7] Standard & Poor's Industry Surveys, "Environmental and Waste Management," March 29, 2012, 39, 42; MarketLine, "Global Water Utilities," July 2012, Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012, 4, 13.
[8] Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012, 13.
[9] Ibid.," June 2012, 4.

The demand for wastewater services largely derives from water consumption patterns, so it, too, is influenced by changes in population, economic activity, and the weather. In addition, the demand for wastewater services is created and driven by national, state (or provincial), and local government regulations that require the treatment of wastewater for environmental reasons.[10]

Recent Trends in the Water Industry

Rapidly aging infrastructure, lack of investment capital, and the growing participation of private-sector entities have all affected the global water and wastewater services industry in recent years. For instance, in both developed and developing countries, a large share of the water infrastructure is suffering from age-related issues, with common problems including substantial water loss through aging pipes and wastewater systems that are unable to process growing volumes of sewage and other wastewater.[11] In the United States, it was estimated that 30 percent of the pipes located in systems serving more than 100,000 people were between 40 and 80 years old, and 10 percent were estimated to be more than 80 years old.[12] Similarly, in the United Kingdom, at least half of London's water mains are estimated to be 100 years old, and a third are estimated to date to the 19th century.[13] Globally, water loss due to aging infrastructure is a severe problem. In the United States, for example, as much as 20 percent of water is wasted due to leakage.[14] In some developed countries, up to 40 percent of the water supply is lost due to leaky water pipes.[15]

Even as the water infrastructure in many countries is deteriorating, the capital resources available to replace or upgrade existing systems are increasingly scarce.[16] Globally, the capital required to address urgent infrastructure needs is estimated to be as much as $16 trillion over the next two decades.[17] In many countries, however, fees for water service cover little more than infrastructure maintenance and operations, leaving little additional money for upgrading, replacing, or extending water systems. The political difficulties of raising prices on water in many jurisdictions, as well as declining tax revenues stemming from an economic downturn in many countries, also reduce the amount of capital available to address aging water systems.[18]

The progressive deterioration of water infrastructure is perhaps the main factor driving privatization and industry consolidation around the world, as cash-strapped local and regional governments in many countries seek to offset, or even offload, large operating and capital expenditures through private sector participation.[19] As indicated above, public water utilities in many countries have entered into partnerships with private water companies to provide services ranging from administrative functions (e.g., metering,

[10] Bueno, "Sewage Treatment Facilities in the U.S.," May 2012, 13.
[11] Leigh, "Water Tight 2012: The Top Issues," 2012, 14.
[12] Abssy, "The Water Industry," 2010, 42.
[13] Leigh, "Water Tight 2012: The Top Issues," 2012, 14.
[14] Calvert Investments, "Freshwater: A Dwindling Supply and Growing Demand," (accessed September 19, 2012).
[15] Murray, "Keep It Clean: The World's Water and Sanitation Challenge," April 6, 2010.
[16] Maxwell, "2012 Water Market Review," 2012, 11.
[17] Leigh, "Water Tight 2012: The Top Issues," 2012, 14.
[18] Leigh, "Water Tight 2012: The Top Issues," 2012, 14; Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012, 6.
[19] MarketLine, "Global Water Utilities," July 2012, 15.

billing, and laboratory testing services) to the outright management of utility operations under various outsourcing contracts or leasing arrangements.[20]

The Global Industry

Global Market for Water Services

According to EBI, the global water market, calculated as revenues collected in the water utility and water treatment services industries, was valued at $247.6 billion in 2010 (figure 3.1). Overall, the market grew by approximately 5.5 percent in 2010, slightly faster than the 4.5 percent compound annual growth rate (CAGR) observed for this sector during 2005–09.[21] At the global level, growth in the water industry is driven by rate increases and, to a lesser extent, infrastructure development in developing countries.

FIGURE 3.1 The global market for wastewaster treatment works and water utilities steadily increased during 2000–2010

Source: Environmental Business International, "The Global Environmental Market by Segment." *Environmental Business Journal*, various issues (2002–12).

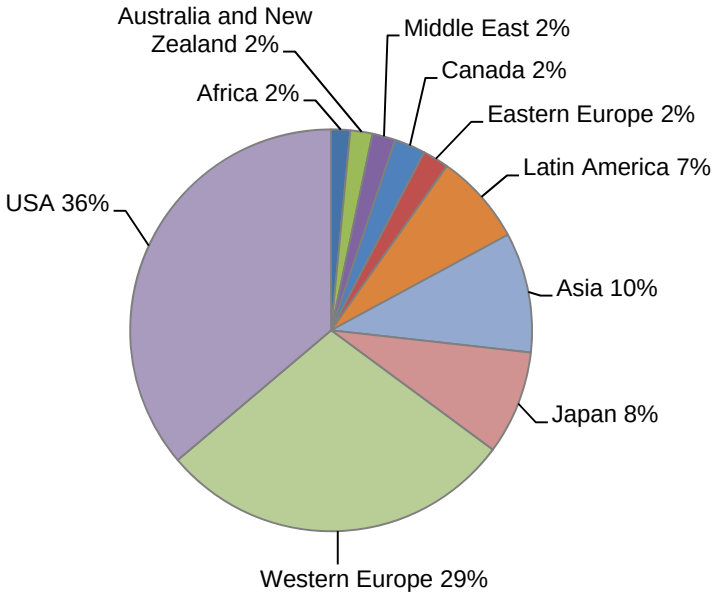
[20] MarketLine, "Global Water Utilities," July 2012, 17. Smith, "Water Supply and Irrigation Systems in the U.S.," 6, 9; Bueno, "Sewage Treatment Facilities in the U.S.," May 2012, 6–7.

[21] Environmental Business International, "The Global Environmental Market by Segment." Environmental Business Journal, various issues (2002–12). Estimates of the size of the global water market are highly sensitive to collection methodology. Research consultancy MarketLine, for example, estimates that the global water market was valued at $725 billion in 2011. MarketLine defines the global water market as the water utilities industry and includes revenues for the collection, treatment, and distribution of water to agricultural, industrial, and residential end users. MarketLine values the utilities industry using average annual end-user prices along with consumption volumes; the value of foreign water markets is converted to U.S. dollars using constant 2011 average annual exchange rates. MarketLine, *Global Water Utilities*, July 2012.

Leading Countries and Suppliers

In 2010, the United States was the largest market for water services, accounting for 36 percent of global revenues, followed by Western Europe and Asia, which accounted for 29 percent and 18 percent of the global market, respectively. In 2010, the Middle Eastern, Eastern European, Canadian, Australia/New Zealand, and African regions each represented 2 percent of the global water services market (figure 3.2).[22]

FIGURE 3.2 Wastewater treatment works and water utilities: The United States had the largest share of global revenue in 2010



Total = $247.7 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

The leading global water services companies include both domestically focused companies/utilities and large multinational firms. In 2011, the two largest water companies, measured by annual revenues, were French firms Veolia Environnement ($45.2 billion) [23] and Suez Environnement ($18.1 billion) (box 3.2), both of which operate in many countries worldwide.[24] Other large water companies, in terms of revenues as reported by Marketline, include those that serve mainly domestic markets: Companhia de Saneamento Básico do Estado de São Paolo (Brazil, $6 billion); Hera S.p.A. (Italy, $5.9 billion); Iride S.p.A. (Italy, $4.8 billion); Tokyo Metropolitan Waterworks Bureau (Japan, $4.2 billion); Hong Kong and China Gas Company Ltd.

[22] Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." Environmental Business Journal 25, no. 6–7 (June/July 2012): 26.

[23] Ford Equity Research, *Veolia Environnement*, November 2, 2012, 1. In addition to the water services industry, Veolia Environnement also operates in the transportation, energy, and solid waste industries.

[24] Mergent, "Suez Environnement," n.d. (accessed January 18, 2012). In addition to the water services industry, Suez Environnement also operates in the solid waste industry.

BOX 3.2 France's global water companies

Veolia Environnement

Founded in 1853 as Compagnie Générale des Eaux, Veolia Environnement, France's leading provider of water services, was fully divested from its parent company, Vivendi Universal, in 2006. Veolia started expanding into international markets in the early 1980s, focusing mainly on Spain, the United Kingdom, and the United States. Although its strength in the French market reduced its reliance on international expansion, Veolia expanded into much of Europe during the 1990s as well as North America, the Middle East, Africa, and Asia. In the early 2000s, Veolia launched a major retrenchment and now largely focuses on Europe, China, and selected developing countries. Veolia operates in some developing countries through subsidiary Veolia Water Africa, Middle East, and India (Veolia Water AMI). In 2007, the International Finance Corporation (IFC), the private sector arm of the World Bank, and PROPARCO, a development agency of the French government, acquired 13.89 percent and 5.56 percent of Veolia Water AMI, respectively. In 2010, Veolia earned approximately $8.0 billion in revenues outside of France, accounting for 18 percent of the $45.2 billion in total revenues earned by Veolia that year.

Suez Environnement

Founded in 1880 as Société Lyonnaise des Eaux et de l'Eclairage, Suez Environnement, France's second-largest water services company, was the leading provider of global water services in 2010, as measured by the number of people served by its water and wastewater operations. Suez estimates that one billion people currently receive water services from its plants, including 20 percent of the Chinese population. After expanding rapidly around the world in the 1990s—often through contracts made via its water and sewage engineering firm, Degrémont—Suez began to severely curtail its international expansion in the early 2000s. Starting in 2003, Suez began to pull out of many developing countries, either by selling contracts or by turning operations over to government entities. By 2010, Suez's international expansion activities were largely confined to China, India, and the developed countries of Europe and North America. In 2010, revenues from Suez's international water operations, which exclude Europe, totaled $4.8 billion, representing 27 percent of $18.1 billion in total revenues earned by Suez in that year.

Source: Pinsent Masons, *Pinsent Masons Water Yearbook 2011–2012,* 2011, 236–39, 265–66, Veolia Web site.

(China, $2.9 billion); American Water Works Company (United States, $2.7 billion); and Sydney Water Corporation (Australia, $2.4 billion).[25] Marketline also reports that, among those companies with wide ranging international operations, the largest companies, measured by people served, include Veolia Environnement and Suez Environnement as well as RWE (Germany), SAUR (France), FCC (United States), ACEA S.p.A. (Italy), Sembcorp (Singapore), and Severn Trent (United Kingdom). According to the Orbis database, the top ten water companies as ranked by recent-year operating revenues include firms based in the United States, the United Kingdom, France, Brazil, Spain, and Korea (table 3.1). Notable omissions from this list include Suez as well as large water providers in Italy and Japan.

[25] MarketLine, "Global Water Utilities," July 2012, 20–29; MarketLine, "Water Utilities in the United States," July 2012, 20–21; MarketLine, "Water Utilities in Asia-Pacific," July 2012, 20–27; MarketLine, "Water Utilities in Brazil," July 2012, 21–23.

TABLE 3.1 Leading suppliers of water and wastewater services

Rank	Company name	Country	Last year data available	Operating revenue (turnover), million $	Number of employees
1	Veolia Environnement	France	2011	38,361	258,400
2	Veolia Water North America-Northeast, LLC	United States	2010	23,000	2,000
3	Korea Water Resources Corp.	Korea	2011	5,492	([a])
4	Veolia Eau–Compagnie Générale des Eaux	France	2010	5,399	10,155
5	Companhia de Saneamento Básico do Estado de São Paulo	Brazil	2011	5,387	14,896
6	Société Lyonnaise des Eaux France	France	2011	3,137	7,545
7	Los Angeles Department of Water and Power	United States	2011	3,126	8,000
8	Kemble Water Holdings Limited	United Kingdom	2011	2,992	4,562
9	Severn Trent PLC	United Kingdom	2011	2,835	8,051
10	Sociedad General de Aguas de Barcelona, S.A.	Spain	2009	2,667	10,425
	Total for top 10			92,396	324,034

Source: Orbis Companies database.

[a]Not available.

Profiles of Key Country Markets

United States

The U.S. water services market, measured by revenues in 2011, was valued at $163.4 billion,[26] representing approximately 22 percent of the global water market. In the five years leading up to 2011, the U.S. water market grew at a CAGR of about 5 percent. Industrial users represent 46 percent of the market, while agricultural and domestic household represent 41 percent and 13 percent, respectively. The largest companies operating in the U.S. water market include the American Water Works Company, Aqua America, and California Water Services Group.[27]

The U.S. market comprises more than 50,000 community water systems (CMSs), ranging from small towns to metropolitan areas. Most of these systems are owned and controlled by a utility owned by the local government, with monopoly rights to provide services within that CMS. Private water companies, which mainly enter the U.S. market by acquiring a local utility, represent a small but growing presence in the U.S. market. Due to the highly fragmented structure of the U.S. water services market, there is very little, if any, competition between water suppliers.[28]

Private sector participation is frequently resisted by CMSs, due to concerns about rate hikes. However, poor service, loss of management control, aging water systems, declining tax revenues, and stricter environmental regulations in the United States will likely motivate greater private sector participation in water services over the next decade. The U.S. Environmental Protection Agency estimates that more than $1 trillion will be required just to maintain the country's current water systems. Opportunities in the U.S.

[26] MarketLine is used in this chapter's country profiles because it is the only source of revenue data that provides an extensive breakout by country.

[27] MarketLine, "Water Utilities in the United States," July 2012.

[28] Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012; Bueno, "Sewage Treatment Facilities in the U.S.," May 2012; Standard & Poor's, *Environmental and Waste Management*, March 29, 2012.

market will likely result from addressing its many widespread problems, including infrastructure deterioration, water shortages (including droughts), outdated wastewater treatment processes, high levels of water usage and aquifer depletion, and contamination of surface water, groundwater, rivers, and lake sediment.[29]

China

The Chinese water services market was valued at about $54 billion in 2011, representing 7 percent of the global water market. In the five years leading up to 2011, the Chinese water market grew at a CAGR of about 3 percent. Agricultural users accounted for 63 percent of the Chinese water services market, whereas industrial and domestic households represented 25 percent and 13 percent, respectively. In 2011, the largest companies serving the Chinese water market included Beijing Capital Company, Beijing Enterprises Water Group, the Hong Kong & China Gas Company, Nanhai Development Company, Qianjiang Water Resources Development Company, and Shanghai Chengtou Corporation.[30]

The Chinese market comprises thousands of state or regional utilities with monopoly rights to serve a designated service area. Due to its highly fragmented market structure, competition between water suppliers is very low. Although private sector companies currently represent a fairly small share of the Chinese market, the government actively solicits private sector participation, and opportunities abound. While China began privatizing water systems in the 1970s, it formally opened the water treatment and supply network to foreign investment in 2002. Over the past 10 years, public-private partnerships, joint ventures with local municipalities, and a wide variety of project finance-based concessions have become commonplace in China. Although there is already strong competition among foreign investors, rapid urbanization and ongoing opportunities in infrastructure expansion and upgrades will likely further spur private investment in the Chinese water services industry.[3132] Other opportunities for global firms include services designed to address water pollution and scarcity.[33]

India

In 2011, the Indian water services market was valued at $21.1 billion, representing approximately 3 percent of the global water market. In the preceding five years, the Indian water market grew at a CAGR of about 7 percent. The agricultural sector represented 90 percent of the India market in 2011, followed by the domestic household and industrial sectors, which accounted for 8 percent and 2 percent, respectively. In 2011, the largest water companies serving the Indian water services market were Hyderabad Metropolitan Water Supply and Sewage Board, Ion Exchange (India), and VA Tech Wabag.[34]

Although local and regional monopolies serve larger towns and cities, water markets in rural areas, which represent a huge share of the population, are highly informal and based

[29] Smith, "Water Supply and Irrigation Systems in the U.S.," June 2012; Smith, "Sewage Treatment Facilities in the U.S.," May 2012; Standard & Poor's, *Environmental and Waste Management*, March 29, 2012.

[30] MarketLine, "Water Utilities in China," July 2012.

[31] Suez is among those foreign firms participating in the Chinese water services market (see p. 3-10).

[32] White et al., *Water Markets of the United States and the World*, November 1, 2010.

[33] Ibid.

[34] MarketLine, "Water Utilities in India," July 2012.

upon collection from local wells, tanks, and streams. Due to the fragmented and informal nature of the market, very little competition exists between suppliers. Although poverty and a general resistance to water privatization schemes are widespread in India, private sector participation in the India water services market is increasing, resulting in large part from water shortages and the inability of the government to finance and undertake infrastructure expansion/upgrade projects.[35] Global firms will likely find opportunities in India's water market if they can offer solutions to its many problems, including infrastructure scarcity and deterioration, lack of capital for infrastructure development, growing water scarcity, widespread contamination of surface and groundwater (including by waterborne diseases), and climate variability leading to sporadic water collection, floods, and droughts.[36]

EU

In 2011, the collective water services markets of the 27 country members of the EU were valued at $260.1 billion, representing 36 percent of the global water market. In the preceding five years, the EU water market grew at a CAGR of approximately 4 percent. In the EU, industrial users accounted for about 49 percent of the market, followed by the users in the agricultural and domestic household sectors, which represented 31 percent and 20 percent of the market, respectively. The leading companies in the EU water market include Veolia Environnement (France), Suez Environnement (France), Hera S.p.A. (Italy), and Iren S.p.A. (Italy).[37]

The EU water services market is dominated by thousands of local or regional utilities with monopoly rights, although private water companies represent a larger share of the market than is common in many countries/regions, largely due to the activities of the leading French water companies. As in many markets, competition between suppliers of water services tends to be low. Due to the developed nature of water systems in most European countries, EU regulations stand as the major driver of the European water market,[38] although the rate of compliance varies greatly among member states.[39] EU water regulations and funding for water projects provided by the EU Structural and Cohesion Funds will likely catalyze ongoing private sector participation in the European water services market. Other opportunities for private sector companies also exist in infrastructure repair and upgrade activities, as well as the cleanup and treatment of contaminated surface and groundwater.[40]

[35] White et al., *Water Markets of the United States and the World,* November 1, 2010.
[36] Ibid.
[37] MarketLine, *Water Utilities in Europe*, July 2012.
[38] For example, the European Commission adopted the Water Framework Directive (WFD) to standardize and harmonize water regulations across the EU member countries; such regulations address the treatment of wastewater and stipulate water quality standards. Component parts of the WFD include, *inter alia*, Bathing Water (76/160, replaced by 2006/07), Drinking Water (80/778, as amended by 98/83), Urban Wastewater Treatment (91/271), Nitrates (91/676), Integrated Pollution Prevention & Control (96/61, codified as Directive 2008/1/EC), and Sewage Sludge (86/278).
[39] White et al., *Water Markets of the United States and the World,* November 1, 2010.
[40] Ibid.

Trade and Investment

Trade in Water Services

Firms participate in international trade in water services primarily by establishing a commercial presence in another country. Most commonly, a water services company from one country acquires an ownership stake in a water utility in another country, making the utility its affiliate. A water company may also establish offices in another country, either to manage and operate water facilities or provide water consulting services.[41] Data pertaining to international trade in water services are very limited because (1) such data are not available from government sources; and (2) most international water companies do not break out international revenues by country of origin.

Between 2005 and 2009, both U.S. exports and imports of water services declined by slightly less than 2 percent annually, resulting in an annual trade deficit that fell gradually from $2.5 billion to $2.3 billion. In 2010, U.S. exports of water services continued to decline, falling by 0.8 percent to $314 million, while imports grew by 3.4 percent to $2.7 billion, pushing the U.S. trade deficit up slightly to approximately $2.4 billion (figure 3.3).[42]

International trade in water services via commercial presence surged in the 1990s as large multinational water firms, primarily based in France and Germany, began to acquire water utilities, or provide water services via operations and maintenance (O&M) or lease arrangements in other countries.[43] However, regulatory, public relations, and financial difficulties associated with many water services acquisitions/projects worldwide caused many international water firms to pull out of some countries, instead focusing their attention and financial resources on a smaller number of carefully selected countries. Nonetheless, several large water companies remain active in foreign markets. In China, for example, Suez Environnement is responsible for 16 major contracts, including an O&M contract to provide wastewater services in Dalian, China; a 40-year concession to provide water services in Chongqing; and a 30-year build-operate-transfer (BOT) arrangement to provide bulk water services in Panjin.[44]

Foreign Investment in Water Services

Although water markets in most countries were historically dominated by government-owned utilities, private companies started to enter the water market beginning in the 1980s, a phenomenon known in the industry as private sector participation. Private sector participation can occur in a number of different ways, such as through O&M and lease contracts, concessions, and acquisition of existing utilities. Under O&M contracts, water

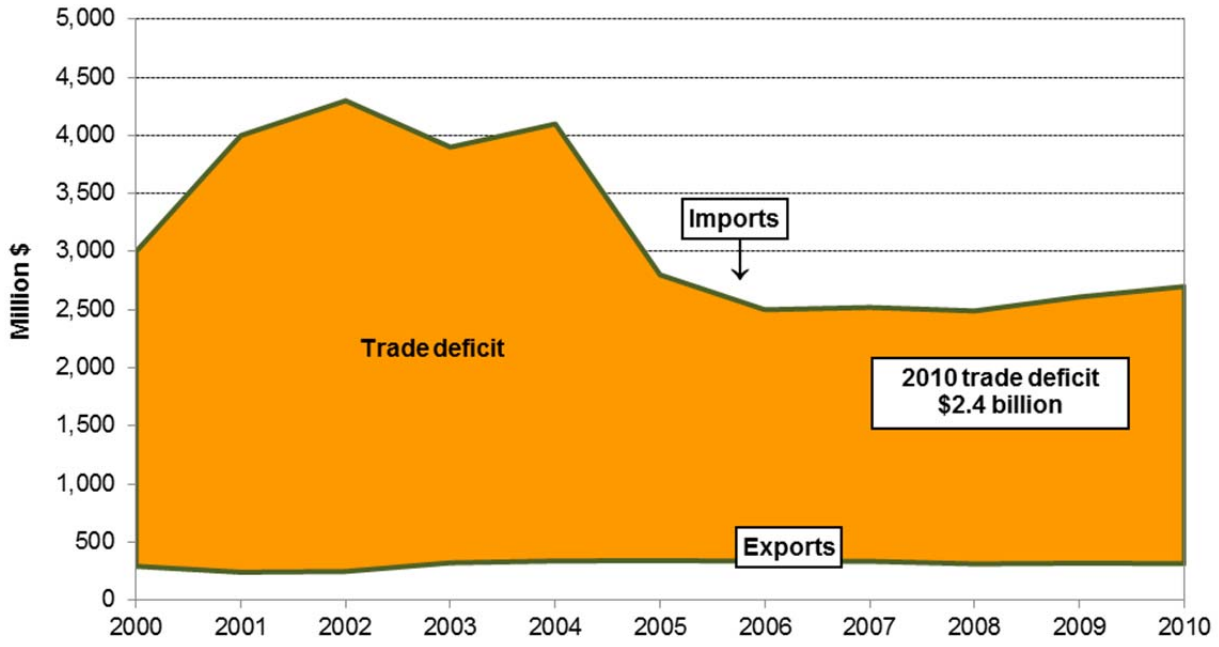
[41] In instances where a consultant or employee of a water company travels to another country to provide consulting or management services, international trade is said to occur via the presence of natural persons (mode 4).

[42] EBI, "U.S. Environmental Trade Balance, 2008," spreadsheet received by email, November 29, 2012.

[43] French firms Veolia Environnement and Suez Environnement and German firm RWE were among the companies that pursued such acquisitions and contracts in the 1990s. For more information, see USITC, *Private Sector Participation in the Water and Wastewater Services Industry*, 29-33.

[44] Pinsent Masons, *Pinsent Masons Water Yearbook 2011–2012,* 2011, 252–253.

