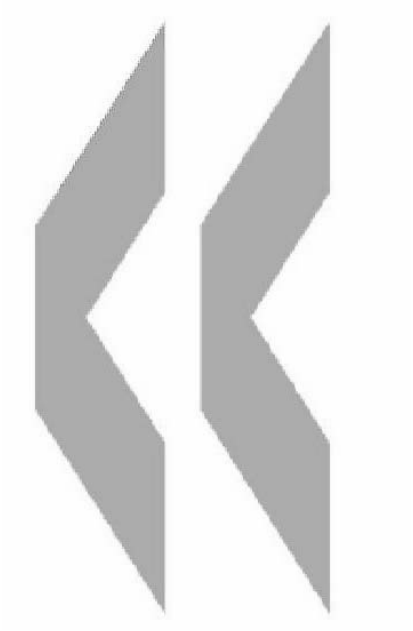

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Synergies between trade in environmental services and trade in environmental goods

Ronald Steenblik
OECD Trade Directorate

Dominique Drouet
Recherche Développement International

George Stubbs
Environmental Business Journal

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SYNERGIES BETWEEN TRADE IN ENVIRONMENTAL SERVICES AND TRADE IN ENVIRONMENTAL GOODS

OECD Trade and Environment Working Paper No. 2005-01

by Ronald Steenblik, Dominique Drouet and George Stubbs

Corresponding author: Ronald Steenblik (tel. +33 1 45 24 95 29; e-mail: ronald.steenblik@oecd.org)

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ABSTRACT

This paper examines the synergistic relationships between trade in environmental services and trade in environmental goods. It forms part of a series of OECD studies that analyse various issues related to Paragraph 31(iii) of the World Trade Organization's 2001 Doha Development Agenda, which mandates negotiations at the WTO on "the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services." For the purpose of this study, environmental services are 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 in the paper. After describing the nature of each environmental service, the paper identifies broad categories of goods used in the performance of those services, and notes that for some goods environmental services are what is driving growth in their markets. The analysis then draws on case studies of actual business-to-business exports of environmental services, mainly from OECD countries to developing countries, to form general insights into the kinds of environmental goods used by service providers, and how these goods are procured. The case studies provide qualitative evidence 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, 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 the businesses that engage environmental-service 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 of this study for developing economies is that the potential benefits to 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.

JEL Classifications: F14, F18, O33, Q56

Keywords: environmental goods, environmental services, trade, developing countries

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Executive summary

This report explores the connections between trade in environmental services and trade in environmental goods. As the OECD has long argued, many of the goods that it and other organisations have identified as essential for environmental protection and remediation are so important, in fact, because they are used in the provision of environmental services. When discussing the benefits of liberalising trade in environmental goods and services it is salutary to keep this synergy in mind.

Merely asserting that there are synergies is not likely to be convincing, however. This paper is addressed to those involved with, or interested in, the current WTO (DDA ¶31(iii)) negotiations on environmental goods and services, and seeks to help them better understand, in as concrete a fashion as possible, why environmental goods on the OECD and APEC (Asia-Pacific Economic Co-operation[1]) lists are essential inputs for environmental services.[2] It: *(i)* describes the different environmental services; *(ii)* highlights the main key environmental goods that are vital for carrying them out; and *(iii)* shows how trade in particular services stimulates the demand for certain goods.

The final section demonstrates, through real-world examples, why liberalisation of environmental services functions best when trade in the environmental goods they require is also made freer. These examples focus on business-to-business trade in different environmental services, such as between chemical companies or steel plants, which have decided to turn over the management of their wastewater treatment to companies that specialise in that activity. The reasons why businesses choose to do that are many: to focus on their core areas of expertise, to reduce their debt burden, to ensure that the technologies and techniques used to manage their waste streams are the best available. In virtually all the cases examined, some goods used in the provision of the service were imported, but many were procured locally. Indeed, there is tentative evidence suggesting that as the market for environmental services expands in particular countries or regions, so does the number and scope of local suppliers of associated goods.

Introduction

At the start of the twenty-first century, much of the world's population still lacks adequate sanitation or has no 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 reduction of poverty in many countries — poses similar environmental challenges.

In recent years, there has been 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

1 APEC's 21 member economies are Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong, China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russia, Singapore, Chinese Taipei, Thailand, United States, and Viet Nam.

