Chapter 5

Synergies between Trade in Environmental Services and Trade in Environmental Goods

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This chapter examines the synergies between trade in environmental services and trade in environmental goods. Environmental services are here defined as wastewater management services, solid-waste management services, sanitation and similar services and other environmental services. Services related to the collection, purification and distribution of water are also discussed. After describing each of the environmental services, the chapter identifies broad categories of goods used in their performance and notes that, for some goods, environmental services are driving growth in their markets. Case studies of business-to-business exports of environmental services, mainly from OECD countries to developing countries, are used to gain insight into the kinds of environmental goods used by service providers and how these goods are procured. The case studies provide qualitative evidence that many goods included on either the APEC or the OECD lists of environmental goods are used in the performance of environmental services. These include, in particular, items for holding, conveying, treating and filtering liquids, and instruments for monitoring and measuring. Many of these goods are procured from local suppliers, if not initially then over time as local demand for the associated services develops. The benefits to businesses that engage environmental services providers are many, allowing them to concentrate on their core activities and to shift some of the liability of meeting environmental regulations to other companies. Local employment is also generated. The general implication for developing economies is that the potential benefits of simultaneously liberalising trade in environmental services and in environmental goods are likely to be much greater than liberalising trade in only one or the other.

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Introduction

At the start of the 21st century, much of the world's population still lacks adequate sanitation or access to safe drinking water. Urban and suburban sprawl in developing and developed nations alike is putting pressure on air quality, water tables and biological diversity. Development of industrial and agricultural capacity — crucial for economic development and poverty reduction n many countries — poses similar environmental challenges.

Recent years have seen an increasing trend towards technology-led responses to these environmental challenges, mostly, but not only, in developed countries. This has created new markets for environmental goods and services to remedy and prevent problems related to hazardous waste, air pollution, noise, habitat degradation and unsustainable resource use. A key issue for policy makers is the role that global trade liberalisation can play in delivering solutions to these problems by building international markets for environmental goods and services. Perhaps even more important is the role that environmental goods and services can play in meeting the development needs of countries that are trying to emerge from poverty while protecting the environment on which the health and welfare of their population depends.

When WTO ministers, in paragraph 31(iii) of their 14 November 2001 Declaration, mandated negotiations on "the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services", they committed the international community to undertake further liberalisation of trade in environmental goods and services. These negotiations are currently taking place in separate WTO bodies: the Negotiating Group on Non-agricultural Market Access (NAMA) and the Special Session of the Council for Trade in Services. Meanwhile, the Committee on Trade and Environment in Special Session (CTE-SS) has been actively engaged in clarifying the concept of an environmental good for the purposes of the NAMA negotiations, and on monitoring developments relating to this mandate which are taking place in the other two negotiating groups. Yet the desirability of pursuing liberalisation of international trade in environmental services, in tandem with efforts to liberalise international trade in environmental products and clean technologies, remains as valid as ever. Environmental products, technologies and services are increasingly provided commercially on an integrated basis, whether "horizontally" by firms that bring together the range of materials and expertise required to undertake an entire project for a particular environmental medium (*e.g.* water, air, landscape), or "vertically" by firms that specialise in construction and engineering across several environmental media.

What are environmental services, who uses them, and how are they performed?

Traditionally, environmental services have been understood and defined quite narrowly in terms of facilities that provide water and waste treatment services, often by the public sector. However, over the last 15 years or so, a need has been felt to move beyond this stage, owing to a combination of new regulatory requirements for the management and control of pollution, growing public sensitivity to environmental problems, and trends in privatisation and liberalisation that have created private demand for environmental services and tied them more closely to the market. To develop a more comprehensive definition of the environment industry, the OECD, working with the Statistical Office of the European Communities (Eurostat), formed an Informal Working Group on the Environment Industry, which met several times during the mid-1990s. After

considering various definitions of the environment industry, the OECD/Eurostat Informal Working Group (OECD/Eurostat, 1999) agreed on the following:

> The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use.

Unlike computer and related services, for example, environmental services are not a set of similar activities (see Box 5.1). Thus, oil spill remediation services are very different from air pollution measurement and control services. Even within the same sub-sector there are important differences in technologies employed and skills required, for example, for the collection or mitigation of hazardous waste or of municipal or solid waste. Furthermore, under the WTO/GATS, some services fall into sectors other than those of the core environmental business activities defined above. For example, architects and engineers offering landscape conservation or biodiversity protection could be considered providers of environmental services. They have different skills, educational, licensing and technical requirements than the architects or engineers who design and build water and wastewater infrastructure projects.

Various proposals have been submitted to the WTO to try to address the most widely recognised problems, while preserving the mutually exclusive nature of the WTO's (1991) Services Sectoral Classification List (also known by its document reference number, W/120). The W/120 list for environmental services includes: sewage services; refuse disposal services; sanitation and similar services; and other environmental services. Some countries continue to use the W/120 CPC Provisional List. On the other hand, the EC has proposed a seven-part classification for core environmental services: water, wastewater management; solid- and hazardous-waste management; protection of ambient air and climate; remediation and cleanup of soil and water; noise and vibration abatement; protection of biodiversity and landscape; and a catchall category for other environmental and ancillary services. The EC has also proposed making certain closely associated services part of a special "cluster" or "checklist" that could be used as an *aide-mémoire* during sectoral negotiations and scheduled in the relevant GATS sectors separately from the "core" environmental services categories. The EC proposal in effect updates the classification to better reflect the types of services provided by modern environmental companies, and countries have used it, or an approximation thereof, in submitting their offers in the current negotiations. This chapter takes a similar approach.

The following paragraphs provide an overview of the various environmental services, the kinds of activities involved, the clients and the kinds of techniques used. In organising the discussion, the chapter adopts a modified version of the headings suggested by the OECD/Eurostat Informal Working Group of Experts (Box 5.1). The categories are consistent with, but not identical to, the EC classification. In addition, the chapter looks at "Services related to the collection, purification and distribution of water", which is not classified as an environmental service in either W/120 or the Provisional CPC, but which is often closely associated with other environmental services, notably in the OECD/Eurostat classification system and the one proposed by the EC.

Box 5.1. Formal classifications of environmental services

The Services Sectoral Classification List (WTO, 1991, also known as W/120), developed during the Uruguay Round of multilateral trade negotiations, is based largely on the United Nations' Provisional Central Product Classification (Provisional CPC) system. The environmental services sector was defined to comprise: "Sewage services" (corresponding to CPC Prov. 9401), "Refuse disposal services" (CPC Prov. 9402), "Sanitation and similar services" (CPC Prov. 9403), and "Other environmental services".[1] Even though the "other" category does not explicitly refer to any CPC items, it is generally presumed to comprise the remaining elements of the CPC environmental services category: cleaning of exhaust gases (CPC Prov. 9404), noise abatement services (CPC Prov. 9405), nature and landscape protection services (CPC Prov. 9406), and other environmental protection services not included elsewhere (CPC Prov. 9409). In 1998 the United Nations produced CPC Version 1.0, which introduced somewhat greater disaggregation into some of the sub-sectors of environmental services, while aggregating others. In March 2002 the UN's Statistical Commission issued a slightly revised version of the CPC (Version 1.1).

In the mid-1990s, many countries felt that, from an environmental policy perspective, the classification of environmental services in document W/120 was unduly limited because it did not include all the services that could benefit the environment. An OECD report summed up this concern: "the environment industry is evolving rapidly beyond its traditional focus on pollution control and remediation/cleanup activities to also incorporate a broader range of pollution management, cleaner technology and resource management activities" (1998, p. 9). An informal working group of experts from OECD countries, meeting under the auspices of the OECD and the Statistical Office of the European Communities, consequently developed a more comprehensive definition of the environment industry (OECD/Eurostat, 1999). Under the Pollution Management Group it identified ten environmental service sub-sectors:

- Air pollution control.
- Wastewater management.
- Solid-waste management (further divided into: *i)* hazardous-waste collection, treatment and disposal; *ii)* waste collection, treatment and disposal; and *iii)* waste recovery and recycling (excludes manufacture of new materials or products from waste and scrap).
- Remediation and cleanup of soil, surface water and groundwater.
- Noise and vibration abatement.
- Environmental R&D.
- Environmental contracting and engineering.
- Analytical services, data collection, analysis and assessment.
- Education, training, information.
- Other.

The OECD/Eurostat informal working group also identified ten "activities" (not differentiated according to goods or services) under the Resource Management Group. Among the activities identified was water supply, for which the services component was defined as "any activity that … designs, constructs or installs, manages or provides other services for water supply and delivery systems, both publicly and privately owned. It includes activities aiming to collect, purify and distribute potable water to household, industrial, commercial or other users."

In their submissions to the WTO's Council for Trade in Services, several OECD member countries have suggested alternative classifications that draw on elements of the OECD/Eurostat classification system. However, as R&D, contracting and engineering, and education, training and information services are generic categories mentioned elsewhere in W/120, they have tended to include the environmental parts of these services as part of an environmental services "cluster" rather than among the "core" list of environmental services.

1. Although the use of the Services Sectoral Classification List (W/120) is not mandatory, most WTO members have used it as a basis for scheduling their commitments.

Reference to these headings is without prejudice to the positions WTO members may take in the Special Session of the Council for Trade in Services. As the WTO's own Guidelines for Scheduling (S/L/92, 28 March 2001) underscore, commitments have been made — and can be made — according to the W/120 or CPC classification systems, or to members' own sectoral or sub-sectoral classification or definition, as long as they provide a "sufficiently detailed definition to avoid any ambiguity as to the scope of the commitment".[1]

Wastewater management services

The job of collecting and treating liquid wastes has existed since the dawn of civilisation. In ancient Greek legend, Hercules is said to have cleaned out the Augean stables by diverting water from two rivers through a wall he created in the cattle yard, flushing the waste out through a hole at the other end. Today, those charged with similar tasks usually use more sophisticated techniques.

Mention of the term "sewage services" typically evokes an image of municipal sewage treatment plants, and it is certainly true that the operation of large sewage systems remains one of the major markets for this sub-sector. But private businesses also require sewage services, as does anyone connected to a septic tank. Even in developed countries, many large hotels, resorts and non-incorporated residential communities either do not have access to, or for various other reasons, do not discharge their effluents into municipal sewage systems. Instead, they build, or have built for them, stand-alone sewage treatment works. Sometimes these plants are operated by the corporate clients, but they are increasingly operated by firms that specialise in that service, usually as part of an integrated system for treating industrial waste.

The other major category of wastewater treatment relates to wastes from mines, processing and manufacturing plants. Many large industrial facilities either choose not to, or are barred from, discharging liquid wastes directly into municipal sewage systems. Half a century ago, most plants generating large volumes of liquid waste were built near rivers or seas and simply discharged untreated effluents into these bodies of water. Nowadays, in most countries, they are required by law to minimise their effluent loading. Improvements in waste recycling have played a big role in reducing the volume and toxicity of industrial pollutants. But few industrial processes involving solvents or water have entirely eliminated waste streams. Pollution abatement, in short, remains a necessity.

The range of chemical compounds found in industrial wastewater effluents is enormous. Each process is unique. Treating the effluent from a Kraft paper mill, which contains numerous organic and sulphurous compounds, requires an entirely different set of technologies and chemicals than treating the effluent from a petrochemical refinery, which in turn bears little resemblance to the effluent from a factory that assembles electronic circuits. However, at their most basic levels, each process for treating liquid effluent usually involves some combination of chemically transforming, filtering and precipitating the target compounds.

Before a waste treatment facility is built, the effluent and receiving medium (usually a stream, lake or saltwater bay) is normally assessed. Although the character and volume of the waste can often be predicted without prior measurement, particularly if the discharging facility is similar to one that has already been built elsewhere, engineers still

1. www.wto.org/english/tratop_e/serv_e/guide1_e.htm.

need data on the physical and chemical characteristics of the receiving waters. This requires on-site measurements. Later, once the plant is running, it is necessary to monitor the waste stream and the downstream aquatic environment to ensure that the plant operates as intended and that the pressure exerted on the environment is within acceptable limits.

Waste treatment is increasingly integrated into industrial processes so as to recycle compounds that were formerly discharged, or to yield new, saleable products. According to Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO),[2] there are potentially six major products that could be produced from wastewater streams:

- Clean water (water mining from sewage and wastewater).
- Methanol and ethanol (transport fuels).
- Methane (as domestic and industrial fuel).
- Sugar-like compounds or polysaccharides.
- Proteins to make pharmaceuticals, fertilisers and feedstock.
- Glycols, such as hydraulic fluids, antifreeze and lubricants.

Solid and hazardous waste services

Measured by mass and volume, wastes generated by humans are not especially hazardous. They include food waste, packaging waste and waste from building sites. Such wastes are difficult to manage mainly because of their volume, and in the case of food because they can spoil and because they attract fauna (such as coyotes in North America, hyenas in Africa, and rats everywhere) that may pose a threat to health and safety. Some wastes collectively referred to as non-hazardous, such as discarded electronic appliances, may nonetheless contain hazardous elements (*e.g.* heavy metals). And disposal methods — incineration, for one — may turn relatively inert materials, like plastics, into compounds that are toxic or carcinogenic.

Homes and commercial entities generate the bulk of non-hazardous waste, collectively often referred to as municipal solid waste. The collection, transport, sorting and disposal of household waste has traditionally been performed in most municipalities either by the municipalities themselves or by companies working under contract to the municipalities. However, private, regulated provision of these services also exists. Already, in both OECD and non-OECD countries, much of the waste generated by food retailers, shopping centres, restaurants and office buildings is collected by private waste collection and disposal service providers. In the United States, private waste management firms sometimes sell services directly to households, with the result that houses in the same neighbourhood might be served by two or more waste management companies.