FIGURE 3.3 Water treatment works and water utilties: U.S. cross-border trade resulted in a U.S. trade deficit each year during 2000–2010



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

companies operate water facilities on a fixed-fee basis, whereas lease contracts typically cover not only asset operation but also tariff negotiation and development. Under both O&M and lease arrangements, infrastructure improvements remain the responsibility of local utilities. Concession contracts grant private water companies the right to provide a service with a degree of exclusivity within a designated geographic area. Companies are usually required to make up-front capital investments under concessions, and as a result, a variety of project financing arrangements are used to increase the probability that subsequent cash flows from the project will allow both debt repayment and a reasonable return on investment. Common contract arrangements in the water industry range from build-own-operate (BOO) and BOT arrangements, in which a private company provides a specific service to a municipality for a specific capital project, to full utility concessions, which grant a private company full responsibility for both capital spending and service provision. Acquisitions involve the complete sale and ownership transfer of a utility's assets to a private water company.[45]

Private companies operating in the water sector range from small local players to large multinational conglomerates that operate in many countries across the globe. From 1987 through 2011, an estimated 1,217 private sector participation contracts were awarded, providing water and/or wastewater services to more than 790 million people worldwide. Of the contract total, approximately 35 percent of projects covered water services, whereas 38 percent covered wastewater and 27 percent covered both

[45] Other project finance arrangements used in the water industry include build, operate, train, transfer (BOTT) and design, finance, build, operate transfer (DFBOT). Pinsent Masons, *Pinsent Masons Water Yearbook, 2011–2012,* 2011, 414.

subsectors.[46] Over the past 25 years, the number and volume of contracts awarded grew at a steady pace, with particular strength noted in Algeria, Brazil, China, Egypt, and India. Since 2008, however, the pace has slowed somewhat, due largely to economic weakness and financial market volatility.[47] In recent years, the market has been driven by small, local water contracts, as opposed to the mega-contracts common in the 1990s. The dominant share of recent contract awards has been in the water sector.[48]

After significant expansion in the 1990s, a period of retrenchment began as many companies began to reconsider their international investments, particularly in developing countries. Such retrenchments occurred for a variety of reasons, including poor financial performance, disputes with regulators, and conflicts with the local populace. Over the past few years, for example, the German firm RWE withdrew from all countries except Germany and a few countries in Central Europe. Similarly, the French firm Suez Environnement withdrew from many overseas markets, focusing attention instead on China and a few countries in the Middle East and North Africa.[49] Currently, most of the activity in the international water market is focused on OECD countries, along with China and India.[50]

[46] Pinsent Masons, *Pinsent Masons Water Yearbook, 2011–2012*, 2011, 6–8.
[47] Ibid., 8.
[48] Pinsent Masons, *Pinsent Masons Water Yearbook, 2011–2012*, 2011, 10.
[49] Ibid., 24.
[50] Ibid., 24 and 28.

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CHAPTER 4
Solid and Hazardous Waste Services

Industry Characteristics

Description of Services and Overview of the Structure of the Industry

Solid and hazardous waste management services include the collection, transfer, treatment, and disposal of solid and hazardous waste (box 4.1). Solid and hazardous waste is usually collected at the point of generation by trucks and transported to transfer stations, where it is consolidated and compacted to increase its density and decrease its volume. The waste is then transported by transfer trucks, barges, or railcars to treatment and disposal facilities.[1] At this point, the waste may be landfilled,[2] incinerated, processed to remove recyclable materials, or composted.[3]

In developed countries, formal waste management services are widely available in cities and towns and in industrial areas. In these countries, the solid and hazardous waste services industry comprises a mixture of publicly owned firms,[4] privately owned firms, and local and municipal governments. Large publicly and privately owned firms are often vertically integrated and provide the full range of waste management services, including the collection, transfer, treatment, and disposal of waste.[5] Small firms frequently provide only a subset of these services, contributing to the industry's fragmentation.[6] [7] In recent years, local and municipal governments have reduced their role in waste management by outsourcing these activities to private firms, both for financial reasons and because some

[1] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 6.

[2] Landfills in developed countries involve much more than simply dumping waste into a large excavated area. Landfills are generally designed, built, operated, and eventually closed to exacting standards prescribed by governmental regulations to limit air and water pollution. The permitting and approval process can be lengthy, and the cost is high. The activities involved with a landfill include excavating the landfill site; constructing liners to prevent contamination of the groundwater by the waste; continuously spreading, compacting, and covering the waste with the appropriate material; and finally capping and closing the landfill site. Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 5, 11.

[3] The waste stream sent to incinerators and landfills may generate additional economic activity. Waste may be burned in waste-to-energy facilities to produce steam and then electricity to power homes and businesses. (The waste can also be burned and the heat allowed to escape into the atmosphere.) As the waste in a landfill decomposes, methane and other gases are produced; the methane gas can be gathered and used to produce electricity and heat (landfill gas projects). Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 8.

[4] Publicly owned firms mentioned here are firms whose shares are traded on stock exchanges.

[5] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 9; Republic Services, Inc., "2011 Annual Report and Form 10-K," 2012, 4. Vertical integration is attractive because it enables firms to achieve economies of scale and lower their operational costs.

[6] Local and municipal governments vary in the waste management services they provide customers.

[7] In the United States, residential waste collection services are frequently provided under contracts with apartment owners and homeowners' associations or by subscriptions with individual households; industrial and commercial waste collection services are frequently provided under customer service agreements ranging from one to five years. Waste Connections, Inc., "2011 Annual Report and Form 10-K," 2012, 4.

BOX 4.1 Solid and hazardous waste

Solid waste is typically differentiated by type. **Municipal solid waste** is waste from households, office buildings, restaurants, stores, schools, and other similar establishments, and includes such things as food waste, clothes, packaging material, yard waste, bottles, cans, newspapers, magazines, and electronic equipment. **Industrial waste** is waste generated by businesses engaged in production and manufacturing activities. **Construction waste** and **demolition waste** are generated from construction and demolition activities, and **agricultural waste** and **mining waste** come from the agricultural and mining sectors.[a]

Statistical data for municipal solid waste are collected by many countries, but these data may not be strictly comparable due to differences in what countries consider as municipal solid waste. Statistical data for the other categories of solid waste are not as prevalent or reliable, since these data often go uncollected in many countries, and there is some overlap in the definitions of these categories between countries.[b]

Hazardous waste is any solid waste that is harmful to individuals and/or the environment when not handled properly, including waste that is ignitable, infectious, reactive, corrosive, or toxic.[c] Although hazardous waste can come from any of the waste streams noted above, it is generally segregated from the rest of these waste streams for collection, treatment, and disposal purposes. Separate data and statistics are available for solid and hazardous waste in some instances. Hazardous waste is much smaller in volume than solid waste.[d]

[a] Chalmin and Gaillochet, "From Waste to Resource," 2009, 9.
[b] Chalmin and Gaillochet, "From Waste to Resource," 2009, 11.
[c] National Solid Wastes Management Association, "Hazardous Waste Fact Sheet," http://www.environmentalistseveryday.org/publications-solid-waste-industry-research/information/faq/hazardous-waste-disposal.php (accessed August 29, 2012).
[d] Chalmin and Gaillochet, "From Waste to Resource," 2009, 10.

believe that the private sector is better equipped to handle these tasks. Nonetheless, local and municipal governments remain significant players in the industry.[8]

In developing countries, formal waste management services are typically available in the more affluent urban areas and are typically supplied by local and municipal governments. These services include the collection, transfer, and disposal of solid and hazardous waste into landfills. In recent years, the efficient and timely provision of these services by government entities has been hampered by declining municipal budgets, corruption, lax supervision of employees, insufficient space for landfills, increasing costs, and inadequate capacity at transfer stations. Such problems have presented opportunities to local, private firms, which have begun to provide waste management services in these countries. Large foreign waste management firms have also begun to take notice of opportunities in this area.[9] For example, Dowa Eco-System Co., Ltd., a Japanese waste management firm, has invested in waste management operations in Thailand and Indonesia.[10]

In some developing countries, individuals earn a living picking through the mounds of garbage in unregulated dump sites, collecting recyclable materials (e.g., paper, plastic, and glass) for eventual sorting and resale.[11] Little or no reliable data are available on the volume of waste handled in this manner; nevertheless, anecdotal evidence suggests that

[8] Republic Services, "2011 Annual Report and Form 10-K," 2012, 2, 6; Chalmin and Gaillochet, "From Waste to Resource," 2009, 20.
[9] Chalmin and Gaillochet, "From Waste to Resource," 2009, 20, 26; International Solid Waste Association, "Globalization and Waste Management," July 2012, 30.
[10] Dowa Eco-System Co. website, http://www.dowa-eco.co.jp/en/global.html (accessed November 8, 2012).
[11] International Solid Waste Association, "Globalization and Waste Management," July 2012, 5.

there are a large number of people working in this informal sector and that the volume of waste involved is sizable.[12]

Factors Affecting Supply and Demand for Solid and Hazardous Waste Services

Supply

Regulation is the principal factor affecting the solid and hazardous waste services industry's ability to provide waste management services to customers. Waste management firms must comply with extensive environmental, health, safety, and transportation regulations at the federal, state, and local levels,[13] and the costs of compliance, as well as the uncertainty of the regulatory environment, may undermine the ability of waste management firms to enter new markets or to expand services in existing markets.[14] For instance, in order to build or operate an incinerator, landfill, or transfer station, waste management firms must acquire government permits and approvals, and comply with regulations affecting greenhouse gas emissions from landfills and other disposal facilities. As noncompliance may make it difficult or impossible for firms to launch or continue operations, firms devote significant resources to satisfying these regulations.[15]

Several other factors also may make it difficult for waste management firms to find new market opportunities. First, entry into the waste disposal segment of the industry is constrained by the high capital costs of developing and operating landfills.[16] Second, despite increasing private sector participation in waste management markets, the provision of waste management services by local and municipal governments continues to preclude private sector involvement in certain areas. Third, where private sector firms perform waste collection, they frequently provide these services under annual or multiyear contracts, limiting opportunities for new competitors to gain market share. These contracts may cover both the collection of waste and the recycling of materials, putting firms that lack their own recycling facilities at a competitive disadvantage.[17] Finally, waste collection firms that do not own disposal facilities must pay fees to dispose of waste, placing them at a cost disadvantage relative to vertically integrated firms.[18]

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[12] Chalmin and Gaillochet, "From Waste to Resource," 2009, 21.

[13] The management of hazardous waste is frequently subject to a different set of laws and regulations. Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 6.

[14] There have not been any new hazardous waste landfills or hazardous waste incinerators built in the United States within the past decade. IBIS World, "Industry Report 56221 Waste Treatment & Disposal," April 2012, 22.

[15] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 6, 11. The regulatory environment for the provision of solid and hazardous waste services in lesser developed countries is generally considerably less restrictive than that in developed countries.

[16] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 5. In addition, to operate efficiently and profitably, landfills and incinerators need a steady stream of waste to process, which means they must have access to a sizable share of the waste collected in the area. But this access may be difficult for a new firm to obtain if most or all of the waste stream is already collected and processed by existing competitors. IBIS World, *Waste Treatment and Disposal*, April 2012, 22.

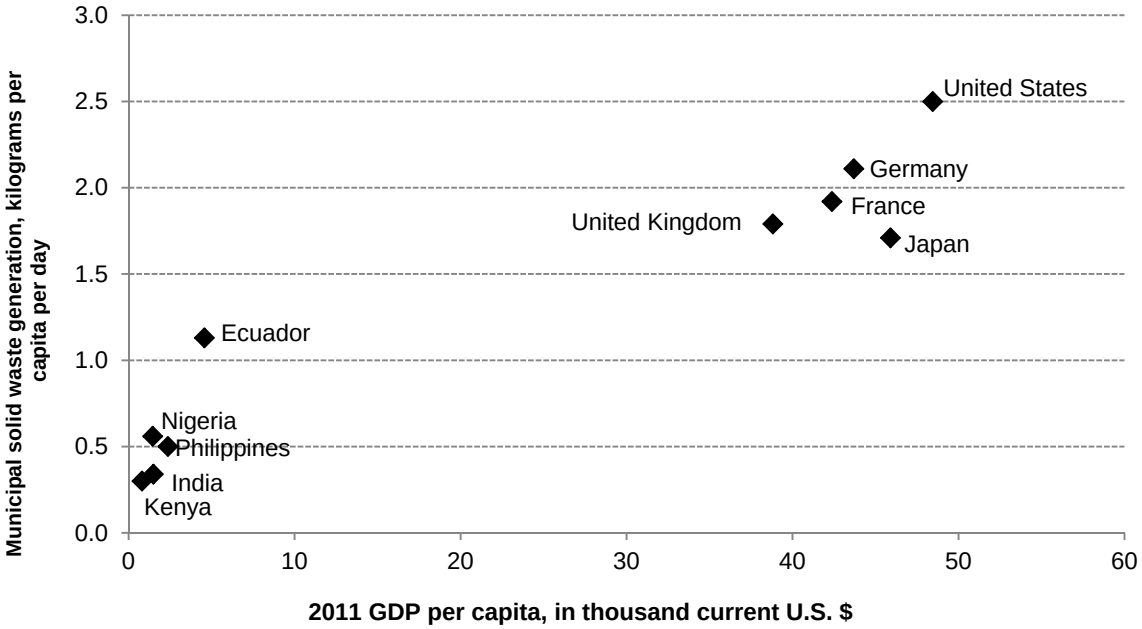
[17] IBIS World, *Waste Collection Services in the U.S.,* April 2012, 24, 25.

[18] Ibid., 24.

Demand

Economic development, population growth, and increased environmental awareness have a significant impact on demand for solid and hazardous waste services.[19] Greater affluence and the higher levels of consumption enjoyed by increasing numbers of people lead to higher waste generation rates and, thus, greater demand for waste management services (figure 4.1).[20] The type of waste generated by both developed and developing countries is also changing, raising the demand for greater sophistication and expertise in the handling and treatment of waste. For example, growth in the use of consumer electronic products has increased the amount of waste containing a complex mix of plastics and metals.[21]

FIGURE 4.1 Municipal solid waste generation and GDP per capita in selected countries



Sources: World Bank, "What a Waste," March 2012, Annex J; World Bank, World Development Indicators.

Note: Countries were selected for illustrative purposes and based upon data availability.

Regulations mandating the collection and treatment of solid and hazardous waste also spur demand for waste treatment services. In developed countries, the prevalence of such regulations typically results in waste collection rates of 100 percent, whereas the lack of similar regulations or inadequate enforcement mechanisms in many lesser developed countries lowers waste collection rates (figure 4.2).[22] As public perceptions concerning

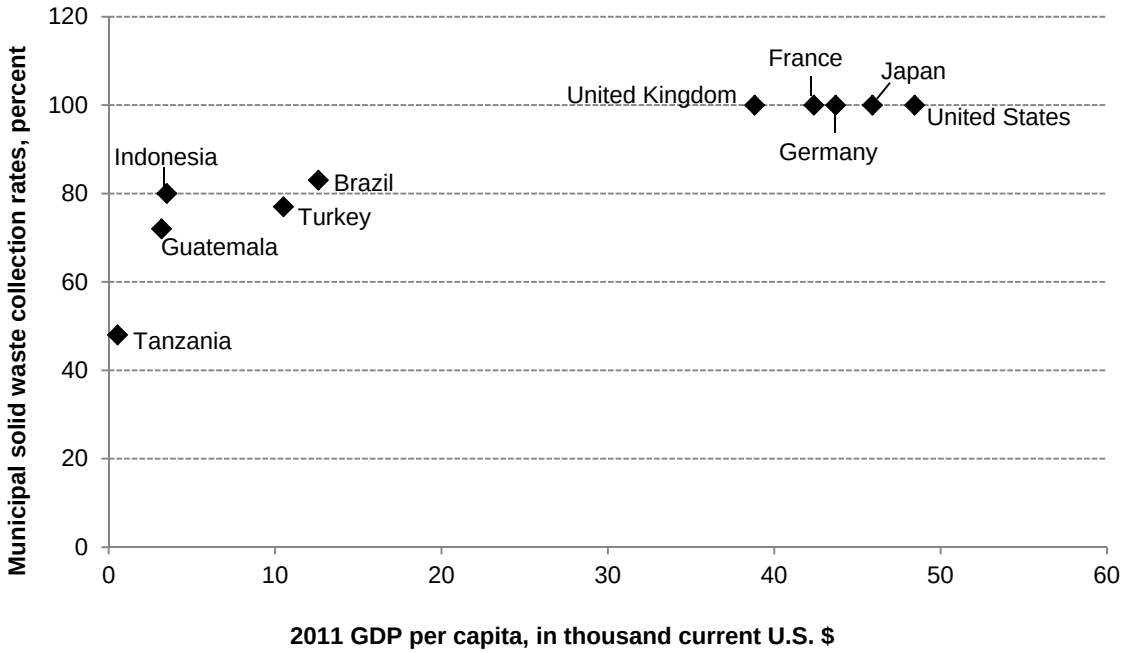
[19] European Commission, "Being Wise with Waste," 2010, 2.

[20] A decade ago, 2.9 billion city dwellers generated an annual amount of 680 million tons of waste. Currently, an estimated 3 billion city dwellers generate 1.3 billion tons of waste. By 2025, it is projected that 4.3 billion city dwellers will generate 2.2 billion tons of waste per year. World Bank, "What a Waste," March 2012, ix.

[21] European Commission, "Being Wise with Waste," 2010, 2.

[22] Chalmin and Gaillochet, "From Waste to Resource," 2009, 16.

FIGURE 4.2 Municipal solid waste collection rates and GDP per capita in selected countries



Sources: World Bank, "What a Waste," March 2012, Annex K; World Bank, World Development Indicators.

Note: Countries were selected for illustrative purposes and based upon data availability.

waste management evolve, so too do the legal and regulatory frameworks concerning waste management, creating demand for new types of waste management services.[23] For instance, within the past decade, both the United States and the EU have introduced regulations requiring a reduction in the amount of waste going into landfills, thereby increasing the demand for recycling and composting services in those countries.[24]

The Global Industry

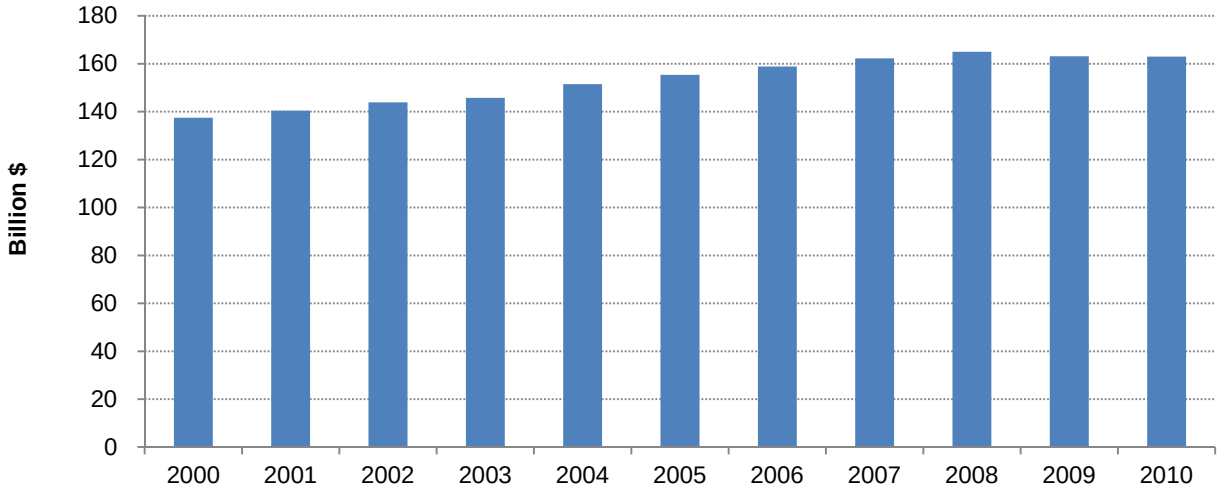
Global Market for Solid and Hazardous Waste Services

The global market for solid and hazardous waste services increased at a CAGR of 1.9 percent between 2000 and 2009, then declined marginally in 2010 from the 2009 level (figure 4.3). In the more recent period (2005–10), the global market for solid

[23] IBIS World, "Industry Report 56211 Waste Collection Services in the U.S." April 2012, 34, 35.

[24] IBISWorld, *Waste Collection Services in the U.S.,* April 2012, 34; European Commission, "Being Wise with Waste," 2010, 7. Demand for recycling has also been driven by the growing recognition that waste has value, accompanied by increased efforts to recover this value. An estimated 75 percent of global waste produced today has some value in it. Veolia Environnement, "2011 Annual and Sustainability Report," 2012, 39. A thriving global market in the international trade and reuse of recycled paper products, metal products, glass products, and plastic products has stimulated greater efforts worldwide to collect and recycle these secondary goods. Chalmin and Gaillochet, "From Waste to Resource," 2009, 27.

FIGURE 4.3 The global market for solid and hazardous waste services increased steadily between 2000 and 2008, declining slightly thereafter



Source: Environmental Business International, "The Global Environmental Market by Segment." *Environmental Business Journal*, various issues (2002–12).

and hazardous waste services grew steadily between 2005 and 2008 ($155.4 billion to $165.0 billion), and then declined in the next two years. The recession during 2008–09, which caused a decline in personal consumption and industrial activity and thus in waste generation, weakened the pricing environment for waste management services in some countries; it also dampened revenues for solid and hazardous waste services.[25] The market in 2010 ($163.0 billion) was 4.9 percent above that in 2005. This modest growth was likely a result of increased global waste generation during the period, which was moderated by source reduction efforts in the United States, the EU, and Japan.[26]

Leading Countries and Suppliers

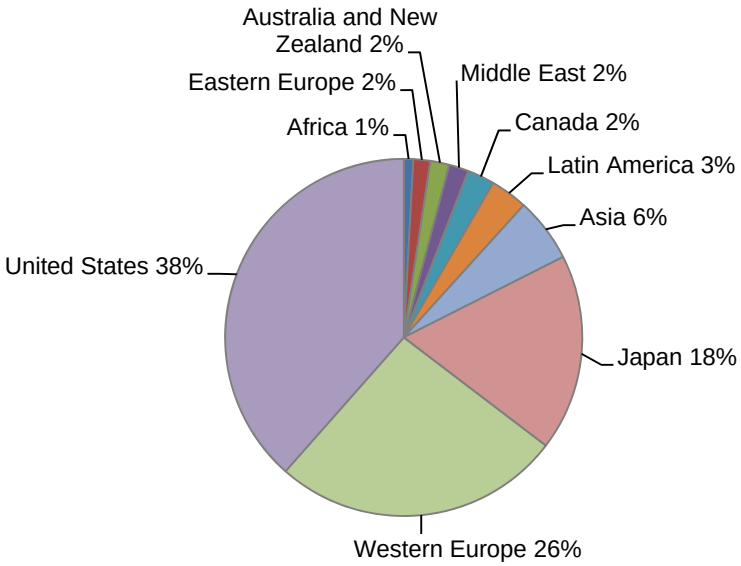
Developed countries account for the majority of revenues earned by the global solid and hazardous waste services industry (figure 4.4). In 2010, the United States accounted for 38 percent of these revenues; Europe, 28 percent; and Japan, 18 percent. These countries generate the most waste and have the private and public sector resources to collect, treat, and dispose of virtually all of it.

In the United States, large suppliers of solid and hazardous waste services include Waste Management, Inc., and Republic Services, Inc. In the EU, Veolia Environnement, Suez Environnement, and Remondis AG & Co. KG are leading waste management firms, and in Japan, Dowa Eco-System Co., Daiseki Co., Ltd., and JFE Kankyo Corporation have sizable waste management operations. The competitiveness of these firms is partly a

[25] Standard & Poor's, "Industry Surveys, Environmental and Waste Management," March 29, 2012, 39; Veolia Environnement, "2011 Annual and Sustainability Report," 2012, 2, 4.

[26] Source reduction (waste prevention) is a way of managing material resources to minimize or eliminate their entry into the waste stream. Source reduction involves the design and manufacture of products that are reusable, last longer, and use fewer and lighter materials. It also involves such things as using yard waste for a backyard compost pile and leaving grass clippings on the lawn, rather than putting this material out for pickup by the local waste management firm. EIA/WASTEC, "Source Reduction Fact Sheet," http://www.environmentalistseveryday.org/print.php (accessed August 29, 2012).

FIGURE 4.4 Solid and hazardous waste services: The United States and Western Europe had the largest shares of global revenue in 2010



Total = $162.9 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

product of size, vertical integration, and legal and regulatory expertise. Larger firms may achieve greater economies of scale and lower costs than smaller firms by providing the full range of waste management services (collection, transfer, treatment, and disposal of waste). Such vertically integrated firms have little need to pay competitors to provide certain waste management services, and customers increasingly favor waste management firms that can handle all of their waste management needs. Larger firms may also have better access to capital, an important advantage given the high costs of building and operating landfills and incinerators. Finally, firms with more capital and legal resources than their competitors may be better able to navigate the complex legal and regulatory environment associated with the waste management industry.[27]

The top 10 firms in the global waste management industry, measured by operating revenue as reported in the Orbis database, are shown in table 4.1.[28] These data generally comport with information gathered from other sources, with the caveat that the Orbis database may list companies in the waste management industry whose reported revenue may include significant revenue earned from other lines of business unrelated to waste management services.