2 The use of these two lists is simply a tool to help in undertaking the analysis. As the Secretariat required some basis for defining environmental goods, it sought a definition of "environmental goods" sufficiently broad to reflect a variety of countries' views (developed and developing). The simple compilation of the OECD and APEC lists provides such a broad definition.

pollution, noise, habitat degradation and unsustainable resource use. Accordingly, a key issue for policy makers is the role that global trade liberalisation can play in building international markets for environmental goods and services to deliver solutions to these problems. But, perhaps more importantly, is the key role that environmental goods and services can play in meeting the development needs of countries that are trying to grow out of poverty while protecting the environment on which the health and welfare of their population depends.

International commitment to further liberalisation of trade in environmental goods and services was made concrete when WTO Ministers, in paragraph 31(iii) of their 14 November 2001 Declaration, mandated negotiations on "(iii) the reduction or, as appropriate, elimination of tariff and non-tariff barriers to 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 (CTESS) 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 that 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 bringing 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 specialising 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, 1998) 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.*

Environmental services do not constitute a discrete set of similar business activities, as do, for example, computer and related services. 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 such as is the case with hazardous waste as opposed to municipal or solid waste collection or mitigation. Furthermore, there are a range of services that under the WTO/GATS fall into other services sectors other than what are called the core environmental business activities whose aim responds to the definition above. For example, among environmental service providers offering landscape conservation or biodiversity protection are architects and engineers. These providers have different skills, educational, licensing and technical requirements than architects or engineers who design and build water and wastewater infrastructure projects.

Box 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. code 9401), "Refuse disposal services" (CPC Prov. 9402), "Sanitation and similar services" (CPC Prov. 9403), and "Other environmental services".[†] 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 came out with CPC Version 1.0 (United Nations, 1998), 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 from (1998, p. 9) summed up this concern: "… the environment industry is evolving rapidly beyond its traditional focus on pollution control and remediation/clean-up activities to also incorporate a broader range of pollution management, cleaner technology and resource management activities." 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, 1998). 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 clean-up 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 classification systems 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.

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[†]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.

Various proposals have been submitted to the WTO that try to address the most-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: (1) sewage services; (2) refuse-disposal services; (3) sanitation and similar services; and (4) 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: (1) water, wastewater management; (2) solid and hazardous-waste management; (3) protection of ambient air and climate; (4) remediation and cleanup of soil and water; (5) noise and vibration abatement; (6) protection of biodiversity and landscape; and (7) a catchall subcategory for other environmental and ancillary services. The EC has also proposed that certain closely associated services could be subject to a special "cluster" or "checklist", which could be used as an *aide-mémoire* during the other sectoral negotiations, and scheduled in the relevant GATS sectors other than 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 other countries have also used it, or similar, in submitting their offers in the current negotiations. This document follows a similar approach.

The following paragraphs provide an overview of the different environmental services, what kinds of activities they involve, who are the clients, and what kinds of techniques are used. In organising the discussion, the paper employs a modified version of the headings suggested by the OECD/Eurostat informal working group of experts (Box 1). The OECD/Eurostat informal working group categories are consistent with but not identical to the EU suggested classification. In addition, the paper looks at a category of "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 Central Product Classification (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.

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 the Members' own sectoral or sub-sectoral sectoral classification or definition, as long as they provide a "sufficiently detailed definition to avoid any ambiguity as to the scope of the commitment."[3]

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 whose task it is to clean up the muck of others 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 of services. But private businesses also require sewage services, as does anybody connected to a septic tank. Even in developed countries, many large-scale 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 that service the facility alone. Sometimes these plants are operated by the

3 http://www.wto.org/english/tratop_e/serv_e/guide1_e.htm

corporate clients themselves, but, increasingly, they are being operated by firms that specialise in that service — usually as part of an integrated system also treating industrial waste.

The other major category of waste-water treatment relates to wastes from mines, processing and manufacturing plants. Many large industrial facilities either choose not to, or are barred from, discharging their liquid wastes directly into municipal sewage systems. Half a century ago, most plants generating large volumes of liquid waste would have been built near rivers or seas, and simply discharged their 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 volumes and toxicity of industrial pollutants. But few industrial processes involving solvents or water have eliminated waste streams entirely. Pollution abatement, in short, remains a necessity.

The range of chemical compounds found in industrial waste-water 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, or precipitating the target compounds.