Hazardous waste is typically a product of activities that handle or produce dangerous chemicals, pathogens or radioactive material. Major producers of hazardous wastes in most countries include manufacturers of pesticides, manufacturers and users of organic solvents, hospitals and medical clinics, and nuclear power plants. Except for hospitals and medical clinics, most enterprises that handle or produce large volumes of hazardous waste

2. www.csiro.au/index.asp?type=mediaRelease&id=WhereTheresMuckTheresBrass.

are private businesses, and they are the main clients of private services that manage such waste streams.

One reason for the growth of private waste management services has been the demand for more innovative solutions to the disposal of waste than simply dumping or burning it. Another has been the advent of extended producer responsibility requirements. The people of Yorkshire, England, have an old saying, "Where there's muck there's brass" (translation: where there is waste there is money to be made). Companies in the business are constantly looking to identify new, positive properties of waste — in effect to turn liabilities into assets. Also, as scientific knowledge about the properties of non-hazardous waste accumulates, the line between non-hazardous and hazardous waste has blurred. Many types of non-hazardous waste are neither inert nor geochemically stable when exposed to the environment, and eventually undergo transformations that can impart hazardous properties that were not evident when the material was freshly generated (Twardowska *et al.*, 2004).[3] Yet many people involved in waste management are not aware of such time-delayed adverse environmental impacts.

Sanitation and similar services

The term "sanitation services" is sometimes confused with two other environmental services: wastewater treatment and the management of solid waste. Under most national and international service nomenclatures, however, it refers more specifically to such activities as street sweeping and the removal of snow from roads, as well as beach cleaning, drain unblocking and ice clearing.[4] In fact, street sweeping is perhaps a misnomer. Besides sweeping, the service usually also involves washing, scraping and removal of weeds. Street sweeping and snow and ice removal are services that are carried out typically by, or on behalf of, municipalities. But they are also used by private businesses. Typical clients are non-incorporated residential communities, operators of large hotels and resorts, and shopping centres and factory sites with extensive paved areas, such as parking lots.

Many technologies are used in street-cleaning services, and the choice depends largely on costs of equipment relative to labour. Sweeping and cleaning services that can be done with the use of hand carts and brooms, or other small equipment, are frequently performed by firms that provide other solid-waste management services. When the cleaning requires larger, mechanised equipment, it is often provided by firms that provide other road-related services. Some of the specialised equipment developed for this industry includes "gully machines" for clearing drains and cesspits, and "grab vehicles" for removing discarded objects.

Other environmental services

Air-pollution control

The corresponding Provisional CPC category for this service is "Cleaning services of exhaust gases" (code 94040), which seems narrower than the definition for this category of the United Nations Statistics Division (UNSD): "Emission monitoring and control

3. Some materials, like boiler ash, are used in common fill, such as in the construction of roads, where they are exposed to environmental conditions similar to those at disposal sites.

4. The Central Product Classification (CPC, 1997) refers to sweeping and snow removal services (94310) and "Other sanitation services" (94390).

services of pollutants into the air, whether from mobile or stationary sources, mostly caused by the burning of fossil fuels; concentration monitoring, control and reduction services of pollutants in ambient air, especially in urban areas".

Operation of private air pollution control facilities by independent service providers is not yet commonplace, although monitoring of emissions and of ambient air conditions is. Techniques for monitoring emissions from stationary sources differ from those for monitoring mobile sources, and both differ from monitoring the quality of ambient air. As for many other services not based around infrastructure, the main private clients for air pollution services are point-source emitters of air pollutants, which are often operators of fossil-fuelled electric power generating stations, waste incinerators, petrochemical refineries and other smokestack industries.

For stationary sources, monitoring may be performed according to an established schedule or continuously. In the former case, technicians visit a facility, insert a sampling tube into the exhaust gases, pump a sample of the gas through a filter or an aqueous solution, or both. The filter or solution is then sent to a laboratory, which may be located on site or even in another country, for analysis. Continuous monitoring usually requires highly specialised equipment that either automates the sampling and analysis process or measures the characteristics of the gas through less direct means, *e.g.* opacity as an indicator of concentrations of particulate matter.

The monitoring of emissions from mobile sources, chiefly cars and lorries, is typically closely tied to policing. A moving vehicle is stopped, directed to the side of the road, and a device is applied to its tail pipe to measure emissions of carbon monoxide (CO) and unburned hydrocarbons. Governments are the main clients for this type of service. In recent years, remote-sensing technologies have been developed that can trace pollutant emissions while vehicles are in motion. The technology works by directing laser beams of different wavelengths across a road; as a vehicle passes through the beams the changes in the light intensity transmitted indicate the concentrations of different gases. One vendor's system can measure emissions of up to four different gases and opacity (as an indicator of particulate matter from diesel engines) and photograph the license plate and the rear of the vehicle for which the measurements were taken.[5]

Monitoring of ambient air quality uses techniques similar to those used for point sources, with a few exceptions. First, because concentrations of pollutants are much lower than in exhaust gases, sampling periods have to be longer. Second, the gases of interest are not identical: some, like ozone, are formed in the atmosphere as a consequence of pollution. Third, whereas the sampling of point-source emissions requires only one or two monitoring devices, ambient air quality monitoring normally requires establishing a network of monitors at locations chosen to give representative results over time and under different wind conditions. Government agencies are major consumers of these types of services, but so are operators of large point-source emitters of pollutants, *i.e.* those that must limit the facility's contribution to increases in ambient concentrations of pollutants.

Besides commercial presence and the presence of natural persons, cross-border supply and consumption abroad may be involved in the provision of these types of services. For example, monitors are often set up by a service provider, but the samples are collected by the client and sent to the service provider's laboratory for analysis.

5. www.mustangdyne.com/pdfs/LT_corp-broch.pdf.

Noise and vibration abatement services

Noise can be a nuisance. It can also damage people's hearing and reduce worker productivity. Often it indicates poor design or a faulty system. Companies therefore have an interest in trying to keep the noise of their machinery and plants to a minimum and to isolate it where it is unavoidable. (Many countries also set limits on occupational exposure to noise.) If noise from their facilities is great enough, they may also have to worry about avoiding complaints from local residents.

Tracing a noise or vibration to its source is not always easy. A loose bearing or a misaligned exhaust fan may cause it, and these are not always easy to identify. Because intervention on the basis of a wrong guess can be costly, noise monitoring and abatement has developed into a specialised service.

Nature and landscape protection services

This category of services concerns a diverse range of activities related to the protection and restoration of individual populations, species or ecosystems, and the geographic features on which they depend. According to the UNSD, this category, which appears in the Provisional CPC (code 94060) but in subsequent versions of the CPC is subsumed under "Other environmental protection services n.e.c. [not elsewhere classified]" (code 9490), covers:

- Services related to the protection of ecological systems such as drylands, lakes, coastlines and coastal waters, including their respective fauna, flora and habitats.
- Services consisting of studies of the interrelationship between environment and climate (*e.g.* the greenhouse effect), including services related to the assessment of natural disasters and their abatement.
- Landscape protection services not elsewhere classified.

The UNSD excludes from this category "forest and damage assessment and abatement services", which are classified in Provisional CPC group 881 ("Services incidental to agriculture, hunting and forestry").[6]

Governments are not the only clients of these services, and in fact may be less important than private firms. Golf courses are a growing client base. In the United States, for example, the US Golf Association supports research to find ways to use native plants in golf courses to improve the habitat for plant and wildlife while reducing irrigation and fertiliser costs. Interest in exploiting the biodiversity-promoting potential of golf courses is already spreading to other countries, and is finding favour in developing countries that are interested in promoting eco-tourism.

Not all services in this sub-sector pertain to problems on land. Many hotels and tourist resorts are built along coasts, near places of natural beauty. Construction and dredging activities in the coastal zone usually entails some disruption, and perhaps alteration, of the inter-tidal area and deeper aquatic environments. In earlier times, these effects would

6. Under the Provisional CPC there are also separate headings for services related to botanical and zoological gardens (code 96331) and nature reserves, "including wildlife preservation services" (code 96332). According to the UNSD's explanatory notes (UN, 1998) to CPC Version 1.0, the latter subclass includes "supervision services of national parks and nature reserves", and "conservation and maintenance services of national parks and nature reserves".

have been ignored. Today, most large hotel chains understand the value to their business of restoring and protecting aquatic ecosystems, both because tourists are drawn to them, and because a healthy and stable coastline provides better protection against storm damage.

Remediation and clean-up of soil, surface water and groundwater

The remediation of soil and of water are normally two distinct types of services, though soil remediation may be required to keep toxic pollutants from leaching into groundwater aquifers. A common type of water remediation service is the cleaning up of an oil spill. Occasionally, a specialised firm will be engaged to remove nutrients or other pollutants from a standing body of water, such as a lake or a pond.

Demand for soil remediation services arose in OECD countries during the 1970s generally as a response to concerns over health problems connected with past (often illegal) dumping of dangerous chemicals on the ground or contamination caused by leaking storage vessels. Over the years, thousands of contaminated sites have been identified in OECD countries, many of them less than a hectare in size. Owners of affected properties, whether or not responsible for the contamination, are generally unable to sell the land until it has been cleaned or otherwise rendered harmless. They may also find themselves liable for any damage caused to other people or property. Numerous firms have appeared that decontaminate properties or at least ensure that the existing contamination does not spread.

Another form of remediation service is mine site rehabilitation.[7] In OECD countries, companies engaged in the extraction of minerals and petroleum are required to restore any land they have disturbed to something close to its original state. That means, in practical terms, carefully removing and storing top soil so that it can eventually be put back in place; refilling and regrading any open pits; and re-establishing a viable ecosystem, complete with local flora and fauna. Although such requirements are not yet universal, many mining and petroleum companies are expected by their shareholders to apply these standards wherever they operate.

The heavier, earth-moving aspects of this work are typically carried out by the mining companies themselves. But the restoration of biodiversity and landscape requires specialist and often local knowledge, so services related to seed and plant selection and propagation are typically performed by outside contractors.

When land restoration requirements were first introduced in OECD countries in the 1970s, the science and technology of ecosystem restoration was in its infancy. Scientists were usually brought in after the disturbance had taken place, and had to learn by doing. One of the lessons they acquired was the importance of undertaking thorough surveys of the local environment before mining or construction takes place, in order to determine the impact these activities will have on the environment and how to mitigate potential impacts. Today, companies that engage experts in biodiversity and landscape protection are well advised to involve them early in the process.

Water protection and remediation services have been driven by increases in the seaborne transport of crude oil and petroleum products, and the demands of governments

7. The different services classification systems leave room for interpretation for this kind of activity. Except for the fact that it can be considered "remediation", it might logically fall under the category "nature and landscape protection services".

for quicker and more effective responses to spills when they occur. Compared with soil remediation, cleaning up after oil spills employs rather simple technologies. Long, floating barriers (called booms) are usually placed around the floating oil slick in order to contain it and prevent it from spreading. Once contained, some of the oil may be removed by "skimmers", either vacuum pumps connected to tanks, or floating disk-and-rope skimmers, to which the oil adheres. In other situations, absorbent materials, such as talc, straw and sawdust, are spread over the oil slick and then collected for processing. Service providers are typically companies that can be called at a moment's notice to fly a team to the site of an oil spill, usually with most of its chemicals, rafts, booms and other cleaning gear in tow.

Environmental protection services not elsewhere classified

This category is a catchall for environmental services not covered under any of the above headings. The EC has suggested that it refers to "other environmental protection services" and "services related to environmental impact assessment". The UNSD provides as examples monitoring, controlling and damage assessment services relating to the deposition of acidifying compounds from the atmosphere ("acid rain") to soils, surface waters and buildings.[8]

In Europe and North America, the 1979 Convention on Long-range Transboundary Air Pollution[9] has been an important framework for efforts to address problems of acid precipitation and deposition, and has spurred the development of related services. Operators of industrial facilities, waste incinerators and coal- or oil-fired electric power plants are the main clients of monitoring and damage assessment services relating to acidifying deposition. Such facilities account for the bulk of acid precursors (sulphur dioxide, nitrogen oxides and hydrogen chloride) emitted to the atmosphere. Controlling acidification can involve either the generators of the acidifying compounds or owners of property affected by acid deposition.

Emissions of acidifying compounds are monitored using techniques similar to those employed in monitoring emissions of other gases from point sources; only the chemistry, and therefore the reagents needed, are different. Monitoring acid deposition basically involves setting up rainfall gauges and then measuring the precipitation's pH and analysing the concentration of different acids. These services may be provided by a wide range of firms, from small laboratories to large, integrated environmental services companies. As with protection of ambient air or climate, cross-border supply and consumption abroad may be involved at different stages in the provision of the service.

Services related to the collection, purification and distribution of water

According to Cossy (2005), neither the W/120 nor the Provisional CPC contains a distinct category for water-related services. Rather, certain sectors include water-related activities. As she explains:

> Nothing in the Secretariat's [W/120] list, however, refers to water distribution and the question does not appear to have been raised at the time it was established. The CPC Prov. only contains an entry for "distribution services on a fee or contract basis of … steam and hot water to household, industrial, commercial and other users" in a section

8. http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=9&Lg=1&Co=94090.

9. www.unece.org/env/lrtap/lrtap_h1.htm.

dealing with *Services incidental to energy distribution* (CPC 88700); this reference concerns activities related to heating systems, but does not cover drinking water. Moreover, the CPC Prov. explicitly excludes from the environmental services section (9401) the "collection, purification and distribution services of water", and classifies it in the subclass 18000, entitled "Natural water". This subclass is in the goods section, which means that, technically, distribution of drinking water does not appear to be included in the CPC Prov.