[27] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 5; IBISWorld, *Waste Treatment and Disposal*, April 2012, 19; IBISWorld, *Waste Collection Services in the U.S.*, April 2012, 21.

[28] In an attempt to identify any large providers of solid and hazardous waste services not previously uncovered via other avenues of research, two searches were performed in the Orbis database (Bureau van Dijk) for companies in the waste management industry, and the results sorted by operating revenue. These included a keyword search and a search based on firms' classification under the North American Industry Classification System (NAICS). The results from the NAICS-based search were more representative of the information collected from other sources than the results from the keyword search.

TABLE 4.1 Leading suppliers of solid and hazardous waste services

Rank	Company name	Country ISO Code	Last year data available	Operating revenue (turnover) million $	Number of employees
1	Waste Management Inc.	United States	2011	13,378	44,300
2	Cemex España, SA	Spain	2011	10,970	29,966
3	Republic Services Inc.	United States	2011	8,193	30,000
4	Alba SE	Germany	2011	2,933	1,959
5	United Trucking Inc.	United States	2011	2,800	6
6	Wheelabrator Connecticut Inc.	United States	2011	2,559	43,000
7	Veolia Environmental Services North America Corp.	United States	2011	2,261	32,950
8	Clean Harbors Inc.	United States	2011	1,984	8,320
9	EnergySolutions, Inc.	United States	2011	1,816	5,700
10	Waste Management Holdings, Inc.	United States	2010	1,758	18,000
	Total for top 10			48,652	214,201

Source: Orbis Companies database.

Profiles of Key Country Markets

United States

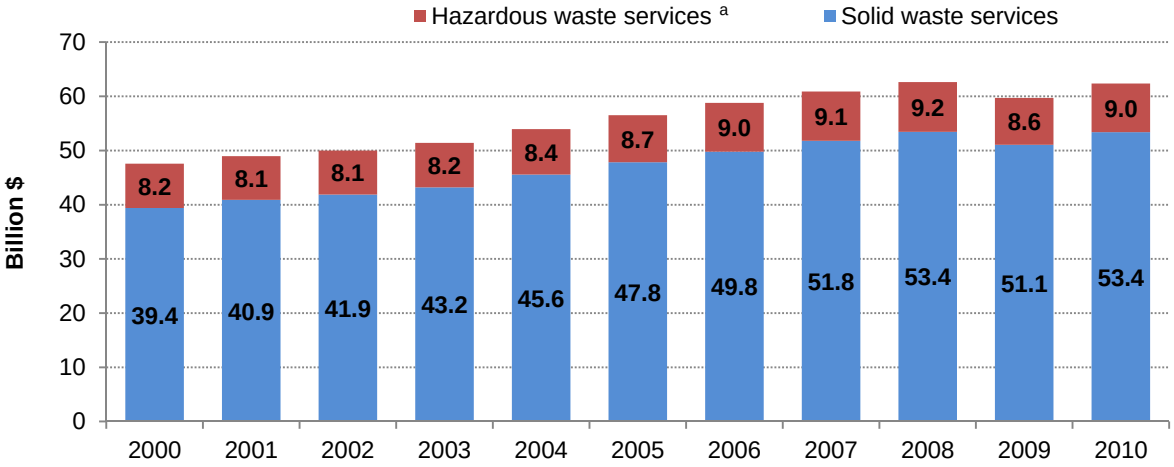
The United States is the world's largest solid and hazardous waste services market. The U.S. market increased at a CAGR of 2.6 percent between 2000 and 2009 and increased by 4.5 percent during 2009–10 (figure 4.5). In the more recent period (2005–10), the U.S. market fluctuated; it grew steadily between 2005 and 2008, declined in 2009 during the recession, and then rebounded in 2010. In 2010, total employment in the industry was 321,600, 6.7 percent higher than in 2005 (figure 4.6). In terms of both revenues and employment, the U.S. solid waste services business is roughly six times the size of the country's hazardous waste services business. Overall, collection activities accounted for 55 percent of 2010 solid waste revenues; disposal activities, 33 percent; and transfer and processing, 12 percent.[29]

The United States generated 249.9 million tons of municipal solid waste in 2010, up from 2009, but below 2005 levels (table 4.2). A decline in personal consumption, precipitated by the economic downturn in 2008–09, caused a drop in the generation of municipal solid waste during these two years.[30] Of all municipal solid waste generated in 2010, 26 percent was recovered for recycling; 8.1 percent was recovered for composting; 11.7 percent was combusted and the heat energy recovered; and 54.2 percent was deposited into landfills (or combusted and the heat energy not recovered). Compared with data for 2000, these percentages show a gradual shift in the United States over the past decade away from landfilling and incineration toward recovery for recycling and composting.

[29] Standard & Poor's, "Industry Surveys, Environmental & Waste Management," March 29, 2012, 20. In 2010, publicly owned firms accounted for an estimated 60 percent of the revenues generated from the provision of solid waste services, private firms for 17 percent of the revenues, and municipal and local governments for 23 percent.

[30] Waste Connections, Inc., "2011 Annual Report and Form 10-K," 2012, 17.

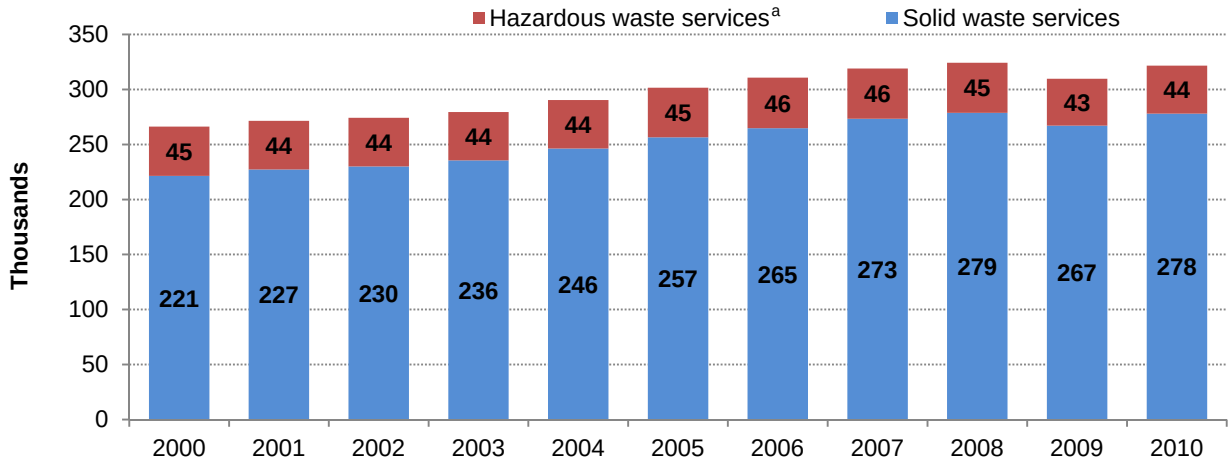
FIGURE 4.5 U.S. solid and hazardous waste services revenues grew during 2000–2008, falling slightly in 2009–10



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

[a]Includes data for utility/commercial nuclear waste, which accounts for approximately 11 percent of the hazardous waste services revenue.

FIGURE 4.6 Employment in the U.S. solid and hazardous waste services industry grew steadily between 2000 and 2008, decreasing slightly thereafter



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

[a]Includes data for utility/commercial nuclear waste, which accounts for approximately 11 percent of the hazardous waste services revenue.

The solid and hazardous waste services industry in the United States is highly competitive and consists of firms that range widely in size and ownership structure.[31] Publicly and privately owned companies collect about half of the commercial, industrial,

[31] Waste Connections, Inc., "2011 Annual Report and Form 10-K," 2012, 7.

TABLE 4.2 Generation of municipal solid waste in the United States and percent of municipal solid waste recovered for recycling, recovered for composting, combusted with energy recovery, and landfilled, 2000 and 2005–10

	2000	2005	2006	2007	2008	2009	2010
	Thousands of tons						
Generation	242,540	252,660	([a])	255,380	251,360	243,650	249,860
	In percent						
Recovery for recycling	21.9	23.5	([a])	24.7	24.5	25.3	26.0
Recovery for composting	6.7	8.1	([a])	8.5	8.8	8.5	8.1
Combustion with energy recovery	13.9	12.5	([a])	12.5	12.6	11.9	11.7
Landfill[b]	57.5	55.9	([a])	54.3	54.1	54.3	54.2
Total	100.0	100.0	([a])	100.0	100.0	100.0	100.0

Source: United States Environmental Protection Agency.

[a]Data not available.
[b]Includes waste that is combusted and the heat energy not recovered.

and residential waste in the United States, and more than half of residential recyclables and compost.[32] Municipal and local governments also collect about one-half of U.S. waste, and own two-thirds of the landfills in the United States.[33] Publicly and privately owned companies may at times operate at a competitive disadvantage, as municipal and local governments have access to tax revenues and tax-exempt financing.[34]

Waste Management, Inc. and Republic Services, Inc. are by far the two largest solid and hazardous waste service providers in the U.S. market. Waste Management holds a 30 percent share of the U.S. waste collection market and a 25 percent share of the U.S. waste treatment and disposal market, while Republic Services' shares of the U.S. waste collection and waste treatment and disposal markets are 18 percent and 20 percent, respectively.[35] Other firms with sizable waste management operations include Waste Connections, Inc., Casella Waste Systems, Inc., Clean Harbors, Inc., and Stericycle, Inc. Waste Connections and Casella Waste Systems provide solid waste services for industrial, commercial, residential, and municipal customers in 29 states and 6 states, respectively. Clean Harbors provides solid and hazardous waste services for businesses and governmental agencies, and Stericycle provides waste management services for medical waste, hazardous waste, and pharmaceutical waste.

In recent years, several factors—including growing environmental awareness and a stricter regulatory environment—have affected the solid and hazardous waste services industry in the United States. In line with global trends mentioned earlier, consumers and businesses have become increasingly environmentally conscious, and there is growing awareness that waste has recoverable value. As a result, consumers increasingly demand products that use fewer materials, that can be reused, and that can be recycled or composted.[36] Many businesses have adopted a zero waste-to-landfill goal, preferring to

[32] National Solid Wastes Management Association website, http://blog.environmentalistseveryday.org/category/ask-the-expert/ (accessed August 29, 2012).
[33] National Solid Wastes Management Association, "Landfills Fact Sheet" (accessed August 29, 2012).
[34] Waste Connections, Inc., "2011 Annual Report and Form 10-K," 2012, 7.
[35] IBISWorld, *Waste Collection Services in the U.S.*, April 2012, 26; IBISWorld, *Waste Treatment and Disposal,* April 2012, 24.
[36] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012; Waste Management, Inc., "To Our Shareholders, Customers, Employees and Communities," 1–4, December 31, 2011; Industry officials, interview by USITC staff, Washington, DC, November 8, 2012.

have their waste recycled, composted, or sent to waste-to-energy facilities.[37] Some state and local governments have enacted legislation that mandates waste reduction at the source and the use of recycling, and that restricts the volume and type of waste that can be sent to landfills.[38]

These trends have had a mixed impact on U.S. solid and hazardous waste services firms. Firms have taken advantage of these changing preferences by expanding their capabilities in recycling, composting, and converting waste to energy, and by investing in new technologies that enable them to derive more value from the waste stream.[39] At the same time, the shift away from landfills may reportedly hinder firms' ability to fully utilize landfill capacity, decreasing the prices they can charge for landfill disposal and reducing revenues.[40]

Increased consolidation and vertical integration also continue to characterize the solid and hazardous waste services industry in the United States. Due to the rising costs associated with regulatory compliance and the demand for new ways to treat and dispose of waste, many smaller firms have found it difficult to remain competitive at their current size. For these firms, consolidation has been an attractive way to achieve greater economies of scale, better access capital, gain technical expertise, and enter new markets.[41]

In the recent past, the U.S. solid and hazardous waste services industry has been affected by increased government regulation and enforcement, which have added to the cost, complexity, and uncertainty associated with the waste management business. For instance, the industry has reportedly experienced greater difficulties and costs in obtaining and maintaining permits to build, operate, and expand landfills and transfer stations.[42] Increased U.S. Environmental Protection Agency (EPA) regulations on greenhouse gas emissions have also expanded the industry's emission reporting, permitting, control technology installation, and monitoring requirements.[43]

EU

The EU is the world's second-largest market for solid and hazardous waste services. Data on revenue and employment in the EU waste management industry are unavailable.[44] However, data on waste generation suggest that in recent years, the EU waste management industry has experienced trends similar to those observed in the United

[37] Standard & Poor's, "Industry Surveys, Environmental and Waste Management," March 29, 2012, 23, 24.

[38] Casella Waste Systems, "2012 Annual Report and Form 10-K," 2012, 20. The types of waste that may be restricted from landfills include newspapers, beverage containers, yard waste, appliances, batteries, and consumer electronic items.

[39] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012; Waste Management, Inc., "To Our Shareholders, Customers, Employees and Communities," 1-4, December 31, 2011.

[40] Casella Waste Systems, "2012 Annual Report and Form 10-K," 2012, 22; Republic Services, Inc., "2011 Annual Report and Form 10-K," 2012, 19.

[41] Waste Connections, "2011 Annual Report and Form 10-K," 2012, 30; Industry officials, interview by USITC staff, Washington, DC, November 8, 2012.

[42] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 11, 20.

[43] Waste Connections, Inc., "2011 Annual Report and Form 10-K," 2012, 23. In 2006, the state of California passed AB 32, the Global Warming Solutions Act of 2006, which limits greenhouse gas emissions and imposes penalties for noncompliance. Other states are considering actions similar to that of California. Waste Connections, Inc., "2011 Annual Report and Form 10-K," 2012, 23.

[44] Revenues in the Western European solid waste and hazardous waste management markets stood at $36.9 billion and $5.7 billion, respectively, in 2010. EBI, "Development of Resources Drives Growth," 2012, 26.

States. Between 2005 and 2007, municipal solid waste generation in the EU rose by 4.1 percent, followed by a decline during the 2008–09 recession as people cut their consumption (table 4.3). In 2009, landfilling accounted for the largest percentage (38.2 percent) of waste treatment and disposal in the EU, followed by recycling (23.5 percent), incineration (20.3 percent), and composting (17.9 percent). Overall, over the past decade, landfilling has declined steadily in the EU as recycling, composting, and incineration have become preferred methods of waste treatment and disposal. However, these EU data mask wide variations between the member countries in their treatment of municipal solid waste. Due to national regulations to reduce or eliminate the amount of municipal solid waste going into landfills, Austria, Belgium, Denmark, Germany, Sweden, and the Netherlands have landfill rates of less than 5 percent.[45] By contrast, landfill rates in Greece, Ireland, Portugal, and Spain exceed 50 percent. Similarly, while some countries within the EU have recycling rates of more than 25 percent, others have rates of less than 10 percent.[46]

TABLE 4.3 Municipal solid waste in the EU and percent of municipal solid waste recycled, composted, incinerated, and landfilled, 2000 and 2005–10

	2000	2005	2006	2007	2008	2009	2010
	Thousands of tons						
Municipal solid waste	242,000	245,000	251,000	255,000	253,000	251,000	([a])
	In percent						
Recycling	15.7	20.8	21.5	22.4	23.3	23.5	([a])
Composting	11.2	15.5	15.9	16.5	17.4	17.9	([a])
Incineration	15.7	19.2	19.5	19.6	19.8	20.3	([a])
Landfill	57.4	44.5	43.0	41.6	39.5	38.2	([a])
Total	100.0	100.0	100.0	100.0	100.0	100.0	([a])

Source: Blumenthal, "Generation and Treatment of Municipal Waste," 2011, 3.

Note: Totals may not sum to 100 percent due to rounding.

[a]Data not available.

The solid and hazardous waste services industry in the EU is vast and multifaceted. In 2009, there were almost 15,000 firms involved in waste collection activities in the EU, and 5,200 firms involved in waste treatment and disposal.[47] These firms are a mixture of private and publicly owned entities, a few of which are owned by private equity investors. Although private companies tend to have smaller waste management operations, a few have operations that rival those of some of the largest publicly owned companies. Local and municipal governments are also active in the waste management business in many of the EU countries.[48] As mentioned earlier, among the largest European waste management providers are France-based Veolia Environnement and Suez Environnement. Other large firms that participate in the waste management business are FCC (Spain), Remondis (Germany), and Urbaser (Spain) (box 4.2). Most of these firms provide a wide range of environmental services—including both solid and hazardous waste management—and supply such services both within and outside the EU.

[45] Landfill rate is the percentage of a country's total waste disposed of in a landfill rather than through the other methods of waste treatment and disposal—recycling, composting, and incineration.

[46] Blumenthal, "Generation and Treatment of Municipal Waste," 2011, 4–5.

[47] Eurostat, "Sectoral Breakdown of Key Indicators, EU-27," 2009.

[48] Hall, "Waste Management Companies in Europe 2009," February 2010, 1–6.

BOX 4.2 EU solid and hazardous waste companies

Veolia Environnement provides the full range of waste management activities for local and municipal governments, more than 800,000 business clients, and 60 million people through the efforts of 77,000 employees. In 2011, Veolia Environnement collected 36.1 million metric tons of waste and treated 59.9 million metric tons of waste in 763 facilities.[a] In December 2011, Veolia Environnement announced that it planned to divest its solid waste business in the United States as part of a program to reduce debt and increase cash flow; in November 2012, the company announced the completion of the sale of this business to ADS Waste Holdings.[b]

In 2011, Suez Environnement collected 35 million metric tons of waste from 57 million people and 435,000 industrial and commercial customers and treated 42 million metric tons of waste through a large network of transfer stations, sorting and recycling centers, composting sites, incinerators, and landfills. The company employed 35,000 people in waste management activities in Europe in 2011 and thousands more in overseas waste management operations.[c]

FCC is a publicly owned Spanish company involved in construction, energy, and environmental services. Its environmental services division includes sizable operations collecting and treating solid and hazardous waste in approximately 5,000 municipalities in 20 countries both within and outside the EU. In 2011, FCC collected and treated 9 million metric tons of waste, using more than 100 facilities and involving the full range of waste treatment options. The company has extensive waste management operations in Spain and the United Kingdom.[d]

Remondis AG & Co. KG, a privately owned German company, has operations in many European countries and in a few countries outside of Europe. Remondis serves consumers, businesses, and local and municipal governments through a large network of collection vehicles and treatment and disposal facilities. It is also active in water and wastewater treatment services.[e] In July 2012, Remondis expanded its presence in the Australian waste management market by purchasing Thiess Waste Management Services, thus becoming one of the top five waste management firms in Australia.[f]

Urbaser, the environmental division of the Spanish company ACS (Actividades de Construcción y Servicios), provides waste management services along with other environmental services. Annually, the company collects, treats, and disposes of millions of metric tons of industrial and municipal waste through a large network of facilities. Although Urbaser's operations are concentrated in Spain, it provides waste management services in a few other countries both within the EU and outside of it.[g]

[a] Veolia Environnement, "2011 Annual and Sustainability Report," 2012, 2, 18, 38, 41.
[b] Veolia Environnement, "Company Announces Plans to Divest," December 6, 2011; Veolia Environnement, "Sale of Veolia Environmental Services Solid Waste Businesses," November 21, 2012.
[c] Suez Environnement, "2011 Annual Report," 2012, 28, 128–30.
[d] FCC company website, http://www.fcc.es/ (accessed October 16, 2012).
[e] Remondis company website, http://www.remondis.com/en/about-us/ (accessed October 16, 2012).
[f] Remondis, "Remondis Acquires Thiess Waste Management in Australia," September 7, 2012.
[g] Urbaser company website, http://www.urbaser.es/ (accessed October 22, 2012).

In recent years, the provision of solid and hazardous waste services in the EU has been affected by legal and regulatory changes resulting from increased environmental awareness.[49] The EU's Waste Framework Directive, the cornerstone of its waste policy, was revised in 2008 to reflect a different approach to waste management. The directive established a five-step hierarchy, with waste prevention accorded the highest priority, followed by reuse, recycling, other recovery (composting and incineration of waste to produce heat and electricity), and disposal in a landfill (the least desirable option).

The directive required member states to adopt waste management plans and waste prevention programs, to recycle 50 percent of their municipal waste and 70 percent of their construction waste by 2020, and to meet recycling targets for certain types of waste

[49] European Environment Agency, "Waste and Material Resources Fact Sheet," http://www.eea.europa.eu/themes/waste/intro (accessed September 12, 2012).

such as end-of-life vehicles, electronic equipment, batteries, and packaging material.[50] The EU also recently adopted a directive that prohibits the disposal of certain types of waste in landfills and sets targets to reduce the amount of biodegradable waste sent to landfills.[51]

The extent to which individual EU countries have progressed towards implementing the revised directive varies widely.[52] Nevertheless, solid and hazardous waste services companies in the EU are positioning themselves to take advantage of the shift in demand away from landfilling by increasing and improving their recycling and recovery capabilities. These firms are also increasing the research and development (R&D) spending that is devoted to improving automated sorting techniques and the development of recycling processes for products that heretofore were unrecyclable. These companies aim to offer their customers a multifaceted approach to waste management that is environmentally sound, preserves resources, and recovers more value from the waste stream. For example, Suez Environnement recently helped a customer achieve a 100 percent recycling or energy recovery rate for all of the waste generated at the customer's multiple manufacturing plants.[53] Veolia Environnement has developed an automated vacuum waste collection system for residential neighborhoods involving collection terminals where waste is deposited and then transported through underground tunnels to a central location for compaction and transport to a treatment facility. The system both increases customer convenience and lowers fuel costs and greenhouse gas emissions from waste collection trucks.[54] The firm has also helped a consumer goods producer to achieve its goal of "zero waste to landfill" by recycling 97 percent of the producer's waste and converting the remainder into energy.[55]

Japan

Japan is the third-largest market in the world for solid and hazardous waste services, with revenues for these services totaling $26.0 billion and $3.0 billion, respectively, in 2010.[56] Unlike the United States and Europe, landfilling has not been a viable option for waste disposal in Japan because of that country's scarcity of level land and the high cost of constructing and operating landfills in hilly or mountainous terrain. Japan has therefore relied primarily on incineration to dispose of its waste.[57] In 2009, incineration accounted for the largest percentage of waste disposal in Japan (79.1 percent), followed by recycling and composting (19.3 percent), and landfilling (1.7 percent) (table 4.4).

[50] European Commission, "Being Wise with Waste," 2010, 4–5; European Commission, Directive 2008/98/EC on waste (Waste Framework Directive), 2008.

[51] European Commission, "Waste Fact Sheet," http://ec.europa.eu/environment/waste/index.htm (accessed September 5, 2012).

[52] European Commission, "Environment: A New Medals Table," August 9, 2012. In the United Kingdom, an escalating landfill tax has increased the attractiveness of recycling and recovery relative to landfills. The tax, which went into effect in 1996, has risen gradually over the years, from the original tax of £1 per metric ton of waste sent to a landfill to the current tax of £56 per metric ton. By 2014, the tax will be £80 per metric ton. Suez Environnement, "2011 Annual Report," 2012, 89.

[53] Suez Environnement, "2011 Annual Report," 2012, 85.

[54] Veolia Environnement, "2011 Annual and Sustainability Report," 2012, 40, 44.

[55] Ibid., 41.

[56] EBI, "Development of Resources Drives Growth," 2012, 26.

[57] Nakamura, "Waste Management and Recycling Business," 2007, 6.

TABLE 4.4 Municipal solid waste in Japan and percentage of municipal solid waste recycled, composted, incinerated, and landfilled, 2000 and 2005–10

	2000	2005	2006	2007	2008	2009	2010
	Thousands of tons						
Municipal solid waste	52,090	49,750	49,000	47,730	45,140	43,630	([a])
	In percent						
Recycling/composting	16.7	19.7	19.9	20.0	19.0	19.3	([a])
Incineration	77.4	77.4	77.7	77.5	79.2	79.1	([a])
Landfill	5.9	2.9	2.4	2.5	1.8	1.7	([a])
Total	100.0	100.0	100.0	100.0	100.0	100.0	([a])

Source: Hitachi Zosen INOVA, "Improvement of EfW in Japan," November 4, 2011.

Note: Totals may not sum to 100 percent due to rounding.

[a]Data not available.

Solid and hazardous waste services in Japan are provided by state governments (prefectures) and publicly and privately owned companies. Prefectures primarily collect, treat, and dispose of municipal solid waste, while most industrial waste in Japan is managed by the generating firms themselves or by waste management companies. In recent years, prefectures have increasingly contracted out their waste management activities to private companies in an attempt to reduce costs. Waste management companies in Japan number in the thousands; some are independent companies involved solely or primarily in waste management activities, while others are subsidiaries of larger corporations involved in multiple lines of business. Costly and time-consuming prefectural requirements to obtain business licenses limit the operations of most waste management companies to certain areas or regions in Japan. Few, if any, private waste management companies have operations that are nationwide in scope.[58]

Although a number of firms in Japan have sizable waste management operations, all of them have market shares of less than 10 percent.[59] Three of the largest firms are Dowa Eco-System Co., Daiseki Co., and JFE Kankyo Corporation. Dowa Eco-System Co., a subsidiary of Dowa Mining Co., provides the full range of waste management services for municipal and industrial waste.[60] Daiseki Co. is a publicly owned company with operations in several regions of Japan; it collects, transports, treats, and disposes of industrial waste by either converting it into salable products or landfilling it.[61] JFE Kankyo Corporation supplies waste management services for municipal and industrial waste.[62]

The major factor affecting the provision of solid and hazardous waste services in Japan in recent years has been the Japanese government's continued efforts to limit and manage the waste generated in the country, in response to the public's heightened environmental awareness. The Fundamental Law for Establishing a Sound Material-Cycle Society (2001) aimed to reduce society's impact on the environment by prioritizing the material cycle in the following order: reduce, reuse, recycle (the 3Rs), heat recovery (through incineration), and finally, landfill disposal. The law set quantitative targets for reductions in solid waste generation by consumers and industry and set goals to increase recycling. In 2008, the law was amended, and more ambitious targets for waste reduction and

[58] Nakamura, "Waste Management and Recycling Business," 2007, 8, 9, 17, 18; Ichinose, Yamamoto, and Yoshida, "Economic Geography and Productive Efficiency," February 2012, 2; Bureau van Dijk, Orbis Companies database.

[59] Bureau van Dijk, Orbis Companies database.

[60] Dowa Eco-System Co. website, http://www.dowa-eco.co.jp/en/ (accessed November 8, 2012).

[61] Daiseki Co. website, http://www.daiseki.co.jp/english (accessed November 7, 2012).

[62] JFE Kankyo Corporation website, http://www.jfe-kankyo.co.jp/ (accessed November 8, 2012).

recycling were set for 2015.[63] As a result of these targets, the amount of municipal solid waste generated in Japan declined during 2005–09 (table 4.4).[64]

Solid and hazardous waste services firms in Japan have responded to these government actions by increasing their efforts to recover and recycle valuable material in the waste stream and thereby reduce the amount of material sent to incinerators or landfills. For example, Daiseki Co. has expanded its ability to treat and recover valuable materials from industrial waste through an active R&D program and the purchase of new equipment. Rather than simply reduce the volume of industrial waste before disposing of it in an incinerator or a landfill, the firm states that it is able to treat and recover much of the waste for use as fuel or raw materials.[65] Dowa Eco-System Co. recovers precious metals from automobile shredder residue, which before had been sent to a landfill.[66] Daiseki Co. asserts that due to this trend, firms that lack the technology and the ability to recover value from the waste stream risk their future in the Japanese market.[67]

Trade and Investment

Trade in Solid and Hazardous Waste Services

International trade in solid and hazardous waste services consists of cross-border trade (such as when a landfill in one country collects tipping fees to dispose of waste imported from another country) and sales by foreign affiliates of solid and hazardous waste services firms (such as when a firm establishes a waste treatment facility in a foreign market in order to provide services to customers in that location). Although global data by mode of supply are not available, the vast majority of this trade likely occurs through foreign affiliates, as cross-border trade is limited because of the high cost of shipping low-valued, bulky waste.[68]

Data from Environmental Business International (EBI) suggest that the United States ran a persistent trade deficit in solid and hazardous waste services during 2000–2010, although the deficit narrowed significantly between 2003 and 2010 (figure 4.7).[69] During the period, U.S. exports of solid and hazardous services were flat, while U.S. imports increased between 2000 and 2003 and then declined unevenly to 2010. These trade data reflect both cross-border transactions and the revenues of solid and hazardous waste services firms' overseas affiliates.

[63] Sakai, et al., "International Comparative Study of 3R," 2011, 90, 92, 93; Ministry of the Environment, Government of Japan, "2010 Establishing a Sound Material-Cycle Society," 2010, 28, 58–60.

[64] Sakai, et al., "International Comparative Study of 3R," 2011, 90, 92.

[65] Daiseki Co., "Annual Report 2009," 2009, 4, 8; Daiseki Co., "Message for Stockholders and Investors," February 2012, 3.

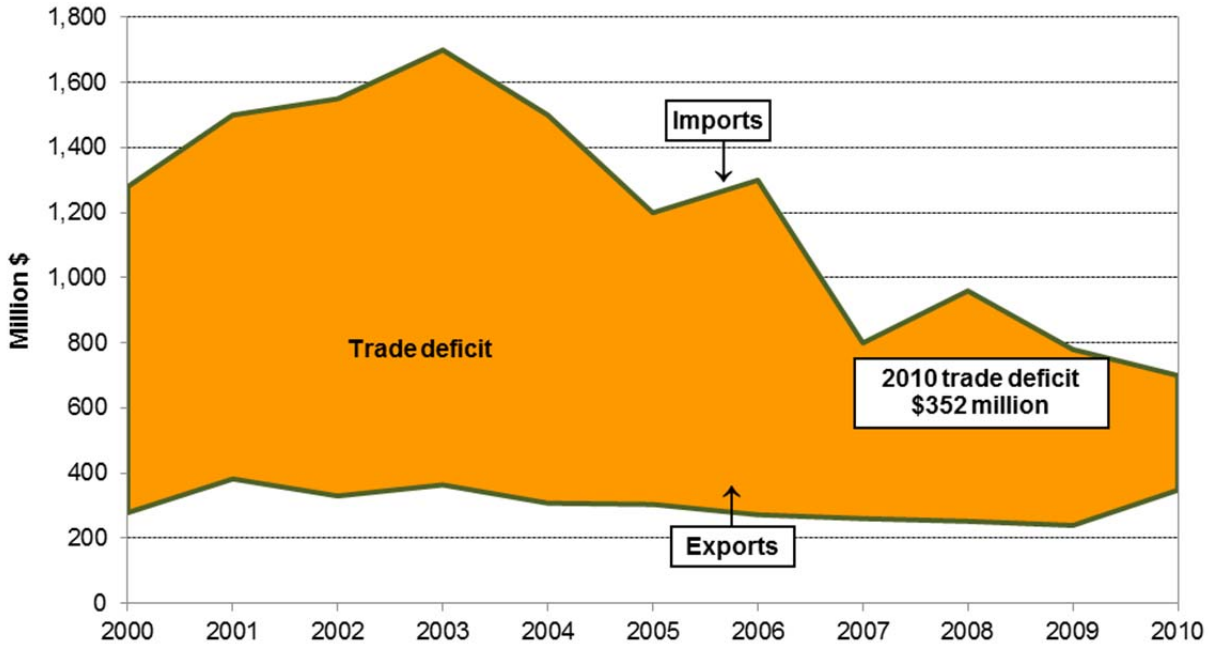
[66] Dowa Eco-System Co. website, http://www.dowa-eco.co.jp/en/recycle.html (accessed November 8, 2012).

[67] Daiseki Co., "Message for Stockholders and Investors," February 2012, 3.

[68] Industry officials, interview by USITC staff, Washington, DC, November 8, 2012; IBISWorld, *Waste Treatment and Disposal,* April 2012, 16.

[69] In the absence of U.S. government data on the sales by foreign affiliates of U.S. solid and hazardous waste services firms, the data in figure 4.7 are the best available and provide a reasonable approximation of U.S. trade in solid and hazardous waste services.

FIGURE 4.7 Solid and hazardous waste services: The U.S. trade deficit fell to its lowest level of the period in 2010



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

Cross-border trade in solid and hazardous waste frequently involves a waste exporter in one country paying a waste importer in another country to provide the service of landfilling or treating the waste.[70] Given the absence of discrete data on cross-border trade in solid and hazardous waste services, data on trade in waste provide a useful proxy for the extent of, and general trends in, waste management services trade. During 2005–10, cross-border trade in solid and hazardous waste generally followed trends in global economic activity, increasing between 2005 and 2008, contracting during 2008–09, and then expanding again as the global economy recovered (tables 4.5 and 4.6). The United States, the EU, and Japan were the largest traders in solid and hazardous waste during 2005–10, accounting for more than 50 percent of global trade. In 2010, the top three markets for U.S. exports of solid and hazardous waste were Switzerland, Canada, and The Bahamas, whereas the top three suppliers to the United States were Canada, China, and Brazil.[71]

[70] For the purposes of this chapter, solid and hazardous waste is captured primarily under the international Harmonized System (HS) code number 3825 (residual products of the chemical or allied industries, not elsewhere specified or included). HS 3825 includes municipal waste, sewage sludge, clinical waste, waste organic solvents, wastes of metal-pickling liquors, hydraulic fluids, brake fluids and antifreeze fluids, and other wastes from the chemical or allied industries. It does not include wastes which contain mainly petroleum oils or oils obtained from bituminous materials.

[71] GTIS, World Trade Atlas database (accessed November 5, 2012).

TABLE 4.5 Solid and hazardous waste (HS 3825): Major exporters, 2005–10

Country	2005	2006	2007	2008	2009	2010
	Million $					
United States	15	25	38	28	24	11
EU	10	23	24	15	14	18
Japan	2	2	18	83	12	15
Canada	5	8	7	6	7	11
Mexico	13	12	6	5	5	10
All other	16	15	28	44	28	23
Total	61	85	121	181	90	88

Source: GTIS, World Trade Atlas database (accessed November 5, 2012).

TABLE 4.6 Solid and hazardous waste (HS 3825): Major importers, 2005–10

Country	2005	2006	2007	2008	2009	2010
	Million $					
United States	9	15	16	10	19	33
EU	8	11	11	12	10	10
Japan	4	7	9	13	7	8
Saudi Arabia	([a])	3	5	0	0	7
All other	29	36	21	24	15	23
Total	50	72	62	59	51	81

Source: GTIS, World Trade Atlas database (accessed November 5, 2012).

[a]Less than $500,000.

Foreign Investment in Solid and Hazardous Waste Services

Although thousands of companies provide solid and hazardous waste services in individual country markets, most are small to medium-sized firms that lack the interest, the capital, and the legal and regulatory expertise necessary to establish overseas affiliates. Nevertheless, some U.S. waste management firms have increased their foreign presence in recent years. For example, in an effort to grow its business, Stericycle, Inc., has expanded outside the United States through numerous purchases of foreign waste management firms. Since 2005, it has expanded into Ireland, Chile, Romania, Portugal, Brazil, Japan, and Spain; in 2011 alone, it purchased 24 overseas firms.[72] In 2010, the U.S. firm Waste Management, Inc., entered into a joint venture with a Chinese waste management firm to operate and manage waste-to-energy facilities and to provide other waste management services in China.[73]

Several non-U.S. firms—including Veolia Environnement, Suez Environnement, and Remondis, among others—have expanded their foreign waste management services to take advantage of opportunities in fast-growing foreign markets. French firm Veolia Environnement has become the largest private waste management firm in China by virtue of 20 years of continuous investment in the country. The company has landfills, hazardous waste treatment facilities, waste-to-energy plants, and landfill gas-to-energy plants in various cities and regions in China.[74] In December 2010, the French firm Suez Environnement expanded its presence in the Australian waste management market by purchasing the waste management operations of the government of New South Wales.[75]

[72] Stericycle, "2011 Annual Report and Form 10-K," 2012, 3–4.
[73] Waste Management, Inc., "2011 Annual Report and Form 10-K," 2012, 7.
[74] Veolia Environnement company website, http://www.veolia-es.cn/veolia-environmental-services-china.html (accessed September 10, 2012).
[75] Suez Environnement, "Suez Environnement Strengthens Its Position," December 15, 2010.

In July 2010, German firm Remondis established a joint venture with Minsk, the capital city of Belarus, to provide waste management services for the city; in September 2008, it set up a joint venture with a large Russian construction company to provide waste management services for that company; and it recently increased its market share in the waste management business in Australia by purchasing a competitor.[76] More recently, Progressive Waste Solutions Ltd., a Canadian waste management firm, purchased waste management companies in Florida and Missouri to continue its growth in the U.S. market.[77]

[76] Remondis company website, http://www.remondis.com/en/news/archive/2010 (accessed November 21, 2012); Remondis company website, http://www.remondis.com/en/news/archive/2008/remondis-aktuell-32008/remondis-environmental-services (accessed November 21, 2012); Remondis, "Remondis Acquires Thiess Waste Management in Australia," September 7, 2012.

[77] Progressive Waste Solutions, "Progressive Waste Solutions Ltd. Acquires," November 16, 2012; IESI-BFC, "IESI-BFC Announces Purchase of Waste Assets," December 23, 2010.

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Sakai, Shin-ichi, Hideto Yoshida, Yasuhiro Hirai, Misuzu Asari, Hidetaka Takigami, Shin Takahashi, Keijirou Tomoda, et al. "International Comparative Study of 3R and Waste Management Policy Developments." *Journal of Material Cycles and Waste Management* 13, no. 2 (August 2011): 86–102.

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Waste Connections, Inc. *2011 Annual Report and Form 10-K Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934 for the Fiscal Year ended December 31, 2011*, 2012.

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CHAPTER 5
Remediation Services

Industry Characteristics

Description of Services and Overview of the Structure of the Industry

For purposes of this report, environmental remediation services (or remediation services) are defined as activities related to the cleanup of groundwater, soil, operating facilities, and contaminated buildings and sites (box 5.1). Site cleanup can encompass several activities, among them remediation consulting (including hazardous waste consulting), remediation construction, wastewater treatment, water purification, air pollution abatement, and solid waste management, among others.[1] Firms in the industry that offer such services also can provide services in response to disasters such as hurricanes, storms, oil spills, and floods.[2]

BOX 5.1 Remediation services

According to the North American Industrial Classification System (NAICS), the remediation services industry comprises establishments primarily engaged in one or more of the following: (1) the cleanup of contaminated buildings, mine sites, soil, or groundwater; (2) integrated mine reclamation activities, including demolition, soil remediation, wastewater treatment, hazardous material removal, contouring land, and revegetation; and (3) abatement of asbestos, lead paint, and other toxic material.[a]

Globally, the remediation services industry is divided into three categories: environmental facilities, environmental services, and environmental use of natural resources. The industry can also be divided into five developmental stages based on volume of pollutants, level of environmental control, types of environmental investments, and level of environmental technologies. These stages signify general conditions in underdeveloped, developing, and developed nations, and their effect on society.[b]

[a] U.S. Census Bureau, "2007 NAICS Definitions: 562910 Remediation Services" (accessed January 11, 2013).
[b] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 1.

Although the remediation services industry has been generally characterized as mature, the market remains highly competitive and fragmented, since firms that provide such services vary markedly in terms of size and degree of specialization.[3] The majority of firms in the industry are small and medium-sized entities operating on a local, regional, or national level, with globalization in the industry estimated to be low, but increasing.[4] Larger firms can offer a range of services across the remediation industry and may be contracted to complete all the different requirements of a major cleanup, while smaller

[1] Scharf, *Environmental and Waste Management*, March 29, 2012, 43.
[2] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 11.
[3] Scharf, *Environmental and Waste Management*, March 29, 2012, 21.
[4] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 21.

firms may be able to perform one or more discrete tasks in a large project based on their specialized equipment, expertise, or technology.[5]

Most of the larger firms providing remediation services offer them as part of a wider portfolio of activities in addition to their primary businesses. For example, CH2M Hill, a global engineering, procurement, and construction company headquartered in Colorado, offers a wide array of services including hazardous waste cleanup and emergency management.[6] These larger firms often seek to increase their service offerings in order to expand their market appeal and win larger, more complex contracts.[7] Consequently, consolidation in the industry, particularly the acquisition of remediation consulting firms, has been growing in recent years. In September 2011, CH2M Hill acquired Halcrow, a UK-based engineering, planning, and design consulting firm, for $200 million.[8]

Entry barriers in this industry are high, as large remediation services firms are willing to face significant financial and operating risks in order to compete for the highest-value contracts.[9] Such risks arise from the long and costly process of remediating a contaminated site. To illustrate, remediation projects generally begin with initial cleanup investigations and feasibility studies. Before commencing cleanup, remediation firms assess the contaminated site to determine the type of sampling, chemical analysis, and remediation method to be used.[10] Large construction companies, or several midsized subcontractors, usually perform the actual site cleanup; their work can include digging up and hauling away contaminated soil, or mixing toxic waste with concrete and fly ash and burying it under rock and clay.[11] In some cases, remediation firms are hired to clean up sites that are slated for future development by either private or public entities. In other cases, they may be contracted by a government to remediate brownfield redevelopment sites,[12] as well as third-party or "Superfund" sites, where the polluter is unable to pay or is not identifiable.[13]

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[5] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 3; Setar, *Environmental Consulting in the U.S.*, April 2012, 23. Competition in the remediation services sector is primarily based on reputation, breadth of services, and quality of services offered. Smaller remediation firms provide differentiated services, but largely compete among each other or act as subcontractors, since most lack the industry profile and resources to compete directly with the largest firms for the most lucrative contracts.

[6] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 22.

[7] Ibid., 18.

[8] Scharf, *Environmental and Waste Management*, March 29, 2012, 21; Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 18.

[9] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 20; Setar, *Environmental Consulting in the U.S.*, April 2012, 24. However, entry barriers for the many smaller, specialized environmental firms remain low, since they do not compete directly with the largest players. In many cases, the only significant barrier to entry for these smaller entities is the extent to which they possess adequate knowledge to consult on particular environmental issues.

[10] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 8. Firms may also have to remediate surrounding sites if these sites have been exposed to hazardous emissions that pollute air, soil, or groundwater.

[11] Scharf, *Environmental and Waste Management*, March 29, 2012, 21.

[12] Scharf, *Environmental and Waste Management*, March 29, 2012, 43–44, 50; Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 20. Brownfields are tracts of land that were developed for industrial purposes, polluted, and then abandoned.

[13] Scharf, *Environmental and Waste Management*, March 29, 2012, 51; Gong, "International Experience," September 2010, 16, 19. The Superfund Program was set up by the U.S. government to fund Environmental Protection Agency (EPA) cleanups of high-priority toxic industrial sites. These sites are on the EPA's National Priority List. Other countries, such as Canada and Japan, have set up similar government-funded remediation programs.

According to Engineering News Record (ENR),[14] leading U.S. firms in the remediation services sector (table 5.1)[15] include AECOM Technology Corp., Bechtel Corp., Black & Veatch, CET Environmental Services Inc., CH2M Hill, Clean Harbors, Earth Tech, Fluor Corp., Insituform Technologies, Jacobs Engineering Group, Kiewit Corp., Roy F. Weston, Shaw Group, Sevenson Environmental Services Inc., Tetra Tech, and URS Corp. Other leading firms in the sector are Arcadis (Netherlands) and RWE AG (Germany). For the most part, these are large multinational firms whose primary business is construction or engineering.[16]

TABLE 5.1 Top global environmental firms by type of work, by revenue, 2012

	Country	Revenue (million $)
Construction, contracting, and/or remediation		
Bechtel Corp.	U.S.	1,635.3
Fluor Corp.	U.S.	902.5
The Shaw Group Inc.	U.S.	881.0
Layne Christensen Inc.	U.S.	638.7
The Walsh Group Ltd.	U.S.	571.5
Engineering and/or design		
CH2M Hill Ltd.	U.S.	1,493.0
MWH Global	U.S.	985.5
Bechtel Corp.	U.S.	804.7
AECOM Technology Corp.	U.S.	729.9
URS Corp.	U.S.	616.4
Consulting and/or studies		
Tetra Tech, Inc.	U.S.	1,503.5
CH2M Hill Ltd.	U.S.	1,480.7
URS Corp.	U.S.	1,271.3
Environmental Resources Management, Inc. (ERM)	U.S./UK	547.8
Golder Associates	U.S.	471.8

Source: ENR, "The Top 200 Environmental Firms," August 13, 2012.

Note: Since the largest environmental firms (e.g., construction, engineering, etc.) characterize remediation services as a sub-business, it is difficult to capture a single comprehensive list of the largest "remediation" firms.

Factors Affecting Supply and Demand for Remediation Services

The supply of and demand for remediation services is largely driven by government regulation and spending. In terms of supply, individual remediation firms can be helped or harmed by regulations that favor particular technologies, depending on whether a subject technology is within the expertise of a given firm. Further, government regulations that apply to trade and investment broadly—such as foreign-equity caps, local-content quotas, and limits on the licensing of foreign professionals—may affect the foreign supply of remediation services.[17] Remediation services supply may also be

[14] When Commission staff conducted a search in the Orbis Companies database, none of the leading remediation firms (based on our qualitative research) were listed. This is likely because large firms that operate in the remediation services field generally do not list remediation as their primary business. More commonly, they will describe themselves as construction or engineering companies, and will list remediation services as one of their ancillary businesses. Orbis Companies database and EBI representative, telephone interview by USITC staff, November 28, 2012.

[15] This (qualitative) list of firms is derived from a variety of sources and will not precisely match the list in table 5.1. However, these firms are widely regarded as leading global remediation services providers.

[16] Scharf, *Environmental and Waste Management*, March 29, 2012, 19; Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 22–24.

[17] EBI representative, telephone interview by USITC staff, November 28, 2012.

affected by a firm's willingness to take on the financial risks of competing for large (usually government) contracts.[18]

In terms of demand, the industry is largely dependent on government spending.[19] Government regulation requires financial assurances that funds will be available for the cleanup and remediation—or the closure and care—of certain public or heavily polluted sites. Thus the Superfund Program and stimulus programs such as the American Recovery and Reinvestment Act (ARRA) of 2009 have contributed significantly to some firms' revenue streams.[20] In the United States, increased government expenditures on remediation services have boosted industry revenue during recent years. From 2007 to 2011, industry revenue is estimated to have grown at an average annual rate of 7.2 percent to $19.3 billion, with a 5.2 percent increase from 2011 to 2012. However, net government spending on remediation projects is expected to decline going forward, as ARRA funding has closed for new projects.[21]

Moreover, protecting the environment and human health from exposure to contaminated air, soil, surface water, and groundwater is a high priority for most countries, particularly in developed countries. Hence, governments and private firms have grown increasingly aware of how their actions affect the environment, and have sought to reduce their larger impact by implementing more environmentally friendly practices. This trend has led to growing demand for innovative remediation services products, and remediation firms have responded to this new demand with technologies that provide "greener" solutions, such as those that employ bioremediation[22] techniques and nanotechnology (box 5.2).[23]

Other important demand factors include economic development (public and private), population growth, and the occurrence of natural or manmade disasters. As countries grow wealthier and increasingly aware of environmental risks, the demand for cleaner air, soil, and water generally results in stronger government regulations.[24] Moreover, the scarcity of land in quickly industrializing cities and regions, such as those in China and parts of the European Union (EU), creates the need to redevelop sites for investment.[25] Demand for remediation services may also be driven by private sector financial interests. In particular, private sector suppliers are more likely to participate in site remediation when the return on redevelopment of the site justifies the cost of its cleanup.[26] For instance, building, development, and other construction companies will hire remediation service providers when they are renovating, repairing, or demolishing structures that are contaminated.[27]

[18] Scharf, *Environmental and Waste Management*, March 29, 2012, 19; Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 22–24.

[19] ENR, "The Top 200 Environmental Firms," August 13, 2012, 5. Depending on the firm, revenue from federal, state, and local governments can account for 40–70 percent of total annual earnings.

[20] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 27.

[21] Ibid.

[22] EPA, "A Citizen's Guide to Bioremediation," April 2001. Bioremediation is the use of naturally occurring microorganisms to absorb or digest pollutants.

[23] Setar, *Environmental Consulting in the U.S.*, April 2012, 4.

[24] Demand in developing countries also depends on project funding from development banks and other nongovernment and foreign government entities. International agreements likely have a negligible effect, as developing countries have few, if any, obligations under such agreements.

[25] Xie and Li, "Overview of the Current Situation on Brownfield Remediation," September 2010, 1.

[26] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 8.

[27] Ibid., 5–6.