The CPC Version 1.0 rectified this omission, by creating a new category for "Water, except steam and hot water, distribution services through mains" (code 69210), which includes "distribution services of water" and "reading and maintenance of [water] meters". However, "Water distribution services through mains (on a fee or contract basis)", is classified under CPC Version 1.0 code 86223.

In their proposal in 2000, the EC suggested the creation of seven environmental sub-sectors, one of which it referred to as "Water for human use & wastewater management". The first part of this sub-sector includes "water collection, purification and distribution services through mains [*i.e.* large pipes], except steam and hot water" and is described as including services related to "potable water treatment, purification and distribution, including monitoring". In this regard, the category appears to be similar to the categories introduced in the CPC Version 1.0, except that it is more specific about the quality of water delivered, which must be for direct human use. It therefore excludes the provision of water as an input to a manufacturing process. To date, the EC is the only WTO member to propose including services relating to water for human use as an environmental service; some countries oppose the idea.

While much water treatment, purification and distribution through mains is undertaken by government-owned enterprises, private company involvement in the supply of water to individual clients is not as uncommon as might be imagined. Large, single-owner tourist resorts, commercial facilities, factories and corporate residential facilities located outside large metropolitan areas tend to procure dedicated sources of water. In many cases, only engineering and construction services are involved: once built, the water treatment facility is then operated by the client. But contracts involving separate ownership and operation of water supply facilities are starting to appear.

The techniques involved in the treatment (*i.e.* disinfection, pH control) and the purification (*i.e.* the reduction or removal of pollutants and suspended solids) of water depend on the characteristics of the water source and the quality that the supplier seeks to attain. Generally, water pumped from deep groundwater wells or sourced from rainwater-fed reservoirs does not require more than filtering and minimal treatment. By contrast, before water drawn from a river is fit for human or even industrial use, especially if the river is polluted (the normal situation for large cities), it can require treatment and purification as complex as any found in the most sophisticated chemical factories.

The service involved in the distribution of water through mains is mainly a logistical one, requiring the orchestration of various components of a network that may include storage tanks, valves, pumps and various monitoring equipment in order to ensure a reliable supply.

What goods are used in what services?

Some of the services described above share characteristics with consultancy and management services, and indeed the dividing line between consultancy services and

other environmental services is a fine one. But whereas consultancy services are usually performed by people with no more than pens, paper and portable computers, most other types of environmental services require goods.

Many of those goods are found on either or both of the environmental goods lists prepared by the Asia-Pacific Economic Co-operation (APEC), the OECD or both. These lists were prepared during the late 1990s for different reasons. APEC's list was intended to form the basis of an early voluntary sectoral liberalisation initiative among the group's member economies. The OECD's list was prepared as part of an exercise to gauge the volume of trade in goods that could potentially deliver environmental benefits and the height of tariffs applied to them. These two lists reflect representative examples of "environmental goods" as deemed appropriate in the context of each exercise (see Chapter 2).

In both exercises, but in particular APEC's, guiding criteria for deciding what goods to include on the lists were whether they: *i)* were used in the performance of one or more environmental services, or *ii)* were likely to be recommended to a client by a service provider. Not all goods used in the provision of environmental services were included in these lists. As explained in Chapter 2, in both the APEC and the OECD exercises, multiple-use goods were often excluded if the environmental use of the good in question accounted for only a small part of the market. Moreover, as techniques and technologies have evolved, new goods have come to be associated with environmental services.[10] Finally, the OECD list includes goods considered to be environmentally preferable because of their intrinsic characteristics in use, or because their disposal places a smaller burden on the environment.

Annex 5.A2 tallies all the goods found on the APEC and OECD product lists, ordered according to the 6-digit HS subheading assigned to them. Arrayed across the column headings are the seven environmental services discussed here, including services related to the collection, purification and distribution of water for human use. An "X" in a cell indicates that the good in question is used in the performance of the corresponding environmental service.

It is clear from the table that certain goods, or clusters of goods, are common to several services. These include (with HS subheadings in brackets):

- Chemicals: limestone flux, slaked (hydrated) lime, magnesium hydroxide and peroxide, and activated carbon (2521.00, 2522.20, 2816.10 and 3802.10).
- Catalysts (3815.00).
- Ion exchangers (3914.00).
- Erosion-control matting (ex outs[11] of 4601.20 and 5911.90).
- Laboratory refractory equipment (ex outs of 6903.10 through 6903.90).
- Laboratory ceramic and glassware (6909.19, 7017.10, 7017.20 and 7017.90).

10. Examples are biological oxidation systems, or biodetergents, which are used in the supply and pre-treatment of water, and in the remediation and cleanup of soil, surface water and groundwater.

11. The term "ex out" means that the good in question is described at a more detailed level (*i.e.* 8- or 10-digit level in national tariff schedules) than the 6-digit level.

- Pumps for liquids, whether or not fitted with a measuring device (8413); vacuum pumps and compressors (8414).
- Heat-exchange units and parts (8419.50 and .90).
- Solar cells (ex out of 8541.40) and photosensitive semiconductors.
- Surveying equipment (selected items between 9015.40 and 9015.90).
- Instruments used in monitoring (selected items between 9027.20 and 9032.20).
- Automated regulating or control instruments, other (9033.89).

The largest cluster of goods, by far, is laboratory equipment and glassware. Laboratory equipment, as a general category, is used in the provision of most environmental services, starting with the diagnostic phase and continuing after major capital works have been undertaken. Designing a wastewater treatment plant, for example, requires tests of the chemical and biological characteristics of both the raw effluent and the receiving river into which the treated effluent is discharged. Such tests are typically carried out locally, as most do not require overly sophisticated equipment or the skills of a PhD chemist. Some laboratory glassware (HS 7017.10), a centrifuge (HS 8421.19), a laboratory scale (HS 8423.81) and a few other assorted pieces of equipment and chemicals are often all that is needed. Analysing the composition of municipal solid waste, or the nature of soil contaminants prior to and following remediation, may require more sophisticated equipment and skills than measuring water and sewage (*e.g.* chromatographs and electrophoresis instruments, spectrometers and other instruments and apparatus for physical or chemical analysis, HS 9027), but the same basic glassware, centrifuges and laboratory scales are also required.

Instruments (selected items between HS 9027.20 and HS 9032.20) are used for the monitoring of all environmental services. Wastewater management service providers use instruments that measure such environmental variables as pH, temperature, dissolved oxygen, electrolytic conductivity and turbidity. Refuse disposal operations may use instruments for optical scanning and sorting of solid waste. Noise abatement services could not function without sound-level meters, and nature protection and landscape services could not function without surveying instruments. But instruments are not just for monitoring. For example, refuse collection vehicles now employ, in some places, GPS and route optimisation software systems similar to those used by express delivery services.

Catalysts also cut across several service sub-sectors. A catalyst is a substance that increases the rate of a reaction but remains chemically unchanged at the end of the reaction. Reaction initiators, reaction accelerators and catalytic preparations (HS 3815.00) refer to a broad range of compounds, usually made from nickel (or nickel compounds) or precious metals, such as platinum, palladium or rhodium, as the active substance. They are increasingly used in a wide range of industrial applications, not least for the reduction and control of environmentally harmful or dangerous substances. Catalysts are used, for example, to control odours during the treatment of sewage or malodorous industrial effluents (such as from pulp and paper mills), to remove hypochlorite (bleach) from chlorinated effluent streams, to suppress the formation of dioxins and furans during the combustion of municipal solid waste, and to strip toxic chemicals from contaminated soil.

Pumps, filters, valves and compressors are vital to any environmental service requiring the conveyance of fluids. In wastewater treatment, pumps move water, as well

as any chemicals in solution used in the treatment process, from one section of the treatment plant to another. Pumps are vital for cleaning up oil spills on water, and portable ones provide the power for sprays used for street cleaning. Different types of pumps are required for different purposes, however. Even in groundwater remediation, the choice of pump will depend on the depth to the groundwater table (Box 5.2).

Box 5.2. Choice of technology in soil and groundwater remediation

Groundwater pollution due to improper disposal of petroleum hydrocarbons or leaking storage tanks is a problem common to most countries, developed and developing alike. Remediation typically involves controlling or preventing contaminants from migrating off site.

Pump-and-treat (P&T) systems are the most commonly applied remediation technologies at most sites contaminated by petroleum products.[1] P&T systems typically use pneumatic groundwater extraction pumps, as opposed to electrical pumps, because of their intrinsic safety advantages and relatively lower costs of acquisition, installation, operation and maintenance. Above-ground diaphragm vacuum pumps can be used at sites where the groundwater table is within 5 metres of the ground surface. For sites with deeper groundwater tables, pumps with stronger suction heads may be needed, and down-hole, tube-well diaphragm pumps are usually preferred.

Typical P&T systems, especially those installed in remote locations, will also involve automated groundwater treatment systems. Among the major components of these systems are electrical control panels, control instruments, blowers, air diffusers, packing materials, oil interceptors and stripping towers.

1. Another widely used type of soil remediation system is soil vapour extraction (SVE). SVE is generally preferred if the organic compounds involved are volatile, the sub-surface is porous, and there is a risk of inhaling the vapour.

One reason for the commonality of certain goods across sub-sectors is that industries borrow from one another. Plants that convert waste to energy, for example, employ burners and pollution control systems originally designed for electric power generating plants. Landfills use leachate filtration systems that are also found in water treatment plants.

Other goods on the lists are less ubiquitous, but nonetheless important. Erosion control matting (ex outs of HS 4601.20 and HS 5911.90), for example, is vital to services involved in nature and landscape protection, especially during the critical period when new vegetation is being established on previously bare land. Similarly, service providers that treat wastewater may recommend its use to their clients, if the factories or power plants they are treating encounter problems in keeping discharge canals from washing away.

Services as market drivers

Many of the goods on the APEC and OECD lists have uses other than pollution prevention, pollution control or environmental remediation. Their use in the performance of environmental services is important, but in many cases will not be what drives the market for those goods. By contrast, some goods are quite closely associated with a

particular environmental service, so that growth in their consumption and trade is highly correlated with the expansion of that service.

There are several obvious examples. Booms or socks consisting of ground corncobs contained in a textile covering (HS 2302.10 ex) and pollution protection booms (HS 8907.90 ex) are used essentially to clean up oil spills. Similarly, trash compactors (HS 8479.89 ex) were created specifically for solid-waste management, the market for which is clearly driven by refuse disposal services.

Many types of air monitoring equipment (most of which fall under HS 9027) are used almost exclusively to measure either exhaust gases or ambient air quality. Examples include gas or smoke analysis apparatus (HS 9027.10), chromatographs and electrophoresis instruments (HS 9027.20), spectrometers, spectrophotometers and spectrographs using optical radiations (HS 9027.30), other instruments and apparatus using optical radiations (HS 9027.50), chemical analysis instruments and apparatus (HS 9027.80), and parts and accessories (HS 9027.90). A recent study undertaken by Business Communications Company, Inc. (Lindsey, 2003) found that the market for such equipment in the United States alone is expected to surpass USD 1.7 billion by 2007. Not all of these instruments are used by firms specialising in providing services for the protection of ambient air or climate — many are used by government inspectors — but service providers depend on them. Thus, as this service industry grows, so will sales of air monitoring equipment.

In the area of noise abatement, many of the goods involved may be purchased by specialists working for firms with a noise exposure problem, such as an industrial plant's occupational safety officers. But independent service providers are also major consumers. Examples most likely to be used in rendering the service would be: exposure meters, including sound-level meters (HS 9027.40), parts and accessories of apparatus of HS sub-headings 9027.20 to 9027.80 (HS 9027.40) and machines for balancing mechanical parts (HS 9031.10). Whether a company diagnoses a noise or vibration problem itself or follows the advice of a noise abatement service, it will often turn to certain goods to solve the problem, such as:

- HS 8708.92: silencers and exhaust pipes, [for] motor vehicles.
- HS 8409.91: parts suitable for use solely or principally with the engines of HS 8407 or 8408; suitable for use solely or principally with spark-ignition internal combustion piston engines (extended heading: industrial mufflers).
- HS 8409.99: parts suitable for use solely or principally with the engines of HS 8407 or 8408, other than aircraft engines or spark-ignition internal combustion piston engines (extended heading: industrial mufflers).

Case histories of environmental goods and services trade with developing countries

This section draws on case histories of services exported from an OECD country supplier to a private (*i.e.* non-governmental) entity in a developing country, as described in Annex 5.A1. Governments are also major consumers of environmental services, through a variety of contractual arrangements (OECD, 2001, p. 110). To avoid possible cases of public procurement, only case histories involving business-to-business trade were chosen. Because of the difficulty of obtaining information on contracts involving smaller companies, most of the case studies involve multinational corporations, either as

service suppliers or clients, and often as both. The range of examples therefore should not be assumed to be necessarily representative of the market as a whole.

Each case study provides a brief description of the nature of the service rendered and highlights the importance of any of the goods on the combined APEC and OECD product list (see Annex 5.A2) either to the service provider, or to the service provider's client following the provision of the service. The cases attempt to identify whether these goods were actually imported, brought in as temporary "tools of the trade", or purchased locally. If they were not brought in on a temporary basis, the cases mention whether any problems were encountered because of tariff or non-tariff barriers.

The market for environmental services

There would appear to be two forces driving businesses in developing countries to outsource environmental services. The first is environmental requirements, whether imposed by domestic or foreign governments or demanded by shareholders of the companies in order to uphold a high standard of corporate social responsibility. The second is the general tendency of manufacturing companies to contract for services that are not part of their core business.

As a series of national case studies carried out for the OECD, UNCTAD and UNDP have documented (see Chapter 1), developing countries are catching up with developed countries in the area of environmental protection. Over the last decade, many (especially the rapidly industrialising countries) have consolidated their previous, piecemeal environmental legislation, and increased their regulatory capacity.