BOX 5.2 There is a greater push for "greener" and more innovative remediation technologies

Conventional technologies, such as incineration and chemical treatment, are still widely used to clean up industrially contaminated sites and ex-military sites, and to pump and treat contaminated groundwater. However, demand for "greener" and more innovative remediation technologies has been growing, since many of these conventional solutions remain inadequate due to their energy costs and maintenance requirements.[a]

For example, the use of nanotechnology [b] may present significant potential for superior remediation results compared with traditional methods. Lab results suggest that nanostructuring[c] may enable greater takeup of contaminants; for example, titanium dioxide nanoparticles have proven effective in combating waterborne bacteria as well as degrading organic pollutants, including pesticides and herbicides. This technology has also demonstrated a high level of effectiveness in the oxidation of contaminants in wastewater. In 2011, the Bren School of Environmental Science and Management at the University of California, Santa Barbara, and AECOM, an international environmental company, collaborated to develop bioremediation techniques and nanomaterials for underground water remediation. Further, naturally occurring minerals such as zeolites[d] are being used more widely in eliminating toxic contaminants from soil, water, and the atmosphere. For example, the Rotorua Lakes in New Zealand were remediated with zeolites, successfully capping phosphate levels and stemming algae growth.[e] These new remediation technologies are expected to significantly reduce life-cycle cleanup expenses while protecting the environment.[f]

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[a] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 4.

[b] EPA, "Nanotechnology for Site Remediation Fact Sheet," October 2008. Nanotechnology is defined as the understanding and control of matter at dimensions between approximately 1 and 100 nanometers. Nano-sized particles have large surface areas relative to their volumes and may have enhanced chemical and biological reactivity. In remediation, these particles can be manipulated for specific applications to create novel properties not commonly displayed by particles of the same material at "macroscale."

[c] Setar, *Environmental Consulting in the U.S.*, April 2012, 4. A nanostructured material (or nanomaterial) is a material that has been either patterned or has structural features on the nanometer (nm) scale.

[d] PRLog, "Zeolites: An Alternative Approach," July 25, 2008. Zeolites are naturally occurring minerals whose crystalline structure is in a honeycomb lattice. Due to a fine pore structure, certain zeolites can be used for the adsorption of harmful contaminants.

[e] PRLog, "Zeolites: An Alternative Approach," July 25, 2008; Scion, "Water Quality Improved by Application of Modified Zeolite," September 2010. High concentrations of phosphates and nitrates promote algae growth, which is harmful to water quality.

[f] Global Industry Analysts, Inc., *Environmental Remediation: A Global Outlook*, January 2012, 4–5 and 27–28.

More short-term changes can also affect demand. As the economic downturn wanes, the resurgent energy and manufacturing sectors are shifting demand patterns and changing firms' mix of work, putting more emphasis on private sector and international contracts, over domestic public sector work.[28] In addition, disasters such as Hurricane Katrina, the British Petroleum (BP) Deep Horizon oil spill, and more recently Hurricane Sandy, have created a large and immediate need for remediation services, and thus lead to increased industry revenue.[29]

Larger Remediation Firms Are Willing to Take On More Risk As They Broaden Their Services

As competition in the remediation services industry remains high, many customers are now requiring remediation firms to agree to fixed-price contracts, often known as guaranteed fixed-price remediation (GFPR) contracts. Fixed-price contracts have come to be preferred to fixed-term contracts, since most of the financial risk is transferred from

[28] ENR, "The Top 200 Environmental Firms," August 13, 2012, 5–7.

[29] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 5.

customers a guaranteed price, eliminating uncertainty about the final project cost. For remediation firms to carry out such projects successfully, and to mitigate their own financial risks, they must perform accurate site evaluations and cost analyses at the initial stages of the project. In the past, remediation firms have contracted out these services to third-party consultants and engineers. More recently, remediation firms—both in the United States and internationally—have increasingly acquired or merged with related service providers so that they can supply "one-stop shop" services to their largest clients and increase their revenue stream. Mergers and acquisitions also increase competitiveness by giving firms the capital resources they need to project risks, as well as the skills to minimize their occurrence.[31]

Large remediation firms also may enjoy a comparative advantage under GFPR contracts since they shift project-related compliance responsibilities from the client to the remediation services provider.[32] Such a shift makes the remediation firm responsible for complying with all the environmental regulations related to a project, including the payment of fines if requirements are not met. Service providers working under such contracts must buy environmental insurance to protect themselves from unanticipated cost growth, changes in regulatory requirements, and other project risks, and larger firms may be better able to negotiate lower prices with insurance companies to cover these risks. [33]

A recent case illustrates the structuring of a GFPR contract. In June 2012, the National Aeronautics and Space Administration (NASA) selected three companies to provide environmental remediation services at Kennedy Space Center, the adjacent Cape Canaveral Air Force Station (CCAFS), and other NASA locations. The combined maximum potential value for the three contracts was $91 million. The services were to be performed over a five-year period, beginning in 2012. The companies selected were Geosyntec Consultants, Jacobs Engineering Group Inc., and Tetra Tech, three of the larger U.S. remediation services firms in operation. Under the contract, the three companies would compete for fixed-price work orders to develop and implement contamination assessment and remediation requirements for Resource Conservation and Recovery Act[34] sites and petroleum contamination for NASA at Kennedy and CCAFS.[35]

Higher Private Spending and Rising Demand in Developing Markets May Offset Lower Government Spending on Remediation in Developed Countries

With government expenditures on remediation services in major developed-country markets such as the United States, Germany, and Japan expected to decrease, the focus for most remediation firms will revert to the private sector and developing markets.[36] In the United States, stimulus measures like ARRA expired at the end of 2012, and in the future the U.S. Congress may not support large spending projects, instead placing greater

[31] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 7, 19.

[32] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 20. These larger firms also often enjoy a comparative advantage when it comes to competing for international contracts, since most have affiliates in several foreign countries with knowledge of local laws and business practices.

[33] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 7.

[34] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 27. The Resource Conservation and Recovery Act (1976) established a framework for controls on hazardous waste, from its generation to its disposal in the United States.

[35] NASA, "NASA Selects Contracts for Environmental Remediation Services," June 28, 2012.

[36] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 1–2.

focus on deficit reduction measures.[37] In addition, over the past several years, private-sector demand has been falling in the United States due to the global economic slowdown.[38] The decline in residential and commercial construction has depressed the demand for remediation of brownfield sites by property developers.[39] However, as economies begin to recover, more construction starts are expected. In particular, business from heavy industries that use hazardous materials will expand slightly in response to increased demand for energy and mining products and services.[40]

Increasing infrastructure needs in developing economies, such as China, which is considered the fastest-growing remediation market in the world, may also lead to greater revenue prospects.[41] For instance, in 2011, a project in Beijing received over $100 million in funding, the most ever spent on a single remediation project in China.[42] According to a nationwide study by the Chinese Society for Environmental Sciences, at least 98,000 industrial plants were closed and relocated across the country from 2001 to 2009. The relocations left vacant a large number of contaminated sites, many located in downtown urban areas, which are set to be redeveloped as commercial or public ventures. Growing opportunities have led to increased interest in the Chinese market among remediation services providers. In 2011 alone, it was noted that more than 20 new land remediation companies were registered in China.[43]

Natural and Manmade Disasters Remain a Profitable but Uncertain Revenue Source

Disaster-related events can also create significant demand for remediation services, as recently occurred with the British Petroleum (BP) Deep Horizon oil spill of 2010.[44] The BP accident resulted in the largest marine oil spill in the history of the industry. An estimated 205.8 million gallons of crude oil were released into the Gulf of Mexico. In response, the U.S. government awarded contracts to U.S. and foreign remediation firms, and BP established a $20.0 billion private fund for the cleanup. As a result, in 2010, U.S. remediation services' revenue increased by 6.0 percent over the previous year.[45]

Another example is Hurricane Sandy, which affected much of the heavily populated New Jersey/New York coastal area in late October/early November 2012. This disaster is already generating significant revenue for U.S. remediation firms, and to date, hundreds of remediation firms have signed up to assist in post-storm recovery work. To illustrate, by October 31, Jarvis Property Restoration (U.S.) had already secured $1 million to $3 million in post-Hurricane Sandy remediation contracts. Jarvis' largest previous engagement was in 2008, when the Cedar River flooded Cedar Rapids, Iowa. The company completed $28 million in building remediation projects for that single event. Another company doing post-storm work is Belfor Property Restoration (U.S.), which

[37] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 4.

[38] Ibid., 5–6.

[39] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 15. The types of private firms generally requiring the most remediation services include real estate developers, auto parts manufacturers, aluminum producers, utility companies, waste disposal firms, engineering firms, and mining companies.

[40] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 8.

[41] Xie and Li, "Overview of the Current Situation on Brownfield Remediation," September 2010, 8; McIlvaine Company, "$36 Billion World Site Remediation Market," April 2012.

[42] McIlvaine Company, "$36 Billion World Site Remediation Market," April 2012.

[43] China Environmental Remediation, "Healing the Land," 2011.

[44] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 11.

[45] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 4–6, 15; EBI, "The Global Environmental Market by Segment, 2000–2010," spreadsheet received by email, November 28, 2012.

dispatched 900 of its workers to the Northeast within the first few days following Hurricane Sandy. Belfor previously worked on disaster recovery for Hurricane Katrina in 2006. They had about 5,000 employees on the ground in New Orleans and reportedly earned revenues of hundreds of millions of dollars for more than a year of cleanup and restoration work.[46]

The Global Industry

The Global Market for Remediation Services

The value of the global remediation services market in 2010 has been estimated by Environmental Business International (EBI) at approximately $37.7 billion.[47] Overall, the global market declined by 2.6 percent in 2010, which contrasted sharply with the 3.8 percent compound annual growth rate (CAGR) recorded during 2000–2009 (figure 5.1). This decline can largely be attributed to private sector funding cuts in countries such as France and the United Kingdom due to the global economic slowdown.[48] However, as noted, overall revenue can fluctuate very quickly, as natural and manmade disasters can affect the industry's activities at any moment.[49]

FIGURE 5.1 Global remediation/industrial services revenues grew steadily during 2000–2007, falling slightly thereafter

Source: Environmental Business International, "The Global Environmental Market by Segment." *Environmental Business Journal*, various issues (2002–12).

[46] Kavilanz, "Cleaning Up after Sandy," October 31, 2012.

[47] EBI, "The Global Environmental Market by Segment, 2000–2010," spreadsheet received by email, November 28, 2012. EBI refers to the sector as "Remediation/Industrial Services."

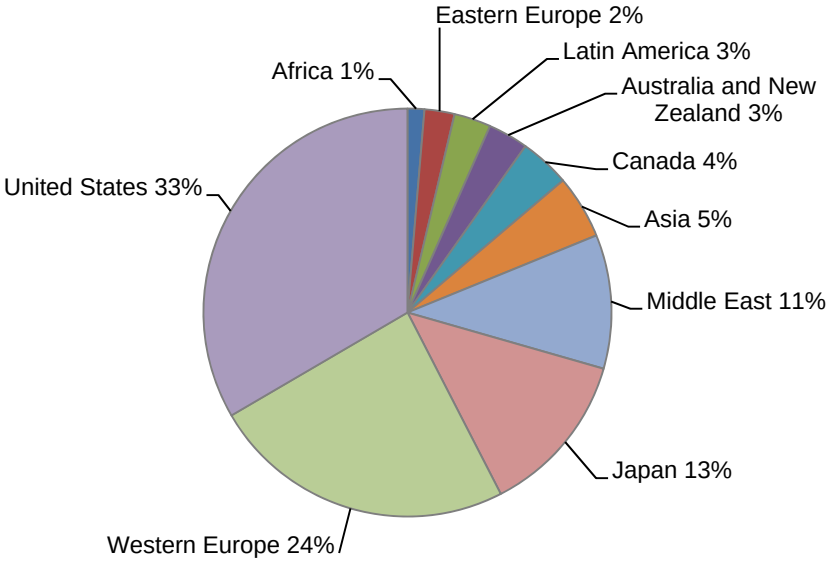
[48] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 81, 83.

[49] Scharf, *Environmental and Waste Management*, March 29, 2012, 21–22.

Leading Countries and Suppliers

In 2010, the last year for which disaggregated data are available, the United States was the largest market for remediation services, accounting for 33.4 percent of global revenues; it was followed by Western Europe with 24.1 percent.[50] Revenues derived from Asia represent 21.2 percent of the global market,[51] whereas the Middle East, Canada, Latin America, and Eastern Europe represent 10.6 percent, 4.0 percent, 2.9 percent, and 2.4 percent, respectively (figure 5.2).[52] Due to their greater access to the most advanced waste process, cleanup, and information systems technologies, developed and rapidly developing countries account for the majority of the global remediation services market.[53]

FIGURE 5.2 Remediation and industrial services: The United States and Western Europe had the largest shares of global revenue in 2010



Total = $37.7 billion

Source: Environmental Business International, "The Global Environmental Market: Regions & Segments Matrix in 2010." *Environmental Business Journal* 25, no. 6–7 (June/July 2012): 26.

Note: Figures may not total 100 percent due to rounding.

Maintaining an international presence has become more important among larger remediation firms that service multinational corporations or large governments.[54] This is particularly true of U.S.-based firms, which dominate the global market for remediation services. Major U.S. firms such as AECOM, Black & Veatch, and URS are increasingly relying on overseas markets to gain revenue and expand their sustainable remediation technical expertise and best practices.[55] For example, URS currently holds five large-

[50] EBI, "The Global Environmental Market, 2010," spreadsheet received by email, November, 28, 2012.
[51] EBI's "Asia" category includes aggregated revenues for Asia, as well as revenues for Australia, Japan, and New Zealand. In some databases, Japanese data are reported separately from the rest of Asia.
[52] EBI, "The Global Environmental Market, 2010," spreadsheet received by email, November, 28, 2012.
[53] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 1.
[54] Setar, *Environmental Consulting in the U.S.,* April 2012, 17.
[55] McIlvaine Company, "$36 Billion World Site Remediation Market," April 2012.

scale contracts for worldwide deployment of emergency response support on 48 hours' notice with more than 1,500 prescreened employees.[56]

Although nearly all enterprises supplying remediation services to the U.S. market are U.S.-based, a small handful of international firms have, or are developing, strong footholds in the United States. Arcadis NV, a Netherlands-based company, is one example.[57] In April 2011, Arcadis signed a master services agreement with the Revitalizing Auto Communities Environmental Response (RACER) Trust[58] to develop site closure solutions and perform comprehensive environmental remediation services for former automobile and related manufacturing sites in Indiana, Michigan, New Jersey, New York, Ohio, Pennsylvania, and Virginia. The agreement requires Arcadis to develop a site-specific portfolio of remediation services before starting site cleanup. The site-specific services involve characterizing each site, assessing human and ecological risk, and choosing sustainable and environment-friendly remedies.[59]

Non-U.S. firms have also been expanding their reach into the U.S. remediation services market through mergers and acquisitions.[60] To illustrate, Cardno Limited of Brisbane, Australia, made three major acquisitions in 2010: ENTRIX of Houston, Texas; Environmental Resolutions Inc. (ERI) of Irvine, California; and JFNew of Walkerton, Indiana. Cardno consolidated ENTRIX and ERI into a new environmental and ecological consulting unit, and subsequently added JFNew to that unit.[61] With these acquisitions, Cardno established a major presence in the U.S. environmental services market with a staff of more than 900 people.[62]

Profiles of Key Country Markets

United States

There are more than 4,500 remediation services providers in the United States. Some of these firms address a niche market segment, while others provide the full range of services intrinsic to the cleanup of contaminated mine sites and buildings, soil and groundwater remediation, hazardous material removal, wastewater treatment, soil remediation, oil spill cleanup, and the abatement of hazardous materials such as lead and asbestos.[63] The U.S. remediation services market increased by 6.0 percent over the previous year to reach approximately $12.8 billion in 2010. While this figure triples the 2.0 percent CAGR recorded during 2000–2009, most growth occurred from 2005 forward, largely due to the effects of Hurricane Katrina (figure 5.3).[64] Employment in

[56] URS company website, "Stabilization, Recovery and Reconstruction Capabilities," http://www.ap.urscorp.com/Services/InternationalDevelopment/StabilisationRecoveryReconstructionCapabilities/ (accessed December 4, 2012).

[57] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 21.

[58] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 21–22. The RACER Trust is involved in the environmental remediation and renewed development of 89 closed General Motors factory sites in the United States.

[59] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 21–22; Arcadis, "Arcadis Wins Large Environmental Remediation Contract," April 21, 2011.

[60] McIlvaine Company, "$36 Billion World Site Remediation Market," April 2012.

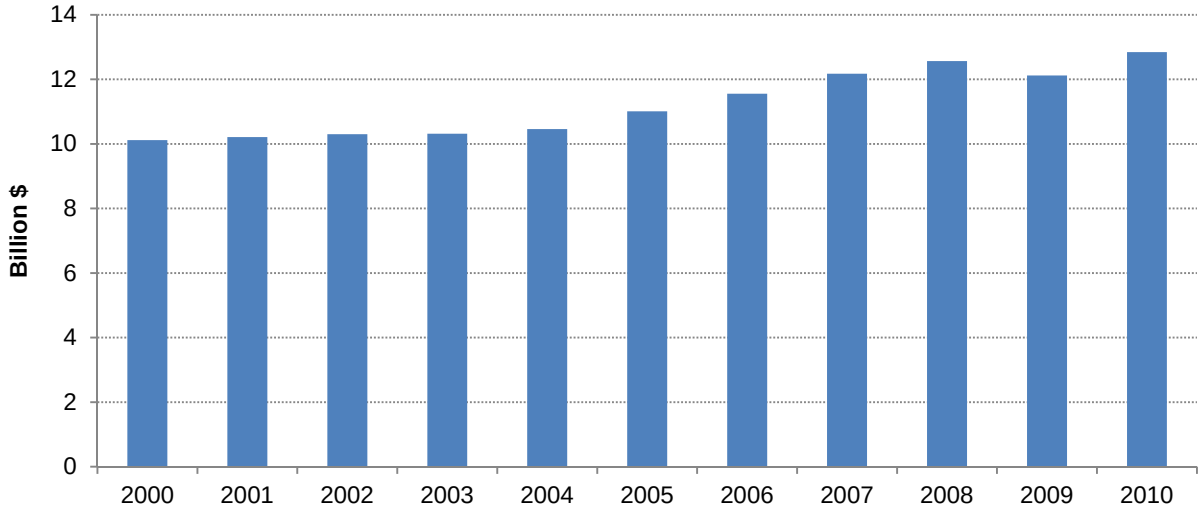
[61] The ENTRIX acquisition was valued at $89 million, ERI at $40 million, and JFNew at $13 million.

[62] EBI, "Business Achievement: Mergers and Acquisitions," 2010.

[63] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 67.

[64] EBI, "The Global Environmental Market by Segment, 2000–2010," spreadsheet received by email, November, 28, 2012. EBI refers to the sector as "Remediation/Industrial Services."

FIGURE 5.3 Overall, U.S. remediation/industrial services revenues grew during the 2000–2010 period



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

the U.S. remediation services market reached about 108,400 workers in 2010. This reflected an increase of about 5.2 percent from the previous year, well ahead of the 0.3 percent CAGR recorded from 2000 to 2009 (figure 5.4).[65] The relatively large increases in both U.S. revenue and employment in 2010 can be explained by federal stimulus spending and the BP oil spill disaster.[66]

Among the federal remediation programs, those of the Department of Defense, the Department of Energy, and the Superfund provide the most funding. The U.S. Department of Housing and Urban Development offers community development block grants aimed at promoting environmental remediation as well as urban redevelopment.

The Economic Development Administration (EDA) of the U.S. Department of Commerce also offers grants that encourage remediation. In addition to these programs, the U.S. government promotes environmental remediation by offering tax-exempt industrial development bonds to private companies that undertake cleanup and redevelopment projects.[67] The EPA estimated that in 2006 (the most recent year for which such data were available) there were about 290,000 U.S. waste sites requiring cleanup, at a projected total cost of more than $200 billion. These contaminated sites include abandoned production facilities, waterfront parcels, and commercial real estate, among other properties. The EPA estimated that if firms employed the most advanced technologies available in the industry, it would take 30 to 35 years to complete the outstanding cleanup work.[68]

[65] EBI, "U.S. Employment by Segment, 2000–2010," spreadsheet received by email, November 28, 2012; Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 11; Scharf, *Environmental and Waste Management*, March 29, 2012, 36.

[66] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 11; Scharf, *Environmental and Waste Management*, March 29, 2012, 36.

[67] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 68.

[68] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 64–65; EPA, "A Citizen's Guide to Bioremediation," April 2001; EPA, CLU-IN, "Contaminated Site Clean-Up Information," n.d. (accessed November 12, 2012).

FIGURE 5.4 Employment growth among U.S. remediation/industrial services firms was somewhat uneven between 2000 and 2010

Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

The EPA proposed to complete the removal of remaining traces of contaminants at about 20 sites by 2009 and at an additional 22 sites before the close of 2010. These Superfund site remediation proposals are the lowest in number since 1991. Of the total 527 contaminated properties appearing on the Superfund list, only about 40 have reached the final state of remediation. This last phase of work involves removing residual contaminated soil, constructing a treatment plant to remove toxic pollutants from groundwater, or capping a landfill to keep contamination from entering the drinking water or the air in nearby areas.[69]

Slow progress at the federal level is largely a result of a lack of funding. Consequently, Superfund sites have become increasingly contaminated, complicated, and costly to remediate. Since most corporate taxes on oil, chemical, and other large industries, which were used in Superfund cleanup efforts, have essentially expired, fewer sites have been remediated and environmental problems have begun to compound.[70]

EU

The European remediation market is largely driven by strong environmental regulations and policies, increasing demand for land, and public awareness that contamination issues can be successfully addressed.[71] Global Industry Analysts, Inc. (GIA) estimated that about 3.2 million sites were potentially contaminated in the EU in 2006. GIA concluded that oil and gas, steel, chemical, mining, power, and other related industries—including military activities—had been the most responsible for creating soil and water pollution across Europe.[72]

[69] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 68–69; EPA, CLU-IN, "Contaminated Site Clean-Up Information," n.d. (accessed November 13, 2012).

[70] Smith, *Remediation and Environmental Cleanup Services in the U.S.*, July 2012, 9; Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 67–69.

[71] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 77.

[72] Ibid., 76.

Eastern Europe, although considered a growth market, continues to lag behind Western Europe in terms of spending on environmental remediation.[73] Since 2004, Denmark and the Netherlands have spent billions of euros on remediation services and continue to have the highest remediation expenditures per euro of gross domestic product (GDP). Germany is the leading country in terms of gross expenditures, but trails behind the leaders in terms of percentage of GDP spent for remediation. Eastern European countries have spent lower percentages of GDP on remediation, but have the most severe problems.[74]

The EU is making rapid progress towards establishing Europe-wide remediation standards; however, most European countries have established and follow their own set of regulations.[75] The Netherlands, a world leader in remediation services, has one of the most rigorous sets of environmental standards.[76] Dutch regulations affecting the remediation market include the Soil Protection Act (Wet Bodembescherming) and the Surfacewater Pollution Act (Wet Verontreiniging Oppervlaktewater).[77] Moreover, due to growing scarcity of land,[78] the Netherlands has become a world leader in soil remediation technology. Approximately 1,000 soil remediation projects take place each year in the Netherlands, and it has become common practice to combine soil remediation with advanced spatial planning techniques to determine the extent of soil treatment needed. The Netherlands' soil remediation market represents one of the largest markets for remediation services in all of Europe.[79]

In addition to the Netherlands, three of the largest and most proactive remediation markets in the EU include Germany, France, and the United Kingdom. Germany has the largest soil remediation market in Europe, accounting for 30 percent of the EU market.[80] In Germany, funds worth €100 million (or about $130 million) were allocated between 1998 and 2008 by the German government for the development of remediation technologies that can cost-effectively clean up contaminated sites. Moreover, since environmental remediation is a key area of interest for most Germans, a growing number of German universities are offering degrees in environmental science with coursework in chemistry, geology, or geo-ecology.[81] In France—home to several of the world's largest and most advanced environmental firms—the remediation services market is sophisticated and extremely competitive.[82] Site remediation represents a lucrative market segment, with about 4,200 French sites (as of 2005) designated as contaminated and in need of some form of remediation. Most of these sites are located in the heavily populated Greater Paris, Nord-Pas-de-Calais, and Rhone-Alps regions. In addition, there were hundreds of other sites, mostly former industrial sites, for which survey and assessment for potential contamination was planned.[83]

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[73] Ernst & Young, "European Commission DG Environment," September 2006, 146.

[74] Mcilvaine Company, "$36 Billion World Site Remediation Market," April 2012.

[75] Ernst & Young, "European Commission DG Environment," September 2006, 151–52.

[76] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 8. In Europe, environmental remediation standards are better known as the "Dutch standards."

[77] Ibid.

[78] Largely due to rising sea levels.

[79] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 85; Ernst & Young, "European Commission DG Environment," September 2006, 144–45.

[80] Ernst & Young, "European Commission DG Environment," September 2006, 145.

[81] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 80.

[82] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 81; Ernst & Young, "European Commission DG Environment," September 2006, 144–45.

[83] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 81.

In the United Kingdom, the contaminated land remediation market was valued at approximately £920 million (or about $1.5 billion) as of 2005.[84] In recent years, regulatory and socioeconomic factors, such as the continuation of tax relief through the Land Remediation Relief program and preparation for the 2012 London Summer Olympics, have fueled growth in the land assessment and remediation services markets.[85] However, the worldwide economic downturn has slowed the UK's market growth, and recovery is expected to be modest once the economy begins to turn around. The UK contaminated land remediation market is served by both conventional service providers and new-technology providers. Though new-technology providers offer advanced remediation solutions, conventional physical solutions (such as excavation and removal) are the most widely used remediation techniques. Physical solutions account for about 88 percent of the total UK contaminated land remediation market, while technology-based solutions, including bioremediation, account for about 12 percent.[86] However, despite the high level of spending on remediation services in the UK, the market is characterized by a shortage of domestic service providers. There are only about 96 companies in the UK that directly offer some sort of remediation services,[87] far fewer than the United States (which, as noted previously, has more than 4,500 remediation firms of varying size and function). As a result, the United Kingdom is a very attractive market for foreign participants.[88]

China

A legacy of inadequate industrial pollution management has made land contamination a serious issue in China. In recent years, rapid urbanization has created an urgent need to redevelop industrial land once occupied—and contaminated—by old industries.[89] Brownfield sites are increasing in major Chinese cities as urban sprawl has overrun many polluting factories, pushing them to new locations and leaving health risks behind. In Beijing, more than 100 polluting factories inside the Fourth Ring Road have been relocated, leaving as much as 8 million square meters of industrial land to be redeveloped. Shanghai, Chongqing, Guangzhou, and other big cities are in a similar situation.[90] Given the growing hazards posed by old industrial sites in many Chinese cities, governments at the national and local levels have begun paying attention to brownfield issues and have started preparing plans for brownfield remediation and redevelopment.[91]

China's legal and regulatory system for soil pollution prevention and control is in its infancy. As land is owned by the state, the government is the main body in charge of land use. However, there is no national law encompassing land contamination and brownfield remediation and redevelopment. Legal requirements related to soil pollution and liability are scattered in the provisions of several existing national laws or regulations, and brownfield management in China is guided by an ad hoc set of documents, rules, and guidance issued by the government over the past several years.[92] For example, the 2008 State Environmental Protection Administration document set the following soil

[84] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 83.
[85] JDSupra, "UK Land Remediation Relief—Spared the Axe," February 7, 2012.
[86] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 83.
[87] Ibid., 84. Of the 96 companies, more than 70 percent are contractors.
[88] Global Industry Analysts, *Environmental Remediation: A Global Outlook*, January 2012, 84; Ernst & Young, "European Commission DG Environment," September 2006, 146.
[89] Xie and Li, "Overview of the Current Situation on Brownfield Remediation," September 2010, 1.
[90] China Environmental Remediation, "Healing the Land," 2011.
[91] Xie and Li, "Overview of the Current Situation on Brownfield Remediation," September 2010, 8.
[92] Ibid., 10.

pollution control targets for completion by 2015: "(1) Install a supervision and management system for soil pollution prevention; (2) develop a series of policies, laws and regulations on soil pollution prevention and control; (3) improve the standard system on soil pollution prevention and control and the soil environmental monitoring network; (4) establish an oil pollution emergency response system; (5) enhance soil environment protection efforts by significantly increasing public awareness of the issue; (6) implement soil pollution prevention planning, develop new soil pollution prevention and control technologies, and demonstrate significant results."[93] The document also calls for local authorities to urgently and fully understand the importance of, and contribute to, strengthening soil pollution prevention and control.[94]

Although nascent, the Chinese market is potentially huge, with the total soil remediation market's expected value to be as high as 40 billion renminbi (RMB) (or $6.4 billion) by 2015. Experts estimate that contaminated industrial sites number 300,000 to 600,000, and most soil remediation projects in China cost more than RMB 100 million ($16 million) each. In larger cities, however, the total costs can be substantially higher since there are more sites in need of remediation. For instance, in 2009, Chongqing (in southwest China) spent RMB 800 million ($127 million) assessing the contamination of 45 lots of land. The cost of cleaning up these sites are expected to exceed RMB 2 billion ($317 million) in total. Moreover, China's heavy demand for soil remediation has also created work for many domestic research institutes specializing in environmental sciences. These institutes assess pollution levels and develop detoxification programs.[95] In Beijing, environmental assessments have been conducted since 2007 on nearly 50 contaminated sites at which steel, coking, chemical and dye, textile, automotive, and pesticide production have occurred. Some of these sites are so severely contaminated that pollutants extend to 20 meters underground. Consequently, the redevelopment of these sites may require soil remediation costing tens of millions of dollars each.[96]

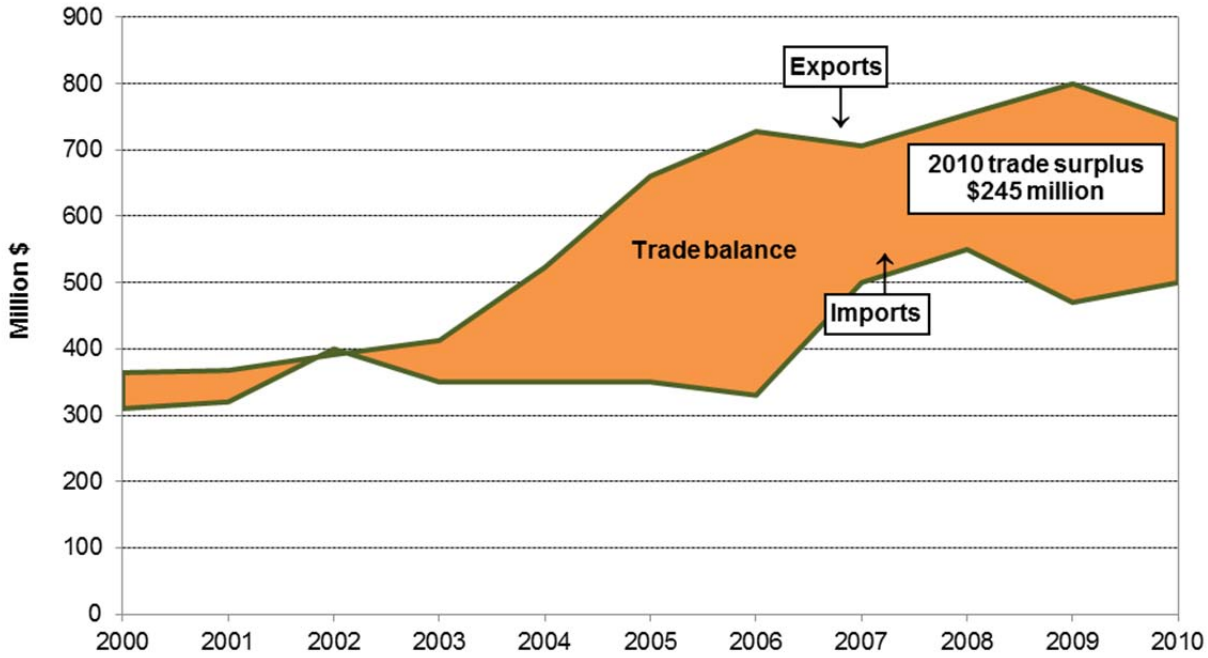
Trade and Investment

Trade in Remediation Services

Publicly available trade data for remediation services are very limited, since most environment-related firms (e.g., construction, engineering, etc.) characterize remediation services as a sub-business, making it difficult to capture the various activities involved in providing such services across borders. In 2010, the most recent year for which data are available, U.S. exports of remediation services totaled $745 million, whereas imports totaled $500 million, for a trade surplus of $245 million (figure 5.5). This trade surplus can largely be attributed to the competitiveness of U.S. remediation firms, which account for over one-third of the global market.[97]

[93] Xie and Li, "Overview of the Current Situation on Brownfield Remediation," September 2010, 7–8.
[94] Ibid., 8.
[95] China Environmental Remediation, "Healing the Land," 2011.
[96] Xie and Li, "Overview of the Current Situation on Brownfield Remediation," September 2010, 23–24.
[97] EBI, "The Global Environmental Market, 2010," spreadsheet received by email, November 28, 2012.

FIGURE 5.5 Remediation and industrial services: U.S. cross-border trade has resulted in a U.S. trade surplus during 2003–10



Source: EBI representative, e-mail message to USITC staff, November 20, 2012.

Nonetheless, overall trade in this industry is relatively low. Some U.S. firms manage remediation projects overseas, working in partnership with local or specialized firms or through foreign affiliates. This is the primary means through which trade occurs in the remediation services industry. Specifically, U.S.-based or other foreign-based consultants travel to remediation sites and provide "front-end" services, which include site assessment and engineering and design.[98] In most cases, the actual site construction and remediation (or "back-end") services are left to specialized subcontractors.[99] For example, in 2012, MWH Global (a U.S. firm) and its subcontractor, Scottish Water (UK), were awarded a contract by the Public Works Authority of Qatar to manage the full operation and maintenance of all Qatari drainage assets, including systems for wastewater treatment and collection, sewage, stormwater, and surface groundwater, in preparation for the Fédération Internationale de Football Association (FIFA) 2022 World Cup.[100] According to industry sources, most remediation firms are exporting only about 10 to 20 percent of the total labor that goes into completing overseas remediation projects from beginning to end.[101]

[98] Industry official, interview by USITC staff, San Francisco, CA, November 2, 2012.
[99] Industry official, interview by USITC staff, San Diego, CA, October 31, 2012.
[100] MWH Global, "Qatar Public Works Authority Appoints MWH Global," May 29, 2012.
[101] Industry official, interview by USITC staff, San Francisco, CA, November 2, 2012.

Foreign Investment in Remediation Services

Disaggregated data on international direct investment in remediation services are scarce. Official data on U.S. direct investment in remediation services are generally combined with data on other sectors, such as solid and hazardous waste services, making it difficult to account for precise macro-level investment flows.[102]

[102] EBI representative, telephone interview by USITC staff, November 28, 2012; USITC, *Solid and Hazardous Waste Services*, April 2004, 2-14 to 2-16.

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APPENDIX A
REQUEST LETTER

EXECUTIVE OFFICE OF THE PRESIDENT
THE UNITED STATES TRADE REPRESENTATIVE
WASHINGTON, D.C. 20508

The Honorable Irving A. Williamson
Chairman
U.S. International Trade Commission
500 E Street, S.W.
Washington, DC 20436

Dear Chairman Williamson,

I am writing to request that the U.S. International Trade Commission (Commission) conduct two investigations under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) regarding trade and market trends in the environmental services and renewable energy services sectors.

Since the publication of the Commission's investigations on environmental and renewable energy services in 2004 and 2005, the U.S. and global markets for such services have undergone significant change. In recent years, overall demand in the environmental services market has continued to rise due to new regulations, population and industry growth, and aging infrastructure. However, factors such as new technologies, tightening government budgets, and growing interest in environmental sustainability have altered the means through which such services are supplied. In the renewable energy services sector, technological improvements and decreasing prices have led to rapid growth in demand, particularly in the industry's wind and solar power segments. At the same time, changes in government incentive programs have created uncertainty regarding the future of the renewable energy market.

To assist us in better understanding recent developments in the environmental services and renewable energy services sectors, I request that the Commission conduct two investigations and prepare reports, as described below. I understand that the Commission will shape its approach to these investigations by the extent to which it can develop appropriate analytical frameworks and collect the requisite data.

Investigation 1: Based on available information, I request that the Commission provide a first report on environmental and related services that, to the extent practicable:

- Estimates the size of the U.S. and global markets for certain environmental and related services—including water and wastewater services, solid and hazardous waste services, and remediation services—identifies top suppliers and key country markets for such services, investigates factors affecting supply and demand in these market segments, and highlights market developments that have occurred within the last five years;
- Estimates the value of trade and investment in the subject environmental services segments, identifies key export and import markets for such services, and discusses recent trends in environmental services trade and investment; and
- Identifies barriers to trade and investment in the subject environmental services segments, discusses recent efforts to liberalize trade and investment in environmental services, and investigates the potential impact of further liberalization in environmental services.

I request that this report be delivered eight months from the date of receipt of this letter.

Investigation 2: Based on available information, I request that the Commission provide a second report on renewable energy and related services that, to the extent practicable:

- Defines types of renewable energy and related services, identifies leading suppliers, and generally describes the relationship of renewable energy services to the development of renewable energy projects worldwide;
- Estimates the size of the U.S. and global markets for certain renewable energy services, identifies key export and import markets for such services, and describes factors affecting supply and demand;
- Examines U.S. and global renewable energy services trade during 2007-11, and highlights recent trends in investment in renewable energy projects and firms, including new business strategies or practices;
- Identifies barriers to U.S. trade and investment in renewable energy services, and examines recent efforts to liberalize trade in leading markets for such services; and
- Examines the role of clean energy incentive programs in encouraging investment in and creating markets for renewable energy goods and services.

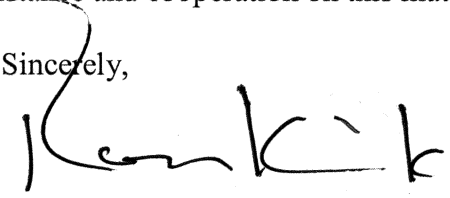
The report should focus on services incidental to the development, generation, and distribution of renewable energy, with particular emphasis on wind energy (onshore and offshore) and solar energy, and other technologies that the Commission's research shows to be of significance. Such services include scientific and technical consulting, services incidental to energy distribution, professional services, construction and engineering services, management consulting and related services, and maintenance and repair of equipment, among others.

I request that the second report be delivered eleven months from the date of receipt of this letter.

As we intend to make the Commission's reports available to the public, these reports should not include confidential business or national security classified information.

I appreciate the Commission's continued assistance and cooperation on this matter.

Sincerely,



Ambassador Ron Kirk

APPENDIX B
Federal Register Notice

ADDRESSES: The meetings will be in the Lewistown Field Office Conference Room at 920 NE Main, Lewistown, Montana.

FOR FURTHER INFORMATION CONTACT: Gary L. ''Stan'' Benes, Central Montana District Manager, Lewistown Field Office, 920 NE Main, Lewistown, MT 59457, (406) 538–1900, *gary_benes@blm.gov*. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1–800–677–8339 to contact the above individual during normal business hours. The FIRS is available 24 hours a day, 7 days a week to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: This 15-member council advises the Secretary of the Interior on a variety of management issues associated with public land management in Montana. During these meetings the council will participate in/discuss/act upon these topics/activities: a roundtable discussion among council members and the BLM; the Charles M. Russell National Wildlife Refuge conservation plan; a Greater Sage-Grouse update; Judith River and Arrow Creek reserved water rights update; district managers' updates; fire and mitigation education program updates; Draft HiLine Resource Management Plan and Ft. Belknap Water compact update; a riparian assessment report; and U.S. Department of the Interior Bison Conservation Initiative update. All RAC meetings are open to the public. The public may present written comments to the RAC. Each formal RAC meeting will also have time allocated for hearing public comments. Depending on the number of persons wishing to comment and time available, the time for individual oral comments may be limited.

Gary L. ''Stan'' Benes,

Central Montana District Manager.

[FR Doc. 2012–21006 Filed 8–24–12; 8:45 am]

BILLING CODE P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–533]

Environmental and Related Services

AGENCY: United States International Trade Commission.

ACTION: Institution of investigation and scheduling of public hearing.

SUMMARY: Following receipt of a request on July 30, 2012 from the U.S. Trade Representative (USTR) under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), the U.S. International Trade Commission (Commission) instituted investigation No. 332–533, *Environmental and Related Services.*

DATES: October 4, 2012: Deadline for filing requests to appear at the public hearing.

October 10, 2012: Deadline for filing pre-hearing briefs and statements.

October 22, 2012: Public hearing.

October 30, 2012: Deadline for filing post-hearing briefs and statements and all other written submissions.

March 29, 2013: Transmittal of Commission report to USTR.

ADDRESSES: All Commission offices, including the Commission's hearing rooms, are located in the United States International Trade Commission Building, 500 E Street SW., Washington, DC. All written submissions should be addressed to the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436. The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at *https://edis.usitc.gov/edis3-internal/app.*

FOR FURTHER INFORMATION CONTACT: Project Leader Jennifer Powell (202–205–3450 or *Jennifer.Powell@usitc.gov*) or Deputy Project Leader Joann Peterson (202–205–3032 or *Joann.Peterson@usitc.gov*) for information specific to this investigation. For information on the legal aspects of this investigation, contact William Gearhart of the Commission's Office of the General Counsel (202–205–3091 or *william.gearhart@usitc.gov*). The media should contact Margaret O'Laughlin, Office of External Relations (202–205–1819 or *margaret.olaughlin@usitc.gov*). Hearing-impaired individuals may obtain information on this matter by contacting the Commission's TDD terminal at 202–205–1810. General information concerning the Commission may also be obtained by accessing its Internet server (*http://www.usitc.gov*). Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2000.

Background: In his letter the USTR requested that the Commission prepare two reports, one on environmental and related services, and a second on renewable energy and related services, and deliver the reports in 8 and 11 months, respectively, after receipt of the letter. This notice announces the institution of an investigation and schedule, including the date for a public hearing, relating to the preparation of the first report; the Commission will announce the institution of a second investigation and schedule relating to preparation of the second report in a second notice.

As requested by the USTR, the Commission will provide a first report, on environmental and related services, that, to the extent practicable:

- Estimates the size of the U.S. and global markets for certain environmental and related services—including water and wastewater services, solid and hazardous waste services, and remediation services—identifies top suppliers and key country markets for such services, investigates factors affecting supply and demand in these market segments, and highlights market developments that have occurred within the last five years;
- Estimates the value of trade and investment in the subject environmental services segments, identifies key export and import markets for such services, and discusses recent trends in environmental services trade and investment; and
- Identifies barriers to trade and investment in the subject environmental services segments, discusses recent efforts to liberalize trade and investment in environmental services, and investigates the potential impact of further liberalization in environmental services.

As requested, the Commission expects to deliver this first report to the USTR no later than March 29, 2013.

Public Hearing: A public hearing in connection with this investigation will be held at the U.S. International Trade Commission Building, 500 E Street SW., Washington, DC, beginning at 9:30 a.m. on October 22, 2012. Requests to appear at the public hearing should be filed with the Secretary no later than 5:15 p.m., October 4, 2012. All pre-hearing briefs and statements should be filed not later than 5:15 p.m., October 10, 2012 and all post-hearing briefs and statements should be filed not later than 5:15 p.m., October 30, 2012; all such pre- and post-hearing briefs and statements must be filed in accordance with the requirements in the ''Submissions'' section below. In the event that, as of the close of business on October 4, 2012 no witnesses are scheduled to appear at the hearing, the hearing will be canceled. Any person interested in attending the hearing as an observer or nonparticipant should contact the Office of the Secretary at 202–205–2000 after October 4, 2012, for

information concerning whether the hearing will be held.

Written Submissions: In lieu of or in addition to participating in the hearing, interested parties are invited to file written submissions concerning this investigation. All written submissions should be addressed to the Secretary, and should be received not later than 5:15 p.m., October 30, 2012. All written submissions must conform with the provisions of section 201.8 of the *Commission's Rules of Practice and Procedure* (19 CFR 201.8). Section 201.8 and the Commission's Handbook on Filing Procedures require that interested parties file documents electronically on or before the filing deadline and submit eight (8) true paper copies by 12:00 noon eastern time on the next business day. In the event that confidential treatment of a document is requested, interested parties must file, at the same time as the eight paper copies, at least four (4) additional true paper copies in which the confidential information must be deleted (see the following paragraph for further information regarding confidential business information). Persons with questions regarding electronic filing should contact the Secretary (202–205–2000).

Any submissions that contain confidential business information (CBI) must also conform with the requirements in section 201.6 of the *Commission's Rules of Practice and Procedure* (19 C.F.R. 201.6). Section 201.6 of the rules requires that the cover of the document and the individual pages be clearly marked as to whether they are the ''confidential'' or ''non-confidential'' version, and that the confidential business information be clearly identified by means of brackets. All written submissions, except for confidential business information, will be made available for inspection by interested parties.

In the request letter, the USTR stated that his office intends to make the Commission's report available to the public in its entirety, and asked that the Commission not include any confidential business information or national security classified information in the report that the Commission sends to the USTR. Any confidential business information received by the Commission in this investigation and used in preparing this report will not be published in a manner that would reveal the operations of the firm supplying the information.

By order of the Commission.

Issued: August 21, 2012.

Lisa R. Barton,

Acting Secretary to the Commission.

[FR Doc. 2012–20956 Filed 8–24–12; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 731–TA–702 (Third Review)]

Ferrovanadium and Nitrided Vanadium From Russia

Determination

On the basis of the record [1] developed in the subject five-year review, the United States International Trade Commission (Commission) determines, pursuant to section 751(c) of the Tariff Act of 1930 (19 U.S.C. 1675(c)), that revocation of the antidumping duty order on ferrovanadium and nitrided vanadium from Russia would not be likely to lead to continuation or recurrence of material injury to an industry in the United States within a reasonably foreseeable time.

Background

The Commission instituted this review on September 1, 2011 (76 FR 54490) and determined on December 5, 2011 that it would conduct a full review (76 FR 79214, December 21, 2011). Notice of the scheduling of the Commission's review and of a public hearing to be held in connection therewith was given by posting copies of the notice in the Office of the Secretary, U.S. International Trade Commission, Washington, DC, and by publishing the notice in the **Federal Register** on February 8, 2012 (77 FR 6582). The hearing was held in Washington, DC, on June 21, 2012, and all persons who requested the opportunity were permitted to appear in person or by counsel.

The Commission transmitted its determination in this review to the Secretary of Commerce on August 22, 2012. The views of the Commission are contained in USITC Publication 4345 (August 2012), entitled *Ferrovanadium and Nitrided Vanadium from Russia: Investigation No. 731–TA–702 (Third Review).*

Issued: August 22, 2012.

[1] The record is defined in sec. 207.2(f) of the Commission's Rules of Practice and Procedure (19 CFR 207.2(f)).

By order of the Commission.

Lisa R. Barton,

Acting Secretary to the Commission.

[FR Doc. 2012–21048 Filed 8–24–12; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 337–TA–844]

Certain Drill Bits and Products Containing Same; Determination To Review an Initial Determination; on Review, Affirmance of Grant of Summary Determination on the Merits; Termination of the Investigation

AGENCY: U.S. International Trade Commission.

ACTION: Notice.

SUMMARY: Notice is hereby given that the U.S. International Trade Commission has determined to review an initial determination (''ID'') (Order No. 9) of the presiding administrative law judge (''ALJ'') granting summary determination of no importation and terminating the investigation. On review, the Commission has determined to affirm the ALJ's grant of summary determination of no importation on the merits and terminates the investigation.

FOR FURTHER INFORMATION CONTACT: Panyin A. Hughes, Office of the General Counsel, U.S. International Trade Commission, 500 E Street SW., Washington, DC 20436, telephone (202) 205–3042. Copies of non-confidential documents filed in connection with this investigation are or will be available for inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 500 E Street SW., Washington, DC 20436, telephone (202) 205–2000. General information concerning the Commission may also be obtained by accessing its Internet server at *http://www.usitc.gov*. The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at *http://edis.usitc.gov*. Hearing-impaired persons are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on (202) 205–1810.

SUPPLEMENTARY INFORMATION: The Commission instituted this investigation on June 4, 2012, based on a complaint filed by Boart Longyear Company and Longyear TM, Inc. both of South Jordan, Utah. 76 FR 32997 (June 4, 2012). The complaint alleged violations of section 337 of the Tariff Act of 1930, as amended 19 U.S.C. 1337, in the

APPENDIX C
Chapter 2: Tables

TABLE C.1 Mode 3 GATS commitments on environmental services

Members	Sewage services (CPC 9401)	Refuse disposal services (CPC 9402)	Sanitation and similar services (CPC 9403)	Other[a]	Sectors included in "Other" category	Nature of restrictions
Albania	Full	Full	Full	Full	CPC 9404 and CPC 9405	
Armenia	Full	Full	Full	Full	CPC 9404, CPC 9405, and CPC 9406	
Australia	Full	Full	Full	No commitment		
Austria	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Bulgaria	Full	Full	Full	Full	Part of CPC 9404, part of CPC 9405, and part of CPC 9406	
Cambodia	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Canada	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Cape Verde	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Central African Republic	No commitment	No commitment	No commitment	Full	Wildlife protection service, ONG environment	
China	Partial	Partial	Partial	Partial	CPC 9404, CPC 9405, CPC 9406, CPC 9409	Foreign services suppliers engaged in environmental services are permitted to provide services only in the form of joint ventures, with foreign majority ownership permitted.
Colombia	No commitment	No commitment	No commitment	Full	Environmental conservation and industrial safety in connection with oil spills, pollution and fire; environmental impact studies.	