In a number of developing countries, however, environmental laws are incomplete or are poorly monitored and enforced. For example, few explicitly require the remediation of soil and groundwater at contaminated sites. Nonetheless, remediation work is taking place, predominantly driven by general corporate mandates (especially if the firm is part of a multinational corporation), or specific concerns to reduce exposure to future liabilities or to protect a company's reputation. Multinational firms increasingly strive for a consistently high level of environmental responsibility and sustainability across all operations, regardless of the regulatory sophistication or commitment to enforcement in a particular country.

Many companies have decided that environmental services fall outside their core competencies, and are better left to professionals. Thus, in 2001, Hynix Semiconductor Inc. decided to divest itself of its water treatment facilities, and to turn that activity over to an independent service provider. Similarly, in Brazil, Arcelor, one of the world's leading steel manufacturers, decided to outsource all its utilities, including environmental services, to an independent service provider, in order to focus its investments on its core business and to reduce and contain costs, especially up-front investment.

Brazil provides an example of another, albeit less common, phenomenon: the diversification of industries from nearby sectors into the environmental sector. Bayer, one of the world's leading chemical manufacturers, has been conducting business in Brazil since the late 1800s. As an operator of chemical plants, it had gained considerable experience in handling a wide range of materials and transforming them through chemical, physical and even biological processes. It was a logical decision, therefore, to establish an Environmental Division specialising in the treatment of wastes. A half-owned subsidiary of that division, Tribel, now treats wastes in Brazil not only from the local Bayer chemical plant but from many other industrial plants as well.

The ability of some service providers to offer an integrated package of environmental technologies to address complex environmental problems may be spurring the move away from end-of-pipe solutions to those based on prevention. As Beatrice Chaytor[12] explains:

> The inclusion of cleaner technologies within the definition of environmental services may contribute to the dissemination of such technologies, through the provision of multidisciplinary services. In Malaysia, a private company operating privatised wastewater plants is following the example of British and French water companies, by providing integrated water services domestically and to other countries in the Asia-Pacific region. Another Malaysian company has expanded into manufacturing in order to complement its design of licensed and proprietary water treatment systems, enabling it to serve markets in Indonesia and Thailand. Although there is no evidence that such services caused direct environmental benefits, the implication of the inclusion of such experiences in empirical analyses of the effects from trade liberalisation seems to be that those benefits naturally follow from such liberalisation.

Goods associated with service contracts

The evidence provided in Annex 5.A1 confirms that many of the goods included on either the APEC or the OECD lists of environmental goods are used in the performance of environmental services. These include, in particular, items for holding, conveying, treating and filtering liquids: tanks, pumps, compressors, valves, chemicals and filters. Also appearing frequently on the lists of goods associated with the case histories are various instruments for monitoring and measuring. Carrying out environmental services such as wastewater treatment and soil and water remediation would simply not be possible otherwise. At the same time, the case histories show that environmental service providers often rely as well on specialty items designed specifically for that service. Passive sorbent collection devices (sorbers) — used to measure the movement of volatile gases in soils — are a case in point.

Several of the case studies provide evidence that there is often a progression in the way that service providers procure the goods they need. In almost all cases, any materials associated with "plumbing" (piping, valves and so forth) are purchased locally from the beginning, as are gravel, sand and similar bulk materials. As the service provider becomes more familiar with local suppliers, it will generally turn more and more to them for equipment and intermediate inputs, as long as the quality of those goods is sufficient for their needs. All else equal, there are advantages to procuring goods locally: delivery times may be shorter, transport costs lower, and after-sales service more reliable.

Consequently, as the market for equipment and inputs associated with environmental services expands, so usually does the number of local suppliers and the range and sophistication of the products they offer, not just to service providers operating in their own country, but also to buyers in other lands. Often, local suppliers are the result of joint ventures between foreign companies with specialised knowledge of the environment goods and services industry and local companies with complementary strengths.

For example, in a joint venture with Dongguan Hu Men Harbour Water Supply Company, Sino French Water Development (a 50-50 subsidiary of Ondeo and the New World Group based in Hong Kong, China) has established an equipment manufacturer

12. Beatrice Chaytor, "A primer on environmental goods and services: definitional challenges to the negotiation of further liberalisation", study commissioned by the Royal Society for the Protection of Birds, www.field.org.uk/PDF/RSPB.pdf.

which produces membrane-technology equipment for water treatment, including microfiltration units (capable of treating up to 50 000 m^3/day). Using ultra-filtration techniques from France and reverse osmosis techniques from the United States, it has additional equipment able to treat up to 45 000 m^3/day. This equipment was not used for the SCIP project discussed in Annex 5.A1, but has been used in other water plants in China and outside China.

The ability of local suppliers of environmental goods to meet the needs of environmental service providers varies, of course, according to the level of development of the local economy and the kinds of manufacturing in which it specialises. Most of the products necessary to treat and manage urban water and wastewater can already be purchased locally in rapidly industrialising countries such as Brazil, China or Korea. Similarly, above-ground diaphragm pumps, which are used for soil and water remediation in areas with shallow groundwater tables (see Box 5.2), are widely available in many developing countries.

However, some segments of the environmental services industry require equipment that is often difficult to find locally. The treatment of end-of-pipe industrial wastewater flows, for example, typically involves processes that are highly specialised (the market segments are narrow) and catered to by a limited number of global suppliers. Tube-well diaphragm pumps (required for remediation of soil and water in areas with groundwater tables) are another example of devices that often have to be imported. Similarly, the blowers for soil vapour extraction systems, because they need to be intrinsically safe, are usually imported, at least initially.

Import barriers

Obtaining information on actual customs duties paid for imported products is, naturally, a sensitive issue for businesses. For that reason, most of the information provided in the case studies included in Annex 5.A1 is quite general.

To the extent that the case studies mention tariff rates, the information is patchy. Some companies reported "no particular problems", others that tariffs on equipment were as high as 60%. Such tariffs raise the price of pollution control equipment, which ultimately has to be borne by the industrial clients, making their final goods less able to compete in the market. The information is simply too sparse to determine whether it is consistent with other information on tariffs applied to environmental goods. According to research carried out by the WTO, for example, the average *applied* tariff on environmental goods levied by developing countries is between 7% and 8%, and by least developed countries (LDCs) around 10% (Teh and Bora, 2004). (In developed countries the average is less than 2%.)

In some countries, including several examined for the purposes of this chapter, governments have at times been willing to waive import duties on equipment used for environmental purposes, or to provide rebates on duties after the equipment has been imported. However, because the administrative processes to obtain these waivers or rebates are often long and difficult, the net benefit to the importer may be substantially reduced. Other difficulties encountered included delays and problems associated with the payment of bribes when shipping goods through ports. Goods shipped by air have generally enjoyed smoother transit, and some companies ship by air wherever possible. However, unless the item is a high-value, low-weight good, the cost of shipping by air rather than sea can easily add 10% or more to the cost of importing it.

Concluding observations

Trade in environmental services is clearly responding to the demands of clients in developing countries. Those demands are being driven in some cases by tighter regulations and in others by corporate policy, especially in terms of corporate social responsibility.

Economies of scale

Businesses that engage outside experts to carry out environmental services reap many benefits. Outsourcing allows them to concentrate on their core activities and to shift some of the liability of meeting environmental regulations to other companies. Especially when the service involves treatment of water or wastes, the facilities can often be built to an optimal scale, which may be larger than what is required for a single client. The resulting economies of scale can help reduce costs and, because several clients can be served, introduce greater flexibility into the contractual arrangements. Keeping an open door to imports of environmental services and goods also helps ensure vigorous competition, which keeps down prices and helps make supply more reliable.

Increased access to the latest know-how

Specialist service providers generally have access to the latest know-how and technology for protecting the environment. That is not only good for communities in the vicinity of the sites where the service providers operate, but it also provides a conduit through which knowledge about pollution control and remediation can flow into the importing country. This effect is strengthened when local people are employed at the service provider's facility. In almost all of the case histories described in Annex 5.A1, the great majority of the staff providing the environmental service was hired locally.

Improved environment for investment

The case studies also suggest that the availability of environmental goods and services in a country or a region of a country removes a barrier to investment by companies whose stockholders require the application of high standards of environmental performance at their plants. This phenomenon is apparent in Brazil, for example, where the creation of a major waste treatment centre associated with Bayer's chemical complex has helped attract subsequent investments by other chemical companies and by companies engaged in the transport of materials, engineering, maintenance, computer science and cleaning services.[13]

Investment and commerce discount uncertainty, however, and place a value on predictability. One way for national governments to remove uncertainty in the area of trade and investment related to environmental goods and services is to make positive commitments for their liberalisation. For environmental goods, that means not just lowering tariffs but also binding tariffs at those low (or zero) rates. Currently, among members of the WTO, the average bound tariff rates on environmental goods included on the APEC and OECD lists are 30% for developing countries and over 50% for LDCs, *i.e.* considerably higher than the applied rates. Moreover, while the share of environmental good tariff lines bound by developing-country WTO members is around

13. www.bayer.com.br/ContentPI/home.nsf/.

80%, for LDCs it is around 50%. By comparison, for developed countries the share of tariff lines that are bound is close to 100%.

For environmental services, the current set of GATS negotiations offers WTO members an opportunity to achieve greater levels of liberalisation in an orderly and flexible manner. As Chapter 4 acknowledges, liberalising trade in environmental services, particularly services that require long-term investments in plant and equipment, may require new regulatory tools, including those relating to pricing and service standards. This is particularly necessary in the case of environmental services, as they involve a wide range of services and a large number of measures may affect access to them. Identifying and removing barriers to commercial presence (Mode 3) and movement of natural persons (Mode 4) are clearly important to achieving the full benefits of liberalisation in this area.

Finally, there would appear to be potential benefits for trade in environmental goods resulting from the WTO negotiations on trade facilitation. In particular, improving customs procedures could address several of the non-tariff barriers mentioned in the case studies.

The main point of this chapter, however, is that the potential benefits of simultaneously liberalising trade in environmental services *and* in environmental goods are likely to be much greater than liberalising trade in either one or the other. These benefits include, naturally, improving the environmental performance of local industries, and thereby increasing a country's attractiveness for foreign direct investment; increasing the availability of these services, for the benefit of the environment and the health of the population; and reducing costs and spurring innovation. But they also include increasing local capacity to produce goods and provide environmental services, capacity that, with multilateral liberalisation, can be translated into increased export opportunities.

Annex 5.A1

Case histories of EG&S trade with developing countries

Some of the following information was obtained from private service providers and should be treated as indicative. The market for technologies using micro-electronics is particularly dynamic, and the processes and the techniques are continuously being adapted. Financial data may be modified by currency exchange rate fluctuations. Consequently, the origin of imported equipment and the share provided by local markets may change over time.

Goods appearing on the APEC list are indicated with a pyramid (▲) and goods appearing on the OECD list are indicated with a round dot (●).

Multi-service contracts

Multi-service contract supplying Arcelor's Vega do Sul plant, Brazil

The client

In the southern Brazilian State of Santa Catarina on the island of San Francisco, Arcelor, the world's largest steel maker, is completing construction of a new steel plant. The Vega do Sul plant, which became operational at the end of the first half of 2003, produces annually some 880 000 tonnes of pickled, cold-rolled and galvanized steel.[14] Built at a cost of USD 420 million, it employs 300 people and is credited with generating indirectly an additional 250 jobs. Final completion of the project is expected in 2005. The steel laminated by Vega do Sul is supplied to manufacturers of automotive vehicles, household appliances, pipes and the building industry in Brazil and throughout the MERCOSUR region.

Arcelor decided to outsource all the utilities supplied to the Vega do Sul (water, energy, waste) in order to:

- Address growing pressure associated with environmental legislation.
- Reduce and contain costs.
- Focus investments on its core business.
- Maximise quality, safety and environmental compliance.

Arcelor entrusted the investment, the construction and the exploitation of a multi-utility power station to an external industrial partner. The financial and contractual

14. The plant can be expanded to 1.4 million tonnes.

agreements allow Arcelor to de-consolidate the utilities and environmental service assets from other industrial assets of the Vega do Sul plant.

The service supplier

The group Veolia Environnement (VE) was selected to supply these services. VE operates in 84 countries, and some 55% of its sales turnover (EUR 29 billion in 2003) is generated outside of its home country, France. For the Vega do Sul contract, VE created a new company, SPC CLE Brazil. VE holds 100% of the capital of SPC CLE Brazil: 50% by Veolia Water, 25% by Onyx (VE's solid-waste management subsidiary). and 25% by Dalkia (its energy subsidiary). The company's annual revenue is estimated at USD 15 million.[15]

The contract

The contract, signed in 2002, envisages the design, the construction and the complete outsourcing of the utility services for a period of 15 years. The contract is of the BOO (build, own and operate) type, and does not require the customer to invest any capital. The scope of the contract includes transformation and distribution of electrical power, the distribution of natural gas, and production and distribution of industrial gases (nitrogen and hydrogen) and of compressed air, solid-waste management, wastewater management, and the provision of water (process water, water for fire fighting, demineralised water, hot water, cooling water and potable water).

For solid-waste management, Veolia Environnement provides on-site collection and organises external treatment of some 3 000 tonnes of waste a year. Treatment includes the recycling of some waste categories, the incineration of waste oils in a cement factory, and the burying of other waste categories in specialised landfills. For the other utility and environmental services it provides, VE operates all the on-line equipment with about 60 employees, most of them recruited locally. For the procurement and financing of equipment used to produce industrial gases, it teamed up with Air Products Brazil. For the procurement of other equipment, engineering and construction it turned to USF Brazil, ABB Brazil and JPE Brazil.

Goods associated with the service contract

As a general rule, about 65% of VE's investment is spent locally in Brazil and 35% is spent on imports from Europe and the United States. The great majority of products and equipment (an estimated 75% of the total investment) for the Vega do Sul facility were purchased in Brazil. These included demineralisation modules, measurement instrumentation (for example HS 9026.10 and 9028.30), part of the instruments used for process control, and all the following products and heavy equipment:

- Various active chemicals from HS Chapters 25 and 28•.
- Tanks (HS 7309.00• and 7310.10•).
- Pumps for liquids (HS 8413.60▲• to 8413.70▲•).
- Compressors (HS 8414.30• to 8414.90•).
- Filters (HS 8421.21▲• to 8421.29▲•).

15. www.veoliaenvironnement-finance.com/.

- Valves and fittings (HS 8481.10• to 8481.80•).

Veolia Environnement estimates that approximately 25% (in value terms) of the equipment used in installations relating to water were imported. These imports, 70% from Europe and 30% from the United States, included:

- Technologies for the treatment of used water flows, notably, technologies for vacuum evaporation, technologies for treating biological and mineral oils and technologies for treating specific industrial wastewater microflux. Most of these specialised technologies were provided by Veolia Water Systems.
- Electrical instruments, command and control instruments, monitoring instruments. Several categories of instruments, presenting specific technical features or adapted to specific operating constraints, cannot be sourced on the Brazilian market. As an example, imports include contacts for high-tension electrical current (HS 9032.89▲•), which are provided by ABB. These types of contacts are currently manufactured only in Norway.

For waste treatment, all capital equipment required by Veolia Environnement (notably, two pump trucks for liquid wastes) was purchased locally. The share of equipment imported to provide industrial gases accounted for more than 50% of the investment required for on-site industrial gas production facilities. This relatively high share is explained by the fact that technologies required for on-site industrial gas production are patent-protected and only proposed by the major international suppliers, such as Air Products & Chemicals and Air Liquide.

Import barriers

The customs tariffs on some equipment imported by Veolia Environment for the Vega do Sul plant were 25% or higher. A customs tariff exemption procedure can be activated if the importer is able to prove that the goods cannot be purchased in Brazil. Veolia Environment activated this procedure and benefited from a tariff waiver on most of the equipment imported for Vega do Sul. Nevertheless, the administrative process to obtain this result was extremely long and difficult.

Multi-service contract supplying local industrial clients in Belford Roxo, Brazil

The clients

The city of Belford Roxo, located 40 kilometres from Rio de Janeiro, is one of the poorest in Brazil, and a large proportion of its estimated 600 000 inhabitants are children. It is also home to many of Brazil's heavy industries. Companies in the area manufacture or assemble, among other goods, chemicals (especially petrochemicals and pharmaceutical products), automobiles, steel and telecommunication equipment. This concentration of industries generates huge volumes of solid and liquid wastes. Many of these wastes are now treated at a central facility operated by *Tratamento de Resíduos Industriais de Belford Roxo S.A.*, or Tribel for short.

The service supplier

In 1956 Bayer, one of the world's leading chemical manufacturers, bought an old sulphuric acid and phosphate factory in the city of Belford Roxo, Brazil, and re-

established it as *Bayer do Brasil Indústrias Químicas S.A.* (Chemical Industries). Today, Belford Roxo is one of Bayer's largest production sites in Latin America.

In the 1980s, Bayer began installing systems for treating both its solid and its liquid wastes. An effluent treatment plant was installed in 1984, followed by a landfill in 1985, and an industrial waste incinerator in 1992. Anticipating the growing demand for managing wastes from industrial facilities in the area (some of which are located in an industrial park established by Bayer in 1997), and that economies of scale were likely, Bayer built its facilities with considerable spare capacity. In August 2001, Bayer transferred the facilities to Tribel, a 50-50 joint venture between the Environmental Division of Bayer and the French company Tredi (now part of the Séché Environnement group), and started contracting with various nearby industries to treat their waste.

Certified to ISO 9002 and ISO 14001 standards (2000 revisions), Tribel's 60-hectare facility comprises:

- An accredited *toxicology laboratory* for waste and effluent analysis, employing around ten scientists.
- A *water purification plant* with two lines and an aggregate capacity of 150 m^3/hour. Physical and chemical treatment includes equalisation, pH adjustment and sedimentation phases, while the biological treatment stage consists of degrading organic substances through the action of micro-organisms in the activated sludge. The resulting sludge is piped to Tribel's industrial landfill, and some of the treated wastewater is recycled through the incinerator's gas treatment system.
- A 22-hectare Class 1 *landfill* with an available annual capacity of around 1.5 million m^3. Solid wastes are dumped on the landfill area, which is protected by a layer of compacted clay over the earth and lined with a high-resistance polyethylene sheet that can withstand physical, chemical and biological attack. Shafts have been sunk around the site to monitor underground water, which is collected and analysed on a regular basis. Leachate is pumped to the wastewater treatment plant.
- An *incinerator* with a capacity to handle 10 000 tonnes a year. Equipped with a rotating kiln, a static oven, an after-combustion chamber and an off-gas treatment system, the plant is capable of completely destroying inorganic residues, and is one of only two in Brazil able to incinerate polychlorinated biphenyls (PCB) in a way that does not damage the environment. The facility is Brazil's first central toxic waste treatment complex and accounts for around 10% of domestic installed capacity.

Currently, 1 000 clients send one or more of their waste streams to the Tribel site. Some 15% of the waste incinerated by Tribel comes from Bayer's own production; the rest comes from other companies.

Goods associated with the service contract

Only general information on goods used in the construction and operation of Tribel's facilities is provided on its Web site (www.tribel.com.br). However, judging from the description of its facilities, it appears that many goods from the combined APEC and OECD list have been or are being used, such as:

- Tanks (HS 7309.00● and 7310.10●).
- Pumps (HS 8413.60▲● to 8413.70▲●).

- Waste incinerators (HS 8417.80▲•).
- Filtering or purifying machinery and apparatus (HS 8421.21▲•, 8421.29▲• and 8421.39▲•).
- Measuring and monitoring equipment for use in laboratories (various subheadings under HS headings 9015, 9022, 9025, 9026, 9027, 9028, 9030, 9031, 9032 and 9033▲●).

Water and wastewater treatment

Water and wastewater treatment for Hynix Semiconductors, Korea

The client

Hynix Semiconductor Inc. (formerly Hyundai Electronics Industries) is a global leader in the production of semiconductors and has become the world's third largest producer of DRAM (dynamic random access memory) chips. Hynix produces DRAM chips at four sites in Korea, as well as computer screens and liquid crystals. As semiconductor production requires ultra-pure water to clean components that are very sensitive to the deposition of impurities, it is essential for Hynix to have access to a constant supply of high-quality, ultra-pure water. Moreover, since the industry recycles most of its wastewater in the production cycle, effective wastewater treatment is also a critical issue. In order to focus on its core business, Hynix decided in 2001 to transfer the risk of managing its water to a specialised supplier of services. This involved selling the existing water treatment plants and drawing up a long-term contract for their operation.

The service supplier

Hynix chose Veolia Water, a subsidiary of the Veolia Environment group, to operate the plants. Veolia Water, one of the world's leading companies in services and technologies related to water, was already established in Korea at the time. In 2000, for example, Veolia acquired the water treatment units of Hyundai Petrochemical's petrochemical complex, and was selected by two large cities to build and operate wastewater treatment plants.

The contract

In 2001 Veolia Water, in association with Korean financial organisations, acquired all of the industrial water treatment and generating stations belonging to Hynix. A second company was set up to operate the facilities. This fully owned subsidiary of Veolia Water contracted to ensure the installation, operation and management of water at all four of Hynix's sites for a period of 12 years. Approximately 150 Hynix employees were transferred to the Veolia Water subsidiary. Veolia Water's 20 manufacturing units produce each day 83 500 m^3 of ultra-pure water, and treat 45 500 m^3 of wastewater, recycling between 60% and 95% of the water that flows through the manufacturing plants.

The contract specifies that Veolia Water will guarantee levels of performance and reliability of service (quality of provided water, delivered quantity, continuity of the service, etc.). For example, Veolia Water's required level of performance in the treatment of wastewater exceeds Korea's environmental regulations for the discharge of wastewater. Penalties are envisaged in the event of non-observance of the criteria.

Goods associated with the service contract

Almost all of the "plumbing" equipment for the plants was purchased in Korea, including:

- Tanks (HS 7309.00• and 7310.10•).
- Pumps (HS 8413.60▲• to 8413.70▲•).
- Compressors (HS 8414.30 to 8414.90).
- Valves (HS 8481.10• to 8481.80•), except special valves and fittings for ultra-pure water distribution and regulation.

Production of ultra-pure water

The installations purchased by Veolia Water were already equipped, mostly with Japanese processes. It is expected that the equipment will have to be entirely replaced at least once during the life of the contract, as advances in the technologies for producing ultra-pure water are constantly evolving (the normal product cycle is approximately six years), and customers ask for upgrades regularly. Currently, Veolia Water uses several processes to produce ultra-pure water at the Hynix sites, including membrane-based filtration (micro-filtration) and resin-based demineralisation through ion exchangers (HS 3914.00•). Demineralisation is gradually being replaced by cleaner processes, such as units using thin-cell continuous deionisation (CEDI), an electronically controlled process that reduces the need for chemicals. This patented technology was provided by US Filter (a former subsidiary of Veolia Water, sold to Siemens in 2004).

Most of these processes are not protected by patents, but they do require very precise engineering for process design. This is provided for the Hynix sites by Europe-based teams of engineers from Veolia Water. The equipment, highly specialised, is then purchased on the world market. It are available from a limited number of suppliers and there is currently no local producer. Approximately 50% (in value terms) of the equipment used to produce ultra-pure water at the Hynix sites has had to be imported. About two-thirds of the imports have come from factories located in Europe and the rest from the United States.

Treatment of residual water and the recycling of process water

The treatment of wastewater also requires highly specialised techniques. It generally involves the use of equipment assembled on skids. For the wastewater treatment units deployed at the Hynix sites, the rate of importation (over 50% in value terms) has been comparable, or even higher, than that for the units for producing ultra-pure water. Recycling requires less imported equipment, but more imports of engineering services provided by staff (based in Europe) employed by Veolia Water. Veolia's re-engineering made it possible to increase the rate of water recycling compared with the recycling rate achieved by the original operator of the facilities.

Consumable items

Some two-thirds of consumable items used at the plants have had to be imported. About half have come from Europe (mainly Germany and France), and the rest from other regions (the United States and Asian countries). The suppliers have been industrial groups such as Dow Chemical and Filmtech (for membranes), Pal (for filtration

cartridges), Nalco and Betz-Dearborn. Veolia Water, which has other clients in Korea, is a major buyer of equipment and consumable items, which allows it to obtain more favourable conditions than other, smaller industrial enterprises.

Instrumentation

Nearly 100% of the control and monitoring instruments integrated in the water facilities at the Hynix sites is imported. Roughly one-third comes from factories located in Europe, one-third from the United States and one-third from Japan. On the combined APEC-OECD list of environmental goods, Veolia Water identified the following categories of instruments as being imported:

- Hydrometers and similar floating instruments, barometers, hygrometers, and psychrometers (HS 9025.80▲•).
- Instruments and apparatus for measuring or checking the flow or level of liquid (HS 9026.10▲•).
- Instruments and apparatus for measuring or checking pressure (HS 9026.20▲•).
- Electricity meters (HS 9028.30▲).
- Automatic regulating or controlling instruments, other (HS 9032.89▲•).

The manufacture of semiconductors requires advanced technology for the management of process water, and only a limited number of companies supply the necessary highly specialised equipment. It is thus probable that the share of imports will remain high in the near future. The second industrial facility managed by Veolia in Korea, that of Hyundai Petrochemicals, requires, for example, imports of products for implementing modules used in reverse osmosis.

Barriers to imports

Veolia Water's Korean subsidiary functions like a local enterprise in Korea, and therefore paid normal customs duties.

Water and wastewater treatment at Shanghai Chemical Industry Park

The client

Shanghai Chemical Industry Park (SCIP), located north of Hangzhou Bay, is one of the largest industrial projects included in China's Tenth Five-year Plan. Within its total planning area of 29.4 km^2, SCIP intends to be one of the leading sites for the production of petrochemicals in Asia. Companies such as BP, BASF, Bayer, Huntsman, Air Products & Chemicals, Vopak, Air Liquide and Praxair, as well as Chinese groups, have already started projects there worth a total investment of over USD 8 billion. Shanghai Chemical Industry Park Development Co., Ltd. (SCIPDC) is responsible for development and construction of Shanghai Chemical Industry Park, and provides industries located in the park with public utilities, logistics and environmental protection services.

The service provider

Ondeo, a subsidiary of the Suez group, was chosen by SCIPDC as its partner for water services. Ondeo is a leading water specialist, supplying water and wastewater services to 115 million people and 60 000 industrial customers in 130 countries, and has

built some 10 000 water treatment plants. Over the last 20 years, its engineering services division, Ondeo Degrémont, has built 118 water plants in China alone. Ondeo has ten long-term water contracts in China.

The contract

A joint venture was formed between Sino French Water Development Co. Ltd. (a 50-50 subsidiary of Ondeo and the New World Group based in Hong Kong, China) and SCIPDC. Ondeo Industrial Solutions, a wholly owned Ondeo subsidiary (created in 2002 by drawing together Ondeo's know-how and technical expertise in industrial water treatment), is the operating branch of this joint venture.

For water supply, SCIP projects include the operation of a 200 000 m^3/day industrial water plant and a 7 000 m^3/day domestic water plant. For wastewater treatment, SCIP projects include designing, financing and managing installations and services for the park's industrial effluents. The duration of the wastewater contract is 50 years. Total investment is expected to reach EUR 50 million for an effluent treatment volume of 50 000 m^3/day. Both water and wastewater plants, located on a "utilities island", which integrates the supply of water, co-generation and industrial gas services, became operational at the end of 2004.