TABLE C.1—*Continued*

Croatia	Partial	Partial	Partial	Full	CPC 9404, CPC 9405, CPC 9406, CPC 9409	These services are legally considered as municipal activities, provided primarily by entities owned by local authorities. Private operators may be allowed to provide these services on the basis of a concession granted by local authorities.
Czech Republic	Full	Full	Full	No commitment		
Ecuador	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, CPC 9409	
El Salvador	No commitment	No commitment	No commitment	Partial	CPC 94040, CPC 94050, CPC 94060, CPC 94090	It is necessary to apply to the municipal authorities for the concession or license to provide refuse disposal services, with the requirement that the applicant be domiciled in El Salvador.
Estonia	Full[b]	Full[b]	Full	Full	CPC 9404, CPC 9405, CPC 9405, and CPC 9406	
European Community	Full	Full	Full	Full	CPC 9404,CPC 9406, and CPC 9409	
Finland	No commitment	Full	No commitment	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9406	
Gambia	Full	No commitment	Full	No commitment		
Georgia	Full	Full	Full	Partial	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	For CPC 9409: Foreign persons are allowed to supply services only through the joint ventures. Participation of foreign equity share is not limited.
Guinea	Full	No commitment	Full	No commitment		
Hungary	No commitment	Full	Full	No commitment		
Iceland	Partial	Partial	Full	Partial	Not explicit	An environmental operation license required.
Israel	Full[c]	Full[c]	Full[c]	Full	CPC 9404 and CPC 9405[c]	

TABLE C.1—*Continued*

Japan	Full	Partial	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	The number of licenses conferred to service suppliers of waste oil disposal at sea from vessels may be limited. All sectors' mode 3 national treatment commitments refer to horizontal commitments.
Jordan	No commitment	No commitment	Full	Full	CPC 9404, CPC 9405, and CPC 9409	
Korea	Partial[d]	Partial[d]	No commitment	Partial	CPC 9404 and CPC 9405 (services other than construction work). Only environmental impact assessment services under CPC 9406 and CPC 9409.	CPC 9401: the number of service suppliers is limited to twenty-five (25). CPC 9402, CPC 9406, CPC 9409: Establishment of a commercial presence is subject to the economic needs test. Refuse collection and transport service suppliers may conduct business only within the jurisdiction of the respective regional environment office which has granted them approval for operation.
Kuwait	Full	Full	Full	No commitment		
Kyrgyzstan	Full	Full	Full	Full	Not explicit	
Latvia	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Lesotho[e]	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406	
Liechtenstein[f]	Full	Full[g]	Full	Full	CPC 9404, CPC 9405, CPC 9406, and part of CPC 9409	
Lithuania	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406 other than destined to national parks, and CPC 9409	
Macedonia	Full	Full	Full	Full	CPC 94040, CPC 94050, CPC 94060	
Moldova	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Morocco	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	

TABLE C.1—*Continued*

Nepal	Partial	Partial	Partial	No commitment		Only through incorporation in Nepal and with maximum foreign equity capital of 51 percent. Foreign equity participation will be increased to 80 percent after 5 years from the date of accession.
Norway	Full	Partial	Full	Partial	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	For some categories of waste there exists a monopoly situation. Government owned monopoly for control services of exhaust-gas from cars and trucks; such services must be offered on a non-profit basis.
Oman	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
Panama	No commitment	No commitment	No commitment	Full	CPC 9404, CPC 9405, and part of CPC 9406[h]	
Poland	No commitment	No commitment	No commitment	Full	CPC 9404, CPC 9405[i]	
Qatar	Full	Full	Full	Full	Not explicit	
Romania	No commitment	No commitment	No commitment	Full	Not explicit	
Rwanda	No commitment	No commitment	Full	No commitment		
Saudi Arabia	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409 (including environmental impact assessment)	
Sierra Leone	Full	Full	Full	Full	Not explicit	
Slovakia	Full	Full	Full	No commitment		
Slovenia	Full	Full	Full	Full	CPC 9406	
South Africa[j]	Full	Full	Full	Full	CPC 9404, CPC 9405, and CPC 9406	
Sweden[k]	Full	Full	Full	Partial	CPC 9404, CPC 9405, and CPC 9406, CPC 9409	CPC 9404: Government owned monopoly for control services of exhaust-gas from cars and trucks. Such services must be offered on a non-profit basis.
Switzerland[l]	Full	Full[g]	Full	Full	CPC 9404, CPC 9405, and CPC 9406, and part of CPC 9409	
Taiwan	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9409, and consulting services incidental to CPC 9406	

TABLE C.1—*Continued*

Thailand	Partial	Partial	Partial	Partial	CPC 9404, CPC 9405, and CPC 9406, and CPC 9409	Market access commitments refer to horizontal section. National treatment conditions indicate no limitations as long as foreign equity participation does not exceed 49 percent.
Tonga	Full	Full	Full	Full	CPC 9404, CPC 9405, and CPC 9406, and CPC 9409	
Turkey	Full	Full	Full	No commitment		
Ukraine	Full	Full	Full	Full	CPC 9404, CPC 9405, CPC 9406, and CPC 9409	
United Arab Emirates	Full	Full	Full	Full	Not explicit	
United States[m]	Full[b]	Full[b]	Full	Full	CPC 9404, CPC 9405, and CPC 9406, and CPC 9409	
Vietnam[n]	Partial	Partial[o]	No commitment	Partial	CPC 9404, CPC 9405, and CPC 9409	CPC 9401, CPC 9402, CPC 9404, CPC 9405: Commitments confirm that services supplied in the exercise of governmental authority as defined in Article I:3(c) may be subject to public monopolies or exclusive rights granted to private operators. Upon accession, joint ventures with foreign capital contribution not exceeding 51 percent are allowed during 4 years after accession. After that, none. CPC 9402: For the purpose of ensuring public welfare, foreign-invested enterprises are restricted from collecting refuse directly from households. They are only permitted to provide services at the refuse collection points as specified by local municipal and provincial authorities. CPC 9409 - foreign ownership is limited to 51 percent during 4 years after accession. After that, none.
Total	49	48	50	49		

Source: WTO, Member/ Sector Matrix Report, Environmental Services, http://tsdb.wto.org/matrixlist.aspx (accessed November 9, 2012); WTO, "Services: Commitments", http://www.wto.org/english/tratop_e/serv_e/serv_commitments_e.htm (accessed March 12, 2013).

This table lists the mode 3 commitments made by members in environmental services. The list of members with commitments in environmental services is derived through the WTO Member/Sector Matrix Report sourced above. An entry marked "Full" indicates there are no restrictions for the particular sector (however, see notes a-o for sectoral exclusions); "Partial" indicates that some restrictions apply (these are listed under the column heading "Nature of restrictions"); "No commitment" indicates no specific commitment has been made. Descriptions under "Nature of restrictions" are taken directly from source as are notes a–o below.

[a] "Other" services most commonly specified in GATS members' environmental services commitments include cleaning services of exhaust gases (9404); noise abatement services (9405); nature and landscape protection services (9406); other environmental protection services not elsewhere classified (9409).
[b] Services contracted by private industry.
[c] Not including industrial activities.

Footnotes—*Continued*

[d] Only collection and treatment services of industrial waste water under CPC 9401. Only collection, transport and disposal services of industrial refuse under CPC 9402.

[e] All entries in this sector are restricted to consultancy services only.

[f] Nothing in this commitment should be construed to include public work functions whether owned and operated by municipalities or the Liechtenstein government or contracted out by them.

[g] Unbound for garbage dumps.

[h] Commitments under CPC 9404 and CPC 9405 will be limited to the following activities: implementation and installation of new or existing cleaning systems, remedial, preventive and monitoring services; consulting services in these fields. Commitments under part of CPC 9406 exclusively include services for conducting studies on the relation between the environment and climate, including services of evaluation of natural disaster and reduction of their consequences.

[i] Includes other monitoring of the environment, consultancy related to environmental protection, cleaning of exhaust gases, and noise abatement.

[j] All entities in this sector are restricted to consultancy services only.

[k] The offer does not include public works functions whether owned and operated by municipalities, state or federal governments or contracted out by these governments.

[l] Nothing in this commitment should be construed to include public work functions whether owned and operated by municipalities, cantons or the federal government or contracted out by them.

[m] U.S. commitments are limited to the following activities: implementation and installation of new or existing systems for environmental cleanup, remediation, prevention and monitoring; implementation of environmental quality control and pollution reduction services; maintenance and repair of environment related systems and facilities not already covered by the US commitments on maintenance and repair of equipment; on-site environmental investigation, evaluation, monitoring; sample collection services; training on site or at the facility; consulting related to these areas.

[n] Access to certain geographic areas may be restricted for national security reasons.

[o] Import of refuse is forbidden by law. Treatment and disposal of hazardous waste is regulated by law.

BOX C.1 Barriers in specific markets

There are two publicly available indicators that together provide an overall snapshot of the barriers described in chapter 2: (1) the OECD FDI Index, which measures restrictions on foreign investment, and (2) the OECD indicators of sectoral regulation (NMR), which measures the extent of anticompetitive regulations, such as licensing provisions, public ownership limitations, and other restrictions which are largely applied to both domestic and foreign service providers. Though there may be additional items that might affect a firm's ability to provide environmental services in foreign markets, together the two indices provide a general view of barriers in the related services discussed above.

The OECD FDI Index focuses on four types of investment barriers: equity restrictions, investment screening and approval requirements, restrictions on foreign key personnel, and other operational restrictions (such as limits on purchase of land or on repatriation of profits and capital).[a] These measures are weighted into a single index ranging from 0 (completely open) to 1 (completely closed). The FDI Index largely captures measures that are discriminatory towards foreign service providers.

Table C.2 lists the FDI restrictiveness scores in 2012 for several countries across five sectors: architecture, engineering, construction, electricity, and road transport services. When a country scores more than zero in any listed sector, the category of restrictions is also listed (in the table) in order to show what type of restrictions are most prevalent. For example, within architecture, engineering, and construction services, foreign equity restrictions are uncommon, while operational restrictions[b] seem customary. Foreign equity restrictions seem to be more frequently applied in road transport (e.g., Brazil, China, and Russia) and electricity services (e.g., China, India, Russia, and the United States).

The OECD NMR Index captures regulations that affect competition in a number of sectors.[c] For professional services, the index includes entry regulations (i.e., licensing and educational requirements, and quotas or economic needs tests applied to foreign suppliers) and conduct regulations (i.e., restrictions on prices and fees, advertising, legal form, and interprofessional cooperation). The categories are collapsed into one index ranging from 0 to 6, where a value of 6 is assigned to the most anticompetitive regulations. Table C.3 shows the architecture and engineering index in 2008 (the latest available year) for several countries: both entry and conduct regulations seem to be applied in each of the countries included in the table.

For electricity services, the index captures entry regulations, public ownership, and vertical integration. For road transport, several categories of entry regulations (including licensing, limitations on industry capacity, and criteria for allowing new operators) and price controls are included. As with professional services, these measures are formed into a single index ranging from 0 to 6. Table C.3 displays the measures for 2007 (the latest available year). Canada, China, India, and South Africa have regulations across all three categories within electricity services, and most of the countries included in the table regulate entry in road transport.

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[a] The data are available at http://www.oecd.org/investment/fdiindex.htm. See Kalinova, Palerm, and Thomsen, "OECD's FDI Restrictiveness Index: 2010 Update," 2010, for information on sources, methodology, and coverage in terms of country, sector, and year.

[b] These restrictions may involve limitations on establishment of branches, requirements for local incorporation, reciprocity requirements, restrictions on profit or capital repatriations and on access to local finance, or restrictions related to land ownership.

[c] The data are available at www.oecd.org/economy/pmr. Note that the PMR refers to "indicators of economy-wide regulation," while NMR refers to "indicators of sectoral regulation." See Conway and Nicoletti, "Product Market Regulation in the Non-Manufacturing Sectors of OECD Countries," 2006, for information on sources, methodology, and coverage in terms of country, sector, and year.

TABLE C.2 OECD FDI restrictiveness score, select countries, 2012

Country	Architecture	Construction	Electricity	Engineering	Road transport
Brazil	.025 (IV)	.025 IV)	.025 (IV)	.025 (IV)	.275 (I, IV)
Canada	.1 (II)	.1 (II)	.1 (II)	.1 (II)	.1 (II)
China	.150 (II, III)	.290 (I, III, IV)	.463 (I, II, III)	.150 (II, III)	.350 (I, II, III)
France	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)
Germany	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)
India	0 (completely open)	.150 (IV)	.050 (I)	.250 (I)	0 (completely open)
Japan	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)
Russia	.050 (IV)	.050 (IV)	.030 (I, II, IV)	.050 (IV)	.350 (I, IV)
South Africa	.010 (IV)	.010 (IV)	.010 (IV)	.010 (IV)	.10 (IV)
Spain	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)	0 (completely open)
United Kingdom	.023 (IV)	.023 (IV)	.023 (IV)	.023 (IV)	.023 (IV)
United States	0 (completely open)	0 (completely open)	.197 (I, III)	0 (completely open)	0 (completely open)

Source: The FDI Regulatory Restrictiveness Index, http://www.oecd.org/investment/fdiindex.htm (accessed November 20, 2012).

Note: For each country the FDI restrictiveness score is shown. The score ranges from 0 (completely open) to 1 (completely closed); for methodology refer to Kalinova, Palerm, and Thomsen, "OECD's FDI Restrictiveness Index: 2010 Update," 2010. If a country has restrictions on FDI, the type of restriction is listed in each cell as either I, II, III, or IV, which respectively refer to:

(I) foreign equity limitations;
(II) screening or approval mechanisms;
(III) restrictions on the employment of foreigners as key personnel; or
(IV) operational restrictions, e.g., restrictions on branching and on capital repatriation or on land ownership.

TABLE C.3 OECD indicators of sectoral regulation (NMR), select countries, 2008 (architecture and engineering) and 2007 (electricity and road transport)

Country	Architecture	Engineering	Electricity	Road freight
Brazil	([a])	([a])	2.2 (I, II)	0.5 (II)
Canada	3.1 (entry I, II; conduct I, II, II)	2.9 (entry I, II; conduct III)	3.3 (I,II, III)	0.5 (II)
China	4.0 (entry I, III; conduct I, II, III)	3.2 (entry I, II, III; conduct I, II, III)	5.4 (I, II, III)	5.2 (I,II)
France	2.8 (entry I, II; conduct I, II)	0 (none)	2.0 (II, III)	2.2 (II)
Germany	3.1 (entry I, II; conduct I, II, III)	2.3 (entry I, II; conduct III)	0.5 (III)	1 (II)
India	2.8 (entry I, III; conduct I, II, III)	1.2 (entry II; conduct I)	3.8 (I, II, III)	1 (II)
Japan	1.2 (entry I, II)	0.3 (conduct II)	1.6 (I, III)	1 (II)
Russia	([a])	([a])	1.5 (II)	([a])
South Africa	3.5 (entry I, II; conduct I, II, III)	2.9 (entry I, II: conduct III)	5.3 (I, II, III)	0 (none)
Spain	2.1 (entry I, II; conduct II, III)	1.6 (entry I, II)	0.5 (II)	0.5 (II)
United Kingdom	0 (none)	0 (none)	0 (none)	0.5 (II)
United States	0.3 (conduct II)	0.3 (conduct II)	1.8 (I, III)	0.5 (II)

Source: OECD Indicators of sectoral regulation in professional services and in energy, transport, and communications: www.oecd.org/economy/pmr (accessed November 20, 2012).

Note: For each country the NMR restrictiveness score is shown along with the nature of the restrictions. The score ranges from 0 to 6, with higher scores denoting increasing restrictiveness; refer to above OECD website for methodology.
For architecture and engineering services, entry regulations are categorized as:
(I) the licensing system;
(II) education requirements;
(III) quotas and economic needs tests.
For the same services, conduct regulations are categorized as:
(I) regulations on the form of business and interprofessional cooperation;
(II) regulations on advertising;
(III) regulations on prices and fees.
For electricity services, regulations are categorized as:
(I) regulations on entry;
(II) structure of public ownership;
(III) degree of vertical integration.
For road transport, regulations are categorized as:
(I) regulations on prices;
(II) regulations on entry.

The following data are missing: data on architecture for entry II in China; data on architecture and engineering for entry I and entry III in India; data on architecture and engineering for entry III in South Africa.

[a]Not available.

TABLE C.4 Sales of environmental services enterprises in the European Union, 2009

	All firms	Foreign affiliates		Intra-EU-27-owned foreign affiliates		Extra EU-27-owned foreign affiliates	
Country where the firm or affiliate is located[a]	Value (million €) (1)	Value (million €) (2)	Percentage of all sales originating from foreign affiliates (3)	Value (million €) (4)	Foreign affiliate sales by intra-EU 27-owned foreign affiliates as a share of all foreign affiliate sales (percent) (5)	Value (million €) (6)	Foreign affiliate sales by extra-EU 27-owned foreign affiliates as a share of all foreign affiliates (7)
EU-27	190,000	:		15,136		:	
Belgium	:	:		:		:	
Bulgaria	659.6	117.4	17.80	115.2	98.13	2.1	
Czech Republic	3,702.7	1,650.0	44.56	1,604.6	97.25	45.4	2.75
Denmark	3,146.4	:		:		:	
Germany	39,511.4	2,439.9	6.18	:		:	
Estonia	207.9	:		:		0.0	0.00
Ireland	1,402.7	106.1	7.56	:		:	
Spain	12,152.6	153.8	1.27	:		:	
France	30,247.3	1,795.1	5.93	1,618.6	90.17	176.5	9.83
Italy	26,806.8	660.5	2.46	598.8	90.66	61.6	9.33
Cyprus	250.8	:		:		0.0	
Latvia	244.6	48.4	19.79	47.4	97.93	1.0	2.07
Lithuania	346.5	56.2	16.22	:		:	
Luxembourg	184.5	85.1	46.12	:		:	
Hungary	2,119.1	315.3	14.88	284.2	90.14	31.1	9.86
Malta	:	:		:		:	
Netherlands	8,257.8	:		:		:	
Austria	3,935.5	220.7	5.61	191.3	86.68	29.4	13.32
Poland	4,690.1	701.5	14.96	:		:	
Portugal	2,492.0	214.7	8.62	:		:	
Romania	2,539.5	874.1	34.42	656.6	75.12	217.5	24.88
Slovenia	763.9	47.2	6.18	:		:	
Slovakia	925.5	141.8	15.32	120.8	85.19	21.0	14.81
Finland	2,141.4	147.2	6.87	147.2	100.00	0.0	0.00
Sweden	3,262.8	402.9	12.35	:		:	
United Kingdom	31,930.9	10,108.0	31.66	3,927.4	38.85	6,180.6	61.15
Norway	2,096.3	:		:		:	
Croatia	:	:		:		:	

TABLE C.4 *—continued*

Country where the affiliate is located[a]	U.S.-owned foreign affiliates		German-owned foreign affiliates		Spanish-owned foreign affiliates		French-owned foreign affiliates		UK-owned foreign affiliates	
	Value (million €) (8)	Foreign affiliate sales by U.S.-owned foreign affiliates as a share of all foreign affiliate sales (percent) (9)	Value (million €) (10)	Foreign affiliate sales by German-owned foreign affiliates as a share of all foreign affiliate sales (percent) (11)	Value (million €) (12)	Foreign affiliate sales by Spanish-owned foreign affiliates as a share of all foreign affiliate sales (percent) (13)	Value (million €) (14)	Foreign affiliate sales by French-owned foreign affiliates as a share of all foreign affiliate sales (percent) (15)	Value (million €) (16)	Foreign affiliate sales by UK-owned foreign affiliates as a share of all foreign affiliate sales (percent) (17)
EU-27	799		1,797		1,220		7,181		728	
Belgium	:		:		:		:		:	
Bulgaria	:		:		:		:		:	
Czech Republic	:		:		:		742.0	44.97	:	
Denmark	0.0		:		0.0		:		0.0	
Germany	:		:		:		1,195.2	48.99	69.4	2.84
Estonia	0.0		:		0.0		:		0.0	
Ireland	:		0.0	0.00	0.0	0.00	:		:	
Spain	:		:		0.0	0.00	:		:	
France	26.1	1.45	358.1	19.95	:		:		11.7	0.65
Italy	:		:		28.8	4.36	465.6	70.49	:	
Cyprus	0.0		0.0		0.0		:		0.0	
Latvia	:		:		0.0	0.00	:		0.0	0.00
Lithuania	:		8.1	14.41	0.0	0.00	:		0.0	0.00
Luxembourg	:		:		0.0	0.00	:		0.0	0.00
Hungary	10.3	3.27	136.6	43.32	:		38.2	12.12	:	
Malta	:		:		:		:		:	
Netherlands	:		:		0.0		:		303.2	
Austria	:		33.6	15.22	136.9	62.03	:		0.0	0.00
Poland	0.0	0.00	343.7	49.00	:		97.9	13.96	0.0	0.00
Portugal	:		:		88.2	41.08	68.2	31.77	:	
Romania	2.0	0.23	261.8	29.95	0.2	0.02	150.3	17.19	85.2	9.75
Slovenia	0.0	0.00	4.0	8.47	0.0	0.00	:		0.0	0.00
Slovakia	:		:		0.0	0.00	:		0.0	0.00
Finland	0.0	0.00	:		0.0	0.00	:		0.0	0.00
Sweden	:		107.7	26.73	0.0	0.00	:		0.0	0.00
United Kingdom	:		:		460.2	4.55	2,946.6	29.15	:	
Norway	:		:		0.0		:		:	
Croatia	:		:		:		:		:	

Source: Eurostat, Structural Business Statistics, "Foreign Controlled EU Enterprises—inward FATS (fats)," http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database (accessed August 29, 2012).

Note: A foreign affiliate is defined as an enterprise resident in a country over which an institutional unit not resident in the compiling country has control; foreign-controlled affiliates are defined as those where foreign investors have more than 50 percent of the voting rights. Missing data are represented as ":" and differ from zero values, which are indicated in the table. "All firms" shows data for all enterprises located in each country or territory. €190,000 million represents total turnover of enterprises (including enterprises under EU-27 control) dealing with water supply, sewage, waste management, and remediation activities which are located in the EU27-area. "Foreign affiliates" shows data for all foreign enterprises located in country (data do not include the enterprises under each country's control); "intra-EU" refers to countries within the EU, consisting of 27 member states; "extra-EU" refers to countries outside of the EU. Data refer to enterprises classified in NACE Rev2 E (water supply, sewage, waste management, and remediation activities). Email communication with Eurostat representative, November 27, 2012; Eurostat website, "Foreign affiliate statistics—FATS," http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Foreign_affiliates_statistics_-_FATS (accessed November 27, 2012); Eurostat website, "Foreign controlled EU enterprises—inward FATS," http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/fats_esms.htm (accessed November 27, 2012).

[a]Countries are listed in the order they appear in Eurostat's database.

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APPENDIX D
Chapter 2: Further Description of Gravity Model and Results

The Model

The empirical model used in this study is based on recent quantitative research assessing foreign direct investment (FDI) stock or flows within a gravity framework. The model is estimated using a Poisson regression, and ordinary least squares (OLS) results are displayed to confirm the Poisson findings.[1] The Poisson is a nonlinear model normally used in the literature to correct for data imperfections. In particular, a common occurrence with trade data is the high number of zero-valued observations, especially at finer levels of sectoral disaggregation or with an expanded dataset including small or developing countries. Traditional gravity equations, which estimate trade flows using OLS in their log form, exclude observations with a value of zero. But the zero-valued observations may contain meaningful information, especially in connection with the impact that barriers may have on prohibiting trade. A number of solutions to this problem have been proposed, including the Poisson model.[2] The Poisson model is useful because, as a nonlinear model, it can incorporate zero-valued trade observations. Using alternatives to OLS is recommended in any case, since estimating OLS in the traditional log-linearized form may produce biased estimates in the presence of heteroskedastic standard errors.[3]

The main independent variable of interest is the "related-service index," which is a measure of barriers on upstream sectors—including architecture, engineering, electricity, and road transport—in host countries. The barriers refer to the OECD's NMR index, which captures regulations that affect competition (see discussion in chapter 2); for example, for professional services, the index includes licensing and education requirements, quotas or economic needs tests applied to foreign suppliers, and restrictions such as those on advertising or legal form (see appendix C, box C.1 for more information). The regulations captured in the NMR index largely apply to all service suppliers (i.e., they are nondiscriminatory towards foreign entities). Hence the NMR index captures the general level of competition and productivity in local sectors and is the preferred index in the estimations below, since U.S. industry representatives have reported that they have used both foreign and local services and other inputs when providing environmental services in foreign markets.