Goods associated with the service contract

Because Ondeo has been operating in China for 30 years, its knowledge of Chinese suppliers is quite good. A growing number of western manufacturers are now establishing joint ventures in China, so the imported share of its equipment is shrinking. For the SCIP contract, several categories of industrial products have been sourced entirely from Chinese suppliers. These categories include heavy products and instrumentation, such as:

- Chemicals (HS Chapters 25 and 28•).
- Tanks (HS 7309.00• and 7310.10•).
- Valves (HS 8481.10• to 8481.80•).
- Various types of monitoring instruments:
  - Photogrammetric surveying instruments and appliances (HS 9015.40▲).
  - Apparatus based on the use of x-rays or of alpha, beta or gamma radiations (HS 9022.29▲).
  - Thermometers and pyrometers (HS 9025.11▲•).
  - Liquid supply, production and calibrating metres (HS 9028.20▲•).
  - Instruments and apparatus for measuring or detecting ionising radiations (HS 9030.10▲•).
  - Cathode-ray oscilloscopes and cathode-ray oscillographs (HS 9030.20▲).
  - Multimeters (HS 9030.31▲).
  - Other instruments and apparatus for measuring electrical quantities (HS 9030.89▲).
  - Thermostats (HS 9032.10▲•).
  - Manostats (HS 9032.20▲•).

- Hydraulic and pneumatic instruments and apparatus (HS 9032.81▲•).

Product categories that are partly sourced from local suppliers include heavy equipment, such as pumps (80% local), compressors and filters (70 % local), as well as several categories of instruments.

Sino French Water Development Co. identified the following industrial product imports from the combined APEC-OECD list of environmental goods:

- Pumps (HS 8413.60▲• and 8413.70▲•): 20% imported.
- Compressors (HS 8414.30• to 8414.90•): 30% imported.
- Filters (HS 8421.21▲• and 8421.29▲•): 30% imported.
- Several categories of instruments (on average 50% imported), including:
  - Hydrometers and similar floating instruments, barometers, hygrometers and psychrometers (HS 9025.80▲•).
  - Instruments and apparatus for measuring or checking the flow or level of liquid (HS 9026.10▲•).
  - Instruments and apparatus for measuring or checking pressure (HS 9026.20▲•).
  - Chromatographs and electrophoresis instruments (HS 9027.20▲•).
  - Spectrometers, spectrophotometers and spectrographs using optical radiations (ultraviolet, visible, infrared) (HS 9027.30▲•).
  - Exposure meters [including sound-level meters] (HS 9027.40▲•).
  - Gas meters (HS 9028.10▲•).
  - Electricity meters (HS 9028.30▲).
  - Automatic regulating or controlling instruments, other (HS 9032.89▲•).

Sino French Water Development Co. has indicated that it did not use ion exchangers (HS 3914.00•) or catalysts (HS 3815.00•) for the SCIP project but, if this type of equipment were needed, the import share would be around 50%.

Trade barriers

Regular custom tariffs apply to goods imported for the SCIP project. (There have been no tariff reductions or exemptions.) Otherwise, Sino French Water Development Co. has not encountered any other obstacles, such as delays caused by slow customs clearance.

Other examples

A French company, Veolia Water Systems, developed and is now operating a water and wastewater recovery system for a DaimlerChrysler truck manufacturing plant in Saltillo, Mexico. The plant requires more than 1 800 m^3 of treated water a day and is forbidden to discharge any wastewater into the local river. The contract involves pumping water from deep, on-site wells; producing drinking and process water; treating sewage (which is reused in irrigation); and treating industrial wastewater (which is reused in the plant). The incoming well water is filtered and purified using a reverse-osmosis system,

which is then used in the manufacturing processes. Some 70% of the plant's wastewater is treated and reused in the plant.

Solid-waste management services

In Chile, industrial and construction solid waste was for years disposed of in residential dumping grounds, clandestine dumping grounds or simply thrown down the drain.[16] In 1997, the industrial solid waste unit of the "Point Source Emissions Control Programme" (*Programa de Control de Emisiones de Fuentes Fijas*, PROCEFF) of the Metropolitan Environmental Health Service (*Servicio de Salud Metropolitano del Ambiente*, SESMA) began to regulate this waste. This coincided with the inauguration of the first authorised waste treatment company, Hidronor, which is owned by the Belgian group, Machiels, and Bravo Energy Chile S.A., whose parent company is based in California. Bravo Energy Chile S.A., through its fully permitted, state-of-the-art treatment plant facility (located in Santiago), is currently providing industrial waste treatment and disposal services and environmental consulting for a wide range of clients.[17] Because its first facility was built before the Chile-US Free Trade Agreement, it had to pay duty on equipment purchased from abroad. It is believed that tariffs were of the order of 10%.

Air pollution and sound-level monitoring

Air pollution and sound-level monitoring for a Jordanian cement manufacturer

The client

For reasons of confidentiality, the service provider (a Canadian consulting firm) has asked that its client's name not be disclosed, but described it as a large multinational firm engaged in the production of cement and aggregates. The client owns and operates two cement plants in Jordan and supplies customers throughout the Middle East.

In order to reduce production costs (by some USD 6 million a year), the client recently proposed to substitute 180 000 tonnes a year of pulverised petroleum coke (petcoke) for some of the heavy fuel oil it used in its plants. The plant sites needed to be modified, using both new and existing equipment, to accommodate new facilities for crushing, milling and storing the petcoke, and new burners for incinerating petcoke in the kilns. The plants would require approximately 190 000 tonnes a year of raw petcoke, transported in covered trucks (25-30 tonnes/truck) from the Syrian border. In addition, around 110 000 tonnes/year of pulverised petcoke would be hauled from one of the company's plants to the other, using 12-15 specialised trucks ("capsules"), each with a capacity of 20 to 25 tonnes.

The client had applied to the Jordanian government for an environmental permit, but non-governmental organisations (NGOs) opposed the application, arguing that burning petcoke would further degrade the ambient air in the vicinity of the two cement plants. The NGOs claimed that the plants were emitting too much dust, NO_X and SO_2, and that these emissions were negatively affecting public health. Moreover, owing to misperceptions about the environmental impact of the plants' operation, local land

16. See the report by the US & Foreign Commercial Service of the US Department of State (2001) at http://strategis.gc.ca/epic/internet/inimr-ri.nsf/en/gr-79378e.html.

17. www.bravoenergy.com/page7.html.

owners complained that prices for their properties were depressed compared with prices for comparable land elsewhere in the region.

In order to obtain an unbiased, independent assessment of the situation, the Jordanian government ordered an environmental assessment and audit by an international consultant able to collect most of the environmental data on its own. The Jordanian authority did not want to rely on local equipment, data or even local staff to complete the job.

The service provider

The Canadian company engaged by the client is an employee-owned scientific and research-oriented consulting firm specialising in evaluations, assessments and quantitative data analysis. Over the past 25 years it has worked in more than 50 countries, for both public- and private-sector clients. The company's associate in Jordan provided technical and logistical support for the project.

The contract

The contract entailed preparing a comprehensive environmental impact assessment (EIA) for the proposed changes in the client's production processes, and conducting an environmental audit of all ongoing activities at both of the client's cement plants in Jordan. This involved drawing up and carrying out a detailed monitoring programme for air pollutants (PM_{10}, $PM_{2.5}$, SO_2 and NO_X) and noise, using its own equipment or equipment leased or rented from other providers.

Goods associated with the service contract

The products involved in the site investigation included:

- Filter assemblies (HS 8421.39▲•).
- Particulate samplers (ex HS 9027.10▲•).
- Pre-weighed and prepared particulate filters (ex HS 9027.10▲•).
- NO_X absorbers (ex HS 9027.10▲•).
- SO_2 absorbers (ex HS 9027.10▲•).
- Sound-level meters (HS 9027.80▲•).

The particulate samplers, power pack, spare batteries and associated equipment were shipped as checked luggage brought into Jordan by the air quality monitoring engineer from the service provider's Canadian office. The particulate filters were supplied by Maxxam Laboratories of Mississauga, Ontario, and the absorbers by the Maxxam Laboratories' facility in Calgary, Alberta. Noise monitoring equipment was rented through another agency in Canada and transported to Jordan in the engineer's hand-carried luggage.

Import issues

Because the equipment used to perform the job was to remain in Jordan only temporarily, no import duties were due. However, affirmations that the equipment was to be so used were required.

Before departing for Jordan, the service provider made inquiries through its Jordanian associate regarding import restrictions and was informed that personnel should bring appropriate letters, operating manuals and other relevant documentation to demonstrate that the equipment to be used for the job was necessary and would be removed from Jordan when the work was completed. A letter specifying the equipment, date of purchase and value was submitted to the Jordanian customs agency prior to the engineer's arrival in Amman. Upon arrival at Amman airport, however, all of the equipment was impounded by the customs service, pending clearance. The service provider's local associate had to work with local authorities for three days and deposit JOD 750 (equivalent to USD 1 070 at the time) as a security deposit to ensure that the equipment would be taken back to Canada. How the security deposit was calculated was never disclosed.

After using the equipment for six months in Jordan, the service provider decided to return the equipment, and it was packed with the check-in luggage of the firm's director, who was in Amman making a final presentation of the report. The firm's director had to spend three hours at the airport customs office prior to check-in to get clearance to take the equipment out. That was in February 2004. As of mid-July 2005, the JOD 750 security deposit had not been returned.

Noise and vibration abatement services

Solving a noise and vibration problem at a Caribbean smelter

The client

In the early 1990s, a large smelter situated in a Caribbean country needed professional help to investigate ventilation noise and a vibration problem associated with an exhaust duct serving one of its furnaces. It turned to Hatch, a Canadian company specialising in such services.

The service provider

Hatch has been exporting sound-level monitoring services for more than 20 years. In Trinidad in the late 1970s, for example, it assisted in ensuring that a plant did not bother people living in the neighbourhood.

Goods associated with the service contract

The agent took an octave-band sound-level meter and several accelerometers into the country as "tools of the trade". The solution turned out to require a modification of some ducts. The work was carried out locally and successfully.

Import barriers

It took a day or two after the agent arrived for a community noise monitor to clear customs. His octave-band sound-level meter came in with him, and perhaps required some paperwork.

Nature and landscape protection services

A co-operative programme between the United States Golf Association (USGA) and Audubon International (an environmental NGO) is promoting ecologically sound land management and the conservation of natural resources on golf courses.[18] Already, nearly 2 000 golf courses around the world have joined the programme, among them three in Costa Rica,[19] three in the Philippines[20] and one in Singapore[21] fulfil requirements in all six of the programme's categories, including the one relating to "wildlife and habitat management". This requirement emphasises maintaining the best possible habitat for wildlife on the non-playing areas of golf courses.

Remediation and cleanup of soil, surface water and groundwater

Remediation and cleanup of soil at a former cosmetics plant in Indonesia

The client

For business confidentiality reasons, the client of this case study asked not to be identified. The company has fairly recently ceased production in Indonesia, but still sells its products (health and beauty aids) to retail outlets in the country.

The service provider

Environmental Resources Management (ERM) is an environmental consultancy employing 2 500 staff at 100 offices in 37 countries. Gross revenues for 2003 totalled USD 348 million, making it the second largest pure environmental services firm in the world after US Filter. The company provides a full range of environmental consulting services, including strategic management planning; development impact assessment and planning; risk and liability management; facility permitting, compliance, and technical support; and contaminated-site management.

The company's Jakarta office employs 15 people, including 12 technical consultants, all but one Indonesian. The company works primarily for clients in the oil and gas industry, but serves many other industries as well.

The contract

The client retained ERM to take over pollution monitoring duties at a production facility which the client sold during the period of the work as part of its decision to close down manufacturing operations in Indonesia. The extent of the site is moderate, but it is potentially contaminated by particularly dangerous hydrocarbons that could pose a

18. www.audubоninternational.org/programs/acss/golf.htm and www.usga.org/turf/environmental_programs/audubon_sanctuary_program/audubon_sanctuary_program.html.

19. Garra de Leon Golf Course, Conchal Beach, Santa Cruz, Guanacaste; Hacienda Pinilla, Guancaste; and Parque Valle del Sol, Santa Ana.

20. Forest Hills Golf and Country Club, Las Piñas City; Manila Southwoods Golf and Country Club, Carmona; and Santa Elena Golf Club, Makiti.

21. National Service Resort and Country Club.

serious threat to groundwater supplies serving nearby communities, which use the supplies for washing and bathing, if not for drinking.

Although the Indonesian government has developed regulations regarding the cleanup of contaminated sites, the regulations are vague, subject to interpretation and not rigorously enforced. Few companies go to the trouble of assessing contamination at their sites in Indonesia, but ERM's client is concerned about the threat to the local groundwater, and as a company that still sells its products in the country, it is concerned to protect its good reputation.

The work, which began in 2002, involved ERM taking over the operation of three groundwater monitoring wells on the site. The company found the construction of the wells unsatisfactory and installed three more wells, using specialised, low-flow positive-displacement bladder pumps that can sample at several levels of the water table. ERM also re-equipped the original wells with diffusion bags filled with distilled water. The bags are left in place for about two weeks, during which time the (potentially) contaminated groundwater seeps through the porous bag linings. They are subsequently removed for analysis.

Another phase of the project could involve the implementation of a soil gas survey to determine particular hot spots of hydrocarbon contamination. This activity is contingent upon the approval of the new site owner, which is not the client for the job but controls access to the site. The soil-gas survey would involve the installation of passive sorbent collection devices (sorbers) at numerous locations, including inside buildings, which could create disruption.