The OECD's FDI index, which measures restrictions on foreign investment, is also used in the estimations below. The OECD FDI Index focuses on four types of investment barriers (see appendix C, box C.1 for more information). Unlike the NMR index, these measures are largely discriminatory towards foreign entities. As with the NMR index, the FDI index is calculated into a weighted "related-services index," though there are data on an additional sector (construction) that are not available in the NMR index. The NMR index is used in the main analysis, as it more fully captures the barriers and impediments faced by potential entrants to the market.

The main model is given below, though models were also estimated for each individual weighted sector *k* (controlling for all remaining related services), and estimations also included models where each sector *k* was added simultaneously:

[1] The OLS model is estimated using the same variables as the one described below with the dependent variable in log form.

[2] See De Benedictis and Taglioni, "Chapter 4: The Gravity Model in International Trade," 2011, 82–85.

[3] Heteroskedastic standard errors are those that do not have a constant variation.

$$ENVFAS_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 BOR_{ij} + \beta_4 lnD_{ij} + \beta_5 LAN_{ij}$$

$$+ \beta_6 MR_{ij} + \beta_7 \sum NMR_{j\ k} * wenv_k + \varepsilon_{ijt}$$

Where

- $lnENVFAS_{ijt}$ is sales by foreign affiliates in the environmental services industry controlled by firms from country i (the source country) in country j (the host country) during time period *t*.

- $lnGDP_{it}$ is the natural logarithm of the gross domestic product (GDP) of the source country *i* during time period *t*. As a larger source-country GDP reflects increased capacity to produce foreign affiliate sales, β_1 is expected to be positive.

- $lnGDP_{jt}$ is the natural logarithm of the GDP of the host country *j* during time period *t*. As a larger host-country GDP indicates increased capacity to accommodate inward foreign affiliate sales, β_2 is expected to be positive.

- BOR_{ij} is a dummy variable that takes a value of one if source country *i* and host country *j* share a border and zero if they do not. Since establishing a commercial presence in a contiguous country is likely less costly than establishing one in a noncontiguous country, β_3 is expected to be positive.

- lnD_{ij} is the natural logarithm of the distance between the biggest cities of source country *i* and host country *j*. As costs associated with foreign commercial presence are assumed to increase with distance, β_4 is expected to be negative.

- LAN_{ij} is a dummy variable that takes the value of one if home country *i* and host country *j* share a common official language. As a common language is assumed to have a positive impact on investment, β_5 is expected to be positive.

- MR_{ij} is a measure of trade costs between source country *i* and host country *j* relative to their trade costs with all other countries, where trade costs are proxied by distance and weighted by trading partners' share of world GDP.[4] The greater the resistance a pair of countries confronts to trading with other partners, the greater is the likelihood that they will trade with each other, and β_6 is expected to be positive.

[4] The measure is based on Baier and Bergstrand, "*Bonus Vetus* OLS," 2009; see Reisman and Vu, "Nontariff Measures in the Global Retailing Industry," 2012, 16, for a simple explanation on how the measure is calculated.

- $\sum NMR_{j\ k} * wenv_k$, or the "related-services index," is a measure of barriers on upstream sectors. It is the weighted sum of the indicators of NMR in host countries for each sector k (sectors include architecture, engineering, electricity, and road transport). The weights are based on the environmental services sector's total input requirements from each respective sector k.[5] The NMR measures the level of anticompetitive regulation and indicates the general ease of doing business in each sector. The higher the level of anticompetitive regulation or the difficulty of doing business within a country (NMR index), the less inward foreign affiliate sales are expected, and β_7 is expected to be negative.

- β_0 is the coefficient for the constant term.

- ε_{ijt} is an error term.

Results

The main results, as indicated by the negative and significant coefficient on the related-services NMR index, show that a reduction in such regulations is associated with an increase in foreign affiliates' sales of environmental services (column 1 of table D.4 shows the results for OLS, and column 1 of table D.5 shows the Poisson estimates). In addition, regressions performed by the Commission show that the main result holds in a variety of specifications: models were estimated for each individual weighted sector *k* (columns 2–4 of tables D.4 and D.5),[6] and estimations also included models where each sector *k* was added simultaneously (column 5 of tables D.4 and D.5).[7]

The results show that the architectural and engineering NMR index and electricity NMR index have a negative and significant impact on foreign affiliates' environmental services

[5] The weights were derived from input-output tables and represent the total input requirements of the environmental services sector being studied. The input-output tables were drawn from the Eurostat EU-17 input-output tables. See technical note that follows for a description of the methodology used for deriving the regression weights. To calculate the related-services index, first the weighted architecture and engineering indices were averaged (since they are aggregated together in the Eurostat input-output tables), and then the weighted electricity and road transport indices were summed to the average.

[6] Regressions for individual sectors control for remaining related-services sectors. The variables "all other related services" shown in tables D.4–D.7 are calculated by subtracting out remaining related services from the related-services NMR index (tables D.4 and D.5) and from the related-services FDI index (tables D.6 and D.7). For example, in the case of architecture and engineering, "all other related services" is calculated by subtracting out the architecture and engineering component from the related-services NMR index (for column 2, tables D.4 and D.5) and from the related-services FDI index (for column 5, tables D.6 and D.7).

[7] The following models were estimated by entering the NMRs for architecture and engineering, electricity, and road transport separately (weighted regressions control for remaining related services), all the NMRs additively, and their weighted total (the related-services NMR index): (1) the OLS and Poisson models with weighted NMR variables (tables D.4 and D.5); (2) the OLS and the Poisson models with unweighted NMRs (all unweighted indices use an average as the related-services index); (3) the OLS and Poisson models with weighted NMR variables, using host-country production (sales of environmental services) in place of host-country GDP; (4) the OLS and Poisson models with unweighted NMRs and using host-country production (sales of environmental services) in place of host-country GDP. The following models were estimated using the FDI index for architecture and engineering, construction, electricity, and surface transport separately (weighted regressions control for remaining related services), all the FDI indices additively, and their weighted total (the related-services FDI index, with and without the inclusion of the construction index): (5) the OLS and Poisson models with weighted FDI index (tables D.6 and D.7); (6) the OLS and Poisson models with unweighted FDI (all unweighted indices use an average as the related-services index); (7) the OLS and Poisson models using weighted FDI index and host-country production (sales of environmental services) in place of host-country GDP; (8) the OLS and Poisson models with the unweighted FDI index and using host-country production (sales of environmental services) in place of host-country GDP.

sales (columns 2–3 of tables D.4 and D.5). The estimated coefficient on road transport is negative and significant only in the OLS specification (column 4 of tables D.4 and D.5); when all the indicators were entered together into a single model (column 5 of tables D.4 and D.5), the coefficient on road transport is again negative and significant only in the OLS specification.

Results for the FDI index were not as robust as those obtained using the NMR index. Column 1 of table D.6 and D.7 show results for the related-services FDI index, where the FDI index is weighted and summed over architecture, engineering, surface transport, electricity, and construction. Within the Poisson estimation, the coefficient is negative and significant just under the levels reported in the table D.7.[8] Coefficients on the individual FDI indices (columns 2–5 of tables D.6 table D.7) tended to be inflated, had varying levels of significance, and at times were positive (indicating greater FDI regulation is positively associated with foreign affiliate sales).

Note on Deriving Regression Weights

The general methodology here follows that laid out in Conway and Nicoletti (2006). The purpose is to calculate appropriate weights to apply to measures of regulatory or other restraints present in services used by environmental services sectors. The restraint measures are index measures, while the weights are derived from input-output tables and represent the total input requirements of the environmental services sectors being studied. The input-output tables are drawn from Eurostat.[9]

Econometric analysis is based on the aggregation of the two sectors below. The combination of these two sectors will be referred to as "environmental services":

1. CPA_E36: natural water; water treatment and supply services
2. CPA_E37–E39: sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services

Basic Approach

To derive the total input requirements for a given industry, we start with the simple input-output equation

$$Y = AY + D,$$

where Y is total (or gross) output, D is final demand, and A is the input requirements matrix. The right-hand side of the equation partitions total output into intermediate demand (AY) and final demand (D). With some rearranging, we can solve for Y in terms of D:

[8] Models were also estimated without including construction in the related-services FDI index, matching the sectors in the related-services NMR Index; the coefficient on the index, only using the Poisson model, was negative and significant. However, both related-services FDI indices' significance levels were sensitive to the inclusion of multilateral resistance (unlike the case with the related-services NMR index).

[9] See Eurostat, "Euro Area Tables Year 2008 in NACE Rev 2," available for download at http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/workbooks/EA17_SIOT_2008_1.xls.

$$Y - AY = D$$

$$(I - A)Y = D$$

$$Y = (I - A)^{-1}D$$

or

$$Y = LD$$

where L is the Leontief inverse. Given any vector of demand D, the L matrix maps this to the vector of total output necessary to satisfy that level of demand (subject to the production technology defined in the underlying A matrix). We can analogously consider the change in total output necessary to support a marginal change in demand, $\hat{Y} = L\hat{D}$. Suppose there are n sectors, and we are interested in the output of sector k, and more particularly in the input requirement of sectors $k + 1$ and $k + 2$. An increase of 1 unit in the final demand of the sector k therefore implies

$$\begin{bmatrix} \hat{Y}_1 \\ \vdots \\ \hat{Y}_n \end{bmatrix} = \begin{bmatrix} L_{1,1} & \cdots & L_{1,n} \\ \vdots & \ddots & \vdots \\ L_{n,1} & \cdots & L_{n,n} \end{bmatrix} \begin{bmatrix} \hat{D}_1 \\ \vdots \\ \hat{D}_n \end{bmatrix}$$

where $\hat{D}_k = 1$, and $\hat{D}_{j \neq k} = 0$. Since we are only interested in the influence of inputs k+1 and k+2,

$$\hat{Y}_{k+1} = L_{k+1,k}\hat{D}_k \text{ , and}$$

$$\hat{Y}_{k+2} = L_{k+2,k}\hat{D}_k$$

To accommodate a 1-unit increase in final demand of sector k, total output of sector $k + 1$ must rise by $L_{k+1,k}$ and total output of sector $k + 2$ must rise by $L_{k+2,k}$. Column k of the Leontief inverse matrix is the source of the n total input coefficients.

Implementation

Our first step is to collapse the two sectors into a new environmental services sector. Starting with the symmetric input-output table total for EA17, we sum rows 25 and 26, and columns 25 and 26, to create a new 64-order matrix. Sector 25, environmental services, is our sector of interest. We next transform the intermediate input portion of the matrix (the first 64 rows and columns) into a 64-order A_tot matrix by dividing the elements of each column by output at basic prices. The Leontief inverse matrix is then calculated as $L = (I - A)^{-1}$. The regression weights for services inputs are then drawn from column 25. They are as follows:

Row	Code	Description	Weight
24	CPA_D35	Electricity, gas, steam, and air-conditioning	0.06936
27	CPA_F	Constructions and construction works	0.05596
31	CPA_H49	Land transport services and transport services via pipelines	0.03559
47	CPA_M71	Architectural and engineering services; technical testing and analysis services	0.04463

Results and other tables

TABLE D.1 Source and host countries in the dataset

Source countries	Host countries
Australia	Austria
Austria	Czech Republic
Belgium	Denmark
Bulgaria	Estonia
Canada	Finland
China	France
Cyprus	Germany
Czech Republic	Hungary
Denmark	Ireland
Estonia	Italy
Finland	Luxembourg
France	Netherlands
Germany	Norway
Greece	Poland
Hong Kong	Portugal
Hungary	Slovakia
Iceland	Slovenia
Ireland	Spain
Israel	Sweden
Italy	United Kingdom
Japan	
Latvia	
Lithuania	
Luxembourg	
Malta	
Netherlands	
New Zealand	
Norway	
Poland	
Portugal	
Romania	
Russia	
Slovakia	
Slovenia	
Spain	
Sweden	
Switzerland	
Turkey	
United Kingdom	
United States	

Note: This table lists source and host countries included in the Poisson model (1,140 observations); there are additional countries in the Eurostat dataset that are not listed here.

TABLE D.2 Sources and descriptive statistics of regression variables

Variable	Years available	Source	Dimension	Units	Mean	Standard deviation	Min	Max
Foreign affiliate sales	2008 and 2009	Eurostat Structural Business Statistics, "Foreign Controlled EU Enterprises—Inward FATS (fats)" (NACE Rev. 2 Section E)	Environmental services sector,[a] source, host, date	Million $	35	297	0	5,850
Source-country GDP	2008 and 2009	World Bank, World Development Indicators	Source, date	Billion $	646	1,600	4	11,600
Host-country GDP	2008 and 2009	World Bank, World Development Indicators	Host, date	Billion $	415	549	8	2,100
Multilateral resistance	2007	CEPII and World Bank, World Development Indicators	Source, host	([b])	35	58	–8	459
Shared border	([b])	CEPII	Source, host	0 or 1	0.07	0.26	0	1
Distance	([b])	CEPII	Source, host	km	3,315	4,214	60	19,586
Language	([b])	CEPII	Source, host	0 or 1	0.03	0.17	0	1
Indicators of sectoral regulation (NMR)	Measures on architecture and engineering refer to 2008 (latest available year); measures on electricity and transport refer to 2007 (latest available year).	OECD Indicators of sectoral regulation (NMR): Regulation in the Professional Services and Regulation in Energy, Transport and Communications	Sector, host	0 to 6	1.51	0.59	0.12	2.48
Foreign direct investment (FDI) index	Measures refer to 2006. Database is continually updated; 2010 is the next available year.	OECD FDI Regulatory Restrictiveness Index	Sector, host	0 to 1	0.04	0.12	0	0.49
Weights	2008	Eurostat Leontief matrix; data refer to EA17	Sector	([b])	([b])	([b])	([b])	([b])

Note: In the OLS regressions, foreign affiliate sales (the dependent variable) are in logs. In both the OLS and Poisson models, the following independent variables are also converted to logs: source-country GDP, host-country GDP, host-country production, and distance. Although units are reported in the table, whole dollar values are used in the regressions. Summary statistics are reported for the average NMR indicator (average of architecture, engineering, electricity, and road transport) and for the average FDI index (average of architecture, engineering, construction, electricity, and surface transport), though sector-specific variables are used as regressors and each is weighted by the coefficients from the Leontief matrix (summary statistics for the weighted NMR indicators are shown on a separate table). Summary statistics include observations that were included in the Poisson model (1,140 observations).

[a]Environmental services correspond to NACE, Rev. 2, Section E.
[b]Not applicable.

TABLE D.3 Descriptive statistics: Unweighted and weighted indicators of sectoral regulation (NMR).

	Mean	Standard Deviation	Min	Max
NMR architecture	1.79	1.16	0.00	3.97
Weighted NMR architecture	0.08	0.05	0.00	0.18
NMR engineering	1.45	1.16	0.00	3.97
Weighted NMR engineering	0.06	0.05	0.00	0.18
NMR electricity	1.56	0.70	0.00	2.80
Weighted NMR electricity	0.11	0.05	0.00	0.19
NMR road transport	1.25	0.61	0.50	2.50
Weighted NMR road transport	0.04	0.02	0.02	0.09
NMR average	1.51	0.59	0.12	2.48
Weighted total NMR (*Related-services index*)	0.23	0.07	0.02	0.34

Source: OECD Indicators of sectoral regulation (NMR): regulation in the professional services and regulation in energy, transport, and communications; Eurostat Leontief matrix.

Note: Summary statistics include observations that were included in the Poisson model (1,140 observations).

TABLE D.4 Gravity models: regulations in related services and environmental services foreign affiliate sales

Variables	(1)	(2)	(3)	(4)	(5)
Dependent variable = *ln*(Foreign affiliate sales)	OLS	OLS	OLS	OLS	OLS
ln(Source country GDP)	0.580***	0.544**	0.521**	0.567**	0.519**
	(0.17)	(0.16)	(0.16)	(0.17)	(0.16)
ln(Host country GDP)	0.316**	0.329**	0.321**	0.307**	0.318**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Shared border	1.162**	1.276***	1.308***	1.168**	1.304***
	(0.35)	(0.36)	(0.35)	(0.34)	(0.35)
ln(Distance)	–0.001	0.113	0.101	–0.031	0.086
	(0.24)	(0.22)	(0.22)	(0.24)	(0.23)
Multilateral resistance	–0.006*	–0.006**	–0.005*	–0.005*	–0.005*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Language	–0.487	–0.562	–0.546	–0.459	–0.534
	(0.48)	(0.44)	(0.45)	(0.50)	(0.45)
Related-services NMR index	–11.622***				
	(2.03)				
All other related services		–8.455**	–15.747***	–10.385***	
		(2.53)	(2.70)	(2.20)	
Architectural and engineering NMR index		–16.233***			–15.145***
		(3.17)			(3.27)
Electricity NMR Index			–6.335*		–6.120*
			(2.74)		(2.77)
Road transport NMR Index				–18.392*	–17.944*
				(7.74)	(7.53)
Constant	–2.969	–3.132	–2.214	–2.159	–1.962
	(6.48)	(6.12)	(6.08)	(6.49)	(6.11)
R-Square	0.454	0.478	0.49	0.461	0.49
Number of observations	87	87	87	87	87

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors in parentheses. Variables expressed in logs include an ln prefix. All the indexes have been weighted by their use in environmental services, and the related services index sums the sectoral indices. For columns 2–4, "All other related services" is calculated by subtracting the respective sectoral indices from the related-services NMR index. All models include time (year) dummy variables.

TABLE D.5 Gravity models: regulations in related services and environmental services foreign affiliate sales

Variables	(1)	(2)	(3)	(4)	(5)
Dependent variable = Foreign affiliate sales	Poisson	Poisson	Poisson	Poisson	Poisson
ln(Source country GDP)	1.795***	1.796***	1.818***	1.776***	1.837***
	(0.29)	(0.29)	(0.29)	(0.28)	(0.29)
ln(Host country GDP)	1.220***	1.218***	1.155**	1.153***	1.028***
	(0.31)	(0.34)	(0.37)	(0.28)	(0.30)
Shared border	0.772	0.77	0.743	0.798	0.771
	(0.52)	(0.53)	(0.53)	(0.54)	(0.52)
ln(Distance)	–0.461**	–0.462*	–0.474**	–0.442**	–0.460**
	(0.17)	(0.18)	(0.18)	(0.17)	(0.17)
Multilateral resistance	–0.016**	–0.016**	–0.017**	–0.015**	–0.016**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Language	1.816**	1.816**	1.829**	1.826***	1.865***
	(0.57)	(0.56)	(0.57)	(0.55)	(0.55)
Related-services NMR index	–12.506***				
	(1.62)				
All other related services		–12.566***	–11.219***	–15.144***	
		(2.04)	(2.90)	(2.79)	
Architectural and engineering NMR index		–12.436***			–13.523***
		(3.26)			(3.22)
Electricity NMR index			–14.762***		–20.920***
			(3.32)		(4.19)
Road transport NMR index				0.223	8.446
				(8.85)	(10.35)
Constant	–57.597***	–57.565***	–56.302**	–55.601***	–53.657***
	(16.01)	(16.56)	(17.31)	(14.62)	(15.29)
Pseudo R-Square	0.718	0.718	0.719	0.722	0.725
Number of observations	1140	1140	1140	1140	1140

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors in parentheses. Variables expressed in logs include an ln prefix. All the indexes have been weighted by their use in environmental services, and the related services index sums the sectoral indices. For columns 2–4, "All other related services" is calculated by subtracting the respective sectoral indices from the related-services NMR index. All models include time (year) dummy variables.

TABLE D.6 Gravity models: environmental services foreign affiliate sales and regulations in related services (FDI index, OLS)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable = *ln*(Foreign affiliate sales)	OLS	OLS	OLS	OLS	OLS	OLS
ln(Source country GDP)	0.659***	0.614***	0.572***	0.663***	0.632***	0.559***
	(0.17)	(0.17)	(0.16)	(0.18)	(0.17)	(0.16)
ln(Host country GDP)	0.570***	0.524***	0.401**	0.569***	0.481***	0.393**
	(0.14)	(0.13)	(0.13)	(0.14)	(0.13)	(0.13)
Shared border	0.853	1.068*	1.237**	0.831	0.959*	1.297**
	(0.47)	(0.45)	(0.38)	(0.48)	(0.41)	(0.39)
ln(Distance)	0.152	0.148	0.027	0.145	0.06	0.033
	(0.37)	(0.35)	(0.24)	(0.37)	(0.29)	(0.24)
Multilateral resistance	–0.008**	–0.007**	–0.006**	–0.008**	–0.008**	–0.006**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Language	–0.128	–0.234	–0.66	–0.139	–0.441	–0.669
	(0.56)	(0.55)	(0.50)	(0.56)	(0.51)	(0.50)
Related-services FDI index	–3.005					
	(6.04)					
All other related services		260.834*	–0.352	22.472	–229.593**	
		(119.60)	(5.58)	(37.16)	(76.73)	
Electricity FDI index		–175.757*				–52.681*
		(78.13)				(20.15)
Construction FDI index			2122.318***			2158.224***
			(393.49)			(403.83)
Surface transport FDI index				–59.656		101.633*
				(82.96)		(40.79)
Architectural and engineering FDI index					2383.305**	
					(803.06)	
Constant	–15.253*	–13.069	–8.06	–15.273*	–11.673	–7.651
	(7.23)	(6.92)	(6.14)	(7.28)	(6.69)	(6.13)
R-Square	0.25	0.295	0.436	0.252	0.353	0.442
Number of observations	88	88	88	88	88	88

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors in parentheses. Variables expressed in logs include an ln prefix. All models include time (year) dummy variables. For columns 2–5, "All other related services" is calculated by subtracting the respective sectoral indices from the related-services FDI Index. The FDI index for architecture and engineering were omitted from model 6.

TABLE D.7 Gravity models: environmental services foreign affiliate sales and regulations in related services (FDI index, Poisson)

Variables	(1)	(2)	(3)	(4)	(5)
Dependent variable = Foreign affiliate sales	Poisson	Poisson	Poisson	Poisson	Poisson
ln(Source country GDP)	1.854***	1.745***	2.039***	1.899***	2.145***
	(0.31)	(0.26)	(0.34)	(0.31)	(0.42)
ln(Host country GDP)	1.466***	1.470***	1.230***	1.514***	1.088***
	(0.39)	(0.41)	(0.26)	(0.40)	(0.21)
Shared border	–0.891	–0.638	0.832	–0.801	1.121*
	(0.97)	(0.86)	(0.47)	(0.86)	(0.44)
ln(Distance)	–0.647*	–0.638*	–0.466**	–0.641*	–0.386**
	(0.28)	(0.27)	(0.15)	(0.26)	(0.13)
Multilateral resistance	–0.016**	–0.014**	–0.020**	–0.017**	–0.024*
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Language	2.892*	2.758**	2.094***	2.850**	1.771***
	(1.17)	(1.05)	(0.54)	(1.05)	(0.50)
Related-services FDI index	–11.707				
	(6.03)				
All other related services		207.183**	–28.546	98.503*	–467.716***
		(63.40)	(16.46)	(41.88)	(47.77)
Electricity FDI index		–155.081***			
		(37.02)			
Construction FDI index			2114.018***		
			(231.56)		
Surface transport FDI index				–261.380**	
				(87.55)	
Architectural and engineering FDI index					4659.069***
					(476.44)
Constant	–66.412***	–64.091***	–66.964***	–68.956***	–66.155***
	–18.5	–17.67	–14.93	–18.82	–15.55
Pseudo R-Square	0.609	0.632	0.752	0.623	0.779
Number of observations	1262	1262	1262	1262	1262

Notes: * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors in parentheses. Variables expressed in logs include an ln prefix. For columns 2–5, "All other related services" is calculated by subtracting the respective sectoral indices from the related-services FDI Index. All models include time (year) dummy variables.

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