Goods associated with the service contract

The products involved with the site investigation included the following:

- Low-flow, positive-displacement bladder pumps.
- Diffusion bags (62 units) containing distilled water (HS 2851.00•).
- Textile products for the construction of the new wells (HS 5911.90▲).
- Filters (HS 8421.29▲•).
- Passive sorbent collection devices (sorbers).
- Bottles for samples (HS 7017.10▲).

The pumps were rented from a company in Australia. The filters and textile products were purchased from Australian suppliers, and the diffusion bags and sorbers were purchased from W.L. Gore, a US supplier which also analysed the sorber contents. Otherwise, sample analysis was conducted by an environmental laboratory in Sydney, Australia.

Import issues

ERM paid import duties of about USD 100 on the entire shipment of diffusion bags and sorbers, worth around USD 1 200 after shipment and insurance costs. A second lot of the bags will likely be required if the soil-gas survey moves forward as originally planned. ERM is finding that Malaysia is increasing its capacity to provide some of the basic environmental goods that were used in this project. Some of the goods that initially

had to be sourced from Australian suppliers are now becoming available from Malaysia at lower prices.

ENSR-Brazil

The client

Petróleo Brasileiro (Petrobras) is a Brazilian company engaged in oil, gas and energy exploration, production, refining and retailing. The Brazilian government owns 32% of Petrobras and 56% of its voting shares. The company — the largest in Brazil, with annual revenues in excess of USD 5 billion — operates 16 refineries, more than 20 000 miles of pipeline, and more than 5 000 gas stations, and has proven reserves of 11.6 billion barrels of oil equivalent. Its subsidiary, Petrobras Distribuidora, is Brazil's leading retailer of oil products and fuel alcohol.

Although Brazil's regulatory framework requiring oil and gas companies and other industrial companies to address pollution is becoming more stringent, Petrobras is already cleaning up its sites on a voluntary basis.

The service provider

ENSR International is an environmental consulting and engineering firm generating more than USD 170 million a year in gross revenue. The privately held company (in 2000, it completed a management-led buyout from the German energy services giant RWE) provides a wide range of environmental services. The company employs about 1 400 people at approximately 70 offices in 17 countries, including a number of developing countries in Latin America and Asia. In Brazil, the company employs a multidisciplinary team of 35 engineers, geologists, biologists, oceanographers and technicians, and it has undertaken numerous offshore and onshore projects for large oil and gas companies like Petrobras, as well as for manufacturing companies.

The contract

In early part of the current decade, ENSR contracted with Petrobras on a time and materials basis to conduct site investigations at Petrobras service stations and, where necessary, to undertake follow-up remediation activities. The sites to be investigated were distributed broadly throughout Brazil, from Rio de Janeiro in the south to the Amazon Basin in the north. Altogether, ENSR conducted a total of about 120 site investigations and undertook about 30 remedial actions. Single investigations were performed for an average price of about USD 5 000, while remediation projects cost an average of about USD 30 000, with jobs ranging from the very small, involving pump-and-treat work, to jobs exceeding USD 100 000.

Goods associated with the service contract

To undertake the site investigations and cleanups, ENSR relied on a broad range of remediation technologies, including pump and treat, air sparging, bioslurping, soil vapour extraction and chemical oxidation. To implement these technologies and to characterise sites, the company uses the following types of products:

- Activated carbon (HS 3802.10•).
- Pumps (HS 8413.60▲• to 8413.70▲•).

- Filters (HS 8421.21▲• to 8422.20▲•).
- Valves and fittings (HS 8481.10• to 8481.80•).
- Instrumentation (HS 9015.40▲ to 9031.90▲).
- Pigs (*i.e.* devices for inline inspection of buried pipelines).
- Oil-water separators.

Because of the lack of local sources, ENSR must import most of these items, generally from suppliers in the United States, Canada and Europe. A company spokesperson attributes the lack of local suppliers of environmental equipment to the lack of a sufficient market to sustain the necessary production infrastructure. Some equipment, such as oil-water separators, can be obtained locally, but even then, not in every case. Pumps in particular are sourced from outside Brazil. All assembly of systems, including electric control panels, is performed by local contractors.

Import barriers

When purchasing equipment through in-country representatives of US, Canadian and German companies, ENSR pays a mark-up of up to 100% for the products compared with their original prices. When ENSR project managers use their own agents to purchase equipment directly from foreign suppliers they pay a 60% import duty. The trade-off, however, is the lack of after-sales services such as instrument calibration and system maintenance.

Another barrier to trade in Brazil is the withholding tax, of up to 25%, on funds spent for services, such as laboratory analysis, procured outside the country. This withholding tax is in addition to any import duties or mark-ups associated with the purchase of equipment.

Environmental impact assessment

Environmental impact assessment for an Indian hazardous-waste site

The client

For reasons of confidentiality, the service provider (a Canadian consulting firm) has asked that the name of its client not be disclosed, but described it as an industry association with a significant membership of large and medium-sized companies based in India. The association's 800 members include large automobile makers, pharmaceutical companies, foundries, petroleum refineries, metal platers, chemical makers and textile dyeing and processing firms. The association is seeking to develop an integrated hazardous-waste management facility for its member organisations.

The service provider

The service provider is the same Canadian consulting firm described above. It has a subsidiary in India, and it employs all local staff, although it regularly deploys Canada-based staff to assist in project management and technical support.

The contract

The client retained the services of the Canadian consulting firm to prepare a comprehensive environmental impact assessment (EIA), including carrying out detailed site assessments and collecting baseline data, in order to select a suitable site for the facility. The data were also to be used to develop an environmental management plan and to inform the design stage.

The consulting firm drew up a detailed monitoring programme for surface water and groundwater, as well as for the assessment of air quality and noise, and then carried out the monitoring, using its own equipment. However, considering the shipping distance and the relatively high costs of shipping, it initially decided to use only its own sound-level meters, which were substantially more sophisticated than those locally available. The service provider did, however, decide to lease other equipment and technical support locally in India.

Goods associated with the service contract

The following equipment from the combined APEC and OECD product list was involved with the site investigation:

- Sample bottles (HS 7017.10▲).
- Filter assemblies (HS 8421.39▲•).
- Particulate samplers with appropriate filters, vacuum pumps and accessories (ex HS 9027.10▲•).
- NO_X absorbers (ex HS 9027.10▲•).
- SO_2 absorbers (ex HS 9027.10▲•).
- Sound-level meters (HS 9027.80▲•).

In addition, the consultants used drills and core samplers for testing the soil and sub-soil. All the material was locally sourced except the sound-level meters, which were initially brought into India from Canada in the project manager's hand-carried luggage.

Import issues

The project manager carried appropriate letters to indicate that the sound-level meters used for the assessment work were the property of the Canadian company and would be returned once the testing was complete. This equipment had been previously used and was substantially lower in value than the original purchase price. However, upon arrival at the New Delhi airport, the customs officials demanded that 100% duty be paid to take the equipment into the country. Once the equipment was re-exported (returned to Canada), the duty was to be claimed by the Canadian company by filling out the appropriate forms.

The company's project manager expected that it would take a substantial amount of time to get the refund. (Box 5.3 provides a perspective on non-tariff barriers to trade in environmental goods and services in India.) Bearing that probability in mind, and considering that a 100% duty was being demanded, even though the sound-level meters were old, he decided not to pay the duty, and instead to take his chances with less sophisticated equipment available for rent locally. The project manager left the sound-

level meters that he had brought with him from Canada under bond with the customs authority at New Delhi airport and picked them up on his return journey.

Box 5.3. Non-tariff barriers to imports of environmental goods and services in India

In early 2003, the US-Asia Environmental Partnership (USAEP) office in New Delhi released a report on non-tariff barriers to trade in environmental goods with India. A summary of some of these findings, submitted to Environmental Business International by a USAEP official in New Delhi, is provided here:

Processing delays and government purchasing practices: The major share (75%) of India's market for environmental technologies is through government procurement. The time taken for a proposal to materialise into an actual sale is so lengthy that, by the time the sale takes place, the imported technology is often obsolete, and the supplier may be wrongly accused of trying to supply obsolete technology.

Certification requirements: Raising financing for infrastructure projects, such as waste-to-energy, water and wastewater treatment projects, poses great problems, because the imported technology has to be tested and certified by local agencies. Only in a few cases is international approval recognised. The Ministry of Environment and Forests (MOEF) sits once every three months. A company that has worked on several waste-to-energy projects, for which gas turbines had to be imported, reported that the MOEF took months to give clearance on this type of equipment.

Service tax: Professional services firms pay a service tax on services provided, a problem also observed in countries such as Brazil.

Annex 5.A2

Goods from the Combined APEC and OECD Product Lists Used in the Performance of Environmental Services

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services					
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
2201.00	Water, incl. natural or artificial mineral water		X					X	X		X
2207.10	Ethanol					X			X		
2302.10	Bran, sharps and other residues, whether or not in the form of pellets, derived from the sifting, milling or other working of corn	Booms or socks consisting of ground corn cobs contained in a textile covering							X		
2521.00	Limestone flux					X		X	X		
2522.20	Slaked (hydrated) lime					X		X	X		X
2801.10	Chlorine		X								X
2801.10	Hydrogen peroxide		X								X
2814.10	Anhydrous ammonia		X								X
2815.11	Sodium hydroxide solid		X								X
2815.12	Sodium hydroxide in aqueous solution		X								X
2816.10	Magnesium hydroxide and peroxide		X			X			X		X
2818.30	Aluminium hydroxide		X								
2820.10	Manganese dioxide		X			X					
2820.90	Manganese oxides (other)		X								
2824.10	Lead monoxide		X								
2832.10	Sodium sulphites		X								X
2832.20	Other sulphites		X								X
2835.10	Phosphinates and phosphonates		X								
2835.21	Phosphates of triammonium		X								
2835.22	Phosphates of monosodium or disodium		X								X
2835.23	Phosphates of trisodium		X								
2835.24	Phosphates of potassium		X								X
2835.25	Calcium hydrogenorthophosphate		X								X
2835.26	Other phosphates of calcium		X								X
2835.29	Other phosphates (excl. polyphosphates)		X								X
2851.00	Distilled and conductivity water										X
2905.11	Methanol					X					
3209.10	Paints and varnishes, in aqueous medium, acrylic or vinyl					X					
3209.90	Other paints and varnishes, in aqueous medium					X					
3802.10	Activated carbon		X			X			X		X
3802.90	Activated earths					X					
3815.00	Catalysts		X	X		X			X		X
3906.90	Flocculating agents		X								X
3914.00	Ion exchangers (polymer)		X						X		X
3920.20	Polypropylene sheeting, etc.			X					X		
3924.90	Household & toilet articles of plastic		X								

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*							Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services				
			Seven-sector environmental service classification[1]							
			WWM	SHM		APC	N/V	BIO	R/C	Other
3926.90	Other articles of plastics and articles of other materials of headings 3901 to 3914; other	1. Bio-film medium that consists of woven fabric sheets that facilitate the growth of bio-organisms.	X						X	
3926.90	Other articles of plastics and articles of other materials of headings 3901 to 3914; other	2. Rotating biological contactor consisting of stacks of large (HDPE) plates that facilitate the growth of bio-organisms.	X						X	
4601.20	Mats, matting, and screens of vegetable materials	1. Erosion control matting (biodegradable)	X					X	X	
5603.14	Non-wovens, whether or not impregnated, coated, covered or laminated: of manmade filaments; weighing more than 150 g/m2	Fabric of polyethylene, polypropylene, or nylon for filtering wastewater.	X						X	
5801.90	Woven pile & chenille fabrics of other textile materials		X							
5911.90	Textile products and articles, for technical uses, specified in note 7 to this chapter; other	Environmental protection cloth	X					X		
6810.99	Other articles of cement, concrete		X	X						X
6902.10	Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous fossil meals or similar siliceous earths; containing by weight, singly or together, more than 50% of the elements Mg, Ca or Cr, expressed as MgO, CaO or Cr_2O_3	Industrial incineration		X						
6902.20	Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous fossil meals or similar siliceous earths; containing by weight more than 50% of alumina (Al_2O_3), of silica (SiO_2) or of a mixture or compound	Industrial incineration		X						
6902.90	Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous fossil meals or similar siliceous earths; other	Industrial incineration		X						

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services					
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
6903.10	Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those of siliceous fossil meal or of similar siliceous earths; containing by weight more than 50% of graphite or other carbon or of a mixture of these products	Laboratory refractory equipment	X	X		X		X	X		X
6903.20	Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those of siliceous fossil meal or of similar siliceous earths; containing by weight more than 50% of a	Laboratory refractory equipment	X	X		X		X	X		X
6903.90	Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those of siliceous fossil meal or of similar siliceous earths; other	Laboratory refractory equipment	X	X		X		X	X		X
6909.19	Ceramic wares for laboratory, chemical or other technical uses; other	Laboratory equipment	X	X		X		X	X		X
7008.00	Multiple walled insulating units of glass					X					
7017.10	Laboratory, hygienic or pharmaceutical glassware, whether or not graduated or calibrated; of fused quartz or other fused silica		X	X		X		X	X		X
7017.20	Laboratory, hygienic or pharmaceutical glassware, whether or not graduated or calibrated; of other glass having a linear coefficient of expansion not exceeding 5 x 10 -6 per Kelvin within a temperature range of 0 °C to 300 °C		X	X		X		X	X		X
7017.90	Laboratory, hygienic or pharmaceutical glassware, whether or not graduated or calibrated; other		X	X		X		X	X		X
7019.90	Other glass fibre products					X					
7309.00	Tanks, vats, etc., > 300 litres		X								X
7310.10	Tanks, drums, etc., >50 litres <300 litres		X								
7310.21	Cans < 50 litres, closed by soldering or crimping		X								
7310.29	Other cans < 50 litres		X								
7325.10	Articles of cast iron		X								X
7806.00	Other articles of lead		X	X							X

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*							Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services				
			Seven-sector environmental service classification[1]							
			WWM	SHM		APC	N/V	BIO	R/C	Other
8404.10	Auxiliary plant for use with boilers of heading 8402 or 8403 (for example, economisers, super-heaters, soot removers, gas recoverers)			X		X			X	
8404.20	Condensers for steam or other vapour power units			X		X				
8405.10	Producer gas or water gas generators, with or without their purifier; acetylene gas generators and similar water process gas generator, with or without their purifiers	Include only those with purifiers.		X		X				
8409.91	Parts suitable for use solely or principally with the engines of heading 8407 or 8408; suitable for use solely or principally with spark-ignition internal combustion piston engines.	Industrial mufflers					X			
8409.99	Parts for diesel or semi-diesel engines						X			
8409.99	Parts suitable for use solely or principally with the engines of heading . 8407 or 8408; other	Industrial mufflers				X	X			
8410.00	Hydraulic turbines 00		X			X				X
8410.11	Hydraulic turbines and water wheels of a power not exceeding 1 000 kW					X				
8410.12	Hydraulic turbines and water wheels of a power exceeding 1 000 kW but not exceeding 10 000 kW					**X**				
8410.13	Hydraulic turbines and water wheels of a power exceeding 10 000 kW					**X**				
8410.90	Hydraulic turbines and water wheels; parts, including regulators					**X**				
8413.20	Root control equipment		**X**							**X**
8413.50	Positive displacement pumps, hand operated [centrifugal pumps]		**X**							**X**
8413.60	Pumps for liquids, whether or not fitted with a measuring device; other rotary positive displacement pumps	Submersible mixer pump to circulate water in wastewater treatment process; sewage pumps, screw type	**X**							
8413.70	Pumps for liquids, whether or not fitted with a measuring device; other centrifugal pumps	Centrifugal pumps lined to prevent corrosion; centrifugal sewage pumps	**X**							
8413.81	Pumps for liquids, whether or not fitted with a measuring device; other pumps	Wind turbine pump				**X**				
8414.10	Vacuum pumps		**X**	**X**		**X**			**X**	**X**
8414.30	Compressors of a kind used in refrigerating equipment		**X**	**X**		**X**			**X**	
8414.40	Air compressors mounted on a wheeled chassis for towing				**X**	**X**			**X**	

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*							Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services				
			Seven-sector environmental service classification[1]							
			WWM	SHM		APC	N/V	BIO	R/C	Other
8414.59	Fans (and blowers) other than table, floor, window, ceiling or roof fans with a self contained electric motor of an output not exceeding 125W				X	X				
8414.80	Other air or gas compressors or hoods		X	X		X				
8414.80	Air or vacuum pumps, air or other gas compressors and fans; ventilating or recycling hoods incorporating a fan, whether or not fitted with filters; other		X	X		X				
8414.90	Parts for air or gas compressors, fans or hoods		X	X		X				
8417.80	Industrial or laboratory furnaces and ovens, including incinerators, non-electric; other than bakery ovens and furnaces for treatment of ores	Waste incinerators		X						
8417.90	Parts of Industrial or Laboratory Furnaces and Ovens, Including Incinerators, Non-electric	Parts of waste incinerators		X						
8419.11	Instantaneous gas water heaters					X				
8419.19	Other instantaneous or storage water heaters, non-electric	Solar water heaters				X				
8419.40	Distilling or rectifying plant									X
8419.50	Heat exchange units		X	X		X				
8419.60	Machinery for liquefying air or other gases					X				
8419.89	Other machinery for treatment of materials by change of temperature					X				
8419.90	Parts for heat exchange equipment		X	X		X				
8421.19	Centrifuges, including centrifugal dryers, other than cream separators and clothes-dryers		X	X		X				X
8421.21	Filtering or purifying machinery and apparatus for liquids: for filtering or purifying water		X							X
8421.29	Filtering or purifying machinery and apparatus for liquids; other		X						X	X
8421.39	Filtering or purifying machinery and apparatus for gases; other			X		X				
8421.91	Parts of centrifuges		X							
8421.91	Parts of centrifuges, including centrifugal dryers	Centrifuges, accessories & parts; except clothes dryers and clothes dryer furniture	X	X		X				X
8421.99	Parts of filtering or purifying machinery and apparatus for liquids or gases			X		X				

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services					
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
8422.20	Machinery for cleaning or drying bottles or other containers			X							
8423.81	Weighing machines capacity <30 kg		X								
8423.82	Weighing machines capacity >30 kg <500 kg		X								
8423.89	Weighing machines		X								
8424.90	Parts for sprayers for powders or liquids					X					
8428.33	Other continuous-action elevators and conveyors, for goods or materials; other, belt type	Belt-type above ground conveyor used to transfer solids or slurries between plants	X	X							
8436.80	Other agricultural, horticultural, forestry, poultry-keeping or bee-keeping machinery	Hot water weed killing system	X					X			
8462.91	Machine tools for working metal, other than punching or notching and combined punching and shearing; hydraulic presses	Shredders/balers for metals; hydraulic		X							
8472.90	Other office machines	Paper shredders		X							
8474.10	Sorting, screening, separating or washing machines	Machines of a kind for use in screening and washing coal		X		X					
8474.10	Sorting, screening, separating or washing machines	Waste foundry sand reclamation equipment		X							
8474.32	Machines for mixing mineral substances with bitumen	Asphalt recycle equipment		X							
8474.39	Other mixing or kneading machines for earth, stone, sand, etc.			X							
8479.82	Mixing, kneading, crushing, grinding, screening, sifting, homogenising emulsifying or stirring machines	Agitator for wastewater treatment	X								
8479.82	Mixing, kneading, crushing, grinding, screening, sifting, homogenizing emulsifying or stirring machines	Other than kneading machinery		X							
8479.89	Machines and mechanical appliances having individual functions, not elsewhere specified or included in this chapter, other	Trash compactors		X	X						
8479.89	Machines and mechanical appliances having individual functions, not elsewhere specified or included in this chapter, other	Radioactive waste press		X							
8479.90	Parts of machines and mechanical appliances having individual functions, not elsewhere specified or included in this chapter, other	Parts of trash compactors		X	X						
8481.10	Valves, pressure reducing		X								X
8481.30	Valves, check		X								X
8481.40	Valves, safety		X								X

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services					
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
8481.80	Other taps, cocks, valves, etc.		X								X
8502.31	Generating sets, electric, wind-powered					X					
8505.90	Electromagnets; other, including parts	Electromagnet		X							
8514.10	Industrial or laboratory furnaces and ovens; electric, resistance heated	Waste incinerators or other waste treatment apparatus		X							
8514.20	Industrial or laboratory furnaces and ovens; electric, induction or dielectric	Waste incinerators or other waste treatment apparatus		X							
8514.30	Industrial or laboratory furnaces and ovens, electric, other	Waste incinerators or other waste treatment apparatus		X							
8514.90	Parts of industrial or laboratory electric furnaces and ovens or other laboratory induction or dielectric heating equipment	Parts of waste incinerators		X							
8516.29	Other electric space heating and soil heating apparatus			X					X		
8539.31	Fluorescent lamps, hot cathode					X					
8541.40	Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes	Solar cells				X		X	X		
8543.89	Electrical machines and apparatus, having individual functions, not specified or included elsewhere in this chapter; other	Ozone production system	X								X
8708.92	Silencers and exhaust pipes, motor vehicles						X				
8907.10	Inflatable rafts	Inflatable oil spill recovery barges							X		
8907.90	Other floating structures	Pollution protection booms							X		
9013.20	Lasers			X							
9015.40	Photogrammetric surveying instruments and appliances		X	X		X	X	X	X		X
9015.80	Other surveying, hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances, excluding compasses		X	X		X	X	X	X		X
9015.90	Parts and accessories of surveying, hydrological, meteorological, or geophysical instruments and appliances, excluding compasses	Photogrammetric instruments; parts and accessories for articles of subheading 9015.40	X	X		X	X	X	X		X

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services					
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
9022.29	Apparatus based on the use of X-rays or of alpha, beta or gamma radiations for other than medical, surgical, dental or veterinary uses		X	X		X	X	X	X		X
9022.90	Apparatus based on the use of X-rays or of alpha, beta or gamma radiations for other than medical, surgical, dental or veterinary uses	Parts and accessories for goods of subheading 9022.29	X	X		X	X	X	X		X
9025.11	Thermometers and pyrometers, not combined with other instruments: liquid-filled, for direct reading		X								X
9025.19	Thermometers and pyrometers, not combined with other instruments: other than liquid-filled, for direct reading		X			X					X
9025.80	Hydrometers and similar floating instruments, thermometers pyrometers, barometers, hygrometers, and psychrometers, recording or not, and any combination of these instruments		X			X					X
9025.90	Parts and accessories for hydrometers and similar floating instruments, thermometers pyrometers, barometers, hygrometers, and psychrometers, recording or not, and any combination of these instruments		X								X
9026.10	Instruments and apparatus for measuring or checking the flow or level of liquid		X								X
9026.20	Instruments and apparatus for measuring or checking pressure		X								X
9026.80	Other instruments and apparatus		X	X		X	X	X	X		X
9026.90	Parts and accessories for articles of subheading 9026		X								X
9027.10	Gas or smoke analysis apparatus					X					
9027.20	Chromatographs and electrophoresis instruments		X	X			X	X	X	X	
9027.30	Spectrometers, spectrophotometers and spectrographs using optical radiations (ultraviolet, visible, infrared)		X	X			X	X	X	X	
9027.40	Exposure meters [including sound-level meters]		X	X			X	X	X	X	
9027.50	Other instruments and apparatus using optical radiations (ultraviolet, visible, infrared)		X	X			X	X	X	X	
9027.80	Other instruments and apparatus for physical or chemical analysis		X	X			X	X	X	X	X

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								Water supply
			Sewage	Refuse disposal	Sanitation	Other environmental services					
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
9027.90	Microtomes; parts and accessories		X	X			X	X	X	X	
9028.10	Gas meters			X		X					
9028.10	Gas supply, production and calibrating meters					X					
9028.20	Liquid supply, production and calibrating meters		X	X							X
9028.30	Electricity meters					X					
9028.90	Parts and accessories for articles of subheading 9028		X	X		X					X
9030.10	Instruments and apparatus for measuring or detecting ionising radiations			X		X			X		
9030.20	Cathode-ray oscilloscopes and cathode-ray oscillographs		X	X			X	X	X	X	
9030.31	Multimeters		X	X			X	X	X	X	
9030.39	Other instruments and apparatus, for measuring or checking voltage, current, resistance or power, without a recording device		X	X			X	X	X	X	
9030.83	Other instruments and apparatus for measuring or checking electrical quantities, with a recording device		X	X			X	X	X	X	
9030.89	Other instruments and apparatus for measuring or checking electrical quantities		X	X			X	X	X	X	
9030.90	Parts and accessories (for nominated articles of HS 9030)		X	X			X	X	X	X	
9031.10	Machines for balancing mechanical parts		X	X			X	X	X	X	
9031.20	Test benches		X	X			X	X	X	X	
9031.30	Profile projectors		X	X			X	X	X	X	
9031.49	Other optical instruments		X	X			X	X	X	X	
9031.80	Other measuring or checking instruments, appliances and machines, not elsewhere specified in this chapter		X	X			X	X	X	X	
9031.90	Parts and accessories (for nominated articles of subheading 9031)		X	X			X	X	X	X	
9032.10	Thermostats		X	X				X	X	X	
9032.20	Manostats		X	X					X	X	
9032.81	Hydraulic and pneumatic instruments and apparatus		X	X				X	X	X	X
9032.89	Automatic regulating or controlling instruments, other		X	X			X	X	X	X	X
9032.90	Parts and accessories		X	X			X	X	X	X	
9033.00	Parts and accessories (not specified or included elsewhere in this chapter) for machines, appliances, instruments or apparatus of Ch. 90		X	X			X	X	X	X	
9603.10	Brooms, hand			X	X						
9603.50	Brushes as parts of machines, appliances			X	X						
9603.90	Hand-operated mechanical floor sweepers, not motorised			X	X						

WWM = Waste-water management.

SHM = Management of solid or hazardous waste.

APC = Air-pollution control.

N/V = Noise and vibration abatement.

BIO = Nature and landscape protection services.

R/C = Remediation and clean-up of soil, surface water and groundwater.

PWT = Services related to the collection, purification or distribution of water.

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Table of Contents

Acronyms

APEC	Asia-Pacific Economic Co-operation
ASEAN	Association of Southeast Asian Nations
CACM	Central American Common Market
CAFTA-DR	Central American-Dominican Republic Free Trade Agreement
CEEC	Central and Eastern European Countries
CEFTA	Central European Free Trade Agreement
COMESA	Common Market of Eastern and Southern Africa
CTE	Committee on Trade and Environment
CTS	Council on Trade in Services
EAC	East African Co-operation
EG&S	environmental goods and services
GDP	gross domestic product
GNP	gross national product
FDI	foreign direct investment
JWPTE	Joint Working Party on Trade and Environment
MEA	multilateral environmental agreement
MERCOSUR	Southern Common Market
MFN	most-favoured nation
NAFTA	North American Free Trade Agreement
NGO	non-governmental organisation
NTB	non-tariff barrier
PPP	purchasing power parity
PPP	public-private partnership
PPM	processes and production methods
Quad	United States, European Union, Japan and Canada
RTA	regional trade agreement
SAPTA	South Asian Preferential Trade Arrangement
SMEs	small and medium-sized enterprises
TBT	technical barriers to trade
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WCO	World Customs Organization
WTO	World Trade Organization