Before any waste treatment facility is built, an assessment of the effluent and receiving medium (usually a stream, lake or saltwater bay) is normally carried out. 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 will still need to have data on the physical and chemical characteristics of the receiving waters. For that the operator will need on-site measurements. Later, after the plant is running, monitoring of the waste stream and of the downstream aquatic environment will be required in order to ensure that the plant is operating as it is intended and that the pressure it exerts on the environment is within acceptable limits.

Increasingly, waste treatment has been integrated into industrial processes so as to recycle compounds that formerly were discharged, or to yield new, saleable products. According to Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO)[4], 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, the bulk of wastes generated by humans are not especially hazardous. These include food waste, packaging waste, and waste from building sites. Such wastes are difficult to

[4] http://www.csiro.au/index.asp?type=mediaRelease&id=WhereTheresMuckTheresBrass

manage mainly because of their volume, and in the case of food because they can spoil and attract fauna — such as coyotes in North America, hyenas in Africa, and rats everywhere — that may themselves pose a threat to health and safety. Some wastes collectively referred to as non-hazardous, however, such as discarded electronic appliances, may nonetheless contain hazardous elements, like heavy metals. And disposal methods — incineration, for one — may render 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 for the municipalities. But private, regulated provision of these services does exist. 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, such 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 of the enterprises that handle or produce large volumes of hazardous waste are private businesses, and it is they who are the main clients of private services that manage such waste streams.

One of the reasons 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 the stuff. 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 — to turn liabilities into assets, in effect. Also, as scientific knowledge about the properties of non-hazardous waste accumulates, the line between it and hazardous waste has become blurred. Many types of non-hazardous wastes are neither inert nor geochemically stable when exposed to the environment, and eventually undergo transformations that can impart hazardous properties to the material that were not evident when it is freshly generated (Twardowska *et al.*, 2004). Some of them, like boiler ash, are often used in civil engineering as a common fill — in the construction of roads, for example — where they are exposed to environmental conditions similar to those at disposal sites. Yet many people involved in waste management are often not aware of such time-delayed adverse environmental impacts of initially non-hazardous wastes.

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 services, drain-unblocking services and ice-clearing services.[5] In fact, street sweeping is perhaps a misnomer. Besides sweeping, the service usually involves also washing, scraping, and the removal of weeds. Street sweeping and snow and ice removal are services that

[5] The Central Product Classification (CPC, 1997) refers to sweeping and snow-removal services (94310) and “Other sanitation services” (94390).

are carried out typically by, or on behalf of, municipalities. But they are used also 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.

The technologies used in street-cleaning services are many, and the choice among them will depend 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. Where the cleaning requires larger, mechanized equipment, they are 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), a name which would seem to be more narrow than the definition offered for this category by the United Nations Statistics Division (UNSD) itself: "emission monitoring and control 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. But 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 with many of the other services not based around infrastructure, the main private clients for air-pollution services are point-source emitters of air pollutants — generally, operators of fossil-fuelled electric power generating stations, waste incinerators, petrochemical refineries and other smoke-stack industries.

In the case of stationary sources, monitoring may be performed according to an established schedule or continuously. In the former case, technicians will visit a facility, insert a sampling tube into the exhaust gasses, pump a sample of the gas through a filter, aqueous solution, or both. The filter or solution is then sent off 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 a service that is closely tied to policing. A suspect vehicle is stopped, directed to the side of the road, and has a device 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 which allow the determination of pollutant emissions while a vehicle is 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 transmitted light intensity 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) as well as record a photographic image of the license plate and the rear of the vehicle from which the measurements were made.[6]

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 gases, like ozone, are formed in the atmosphere as a consequence of pollution. Third, whereas the sampling of point-source emissions will require only one or two monitoring devices, ambient air-quality monitoring normally requires establishing a network of monitors at locations carefully 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 obtain permits which limit the contribution that the facility can make 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 will often be set up by a service provider, but the samples will be collected by the client and then sent off to the service-provider's laboratory for analysis.

Noise and vibration abatement services

Noise can be a nuisance. It can also damage people's hearing and reduce worker productivity. Often it indicates of a poor design or fault in a 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. (And many countries set limits on occupational exposure to noise.) If the noise emanating from their facilities is great enough, they may have to worry also about avoiding complaints from local residents.

Tracing a noise or vibration problem to its source is not always easy. A loose bearing may be causing it, or perhaps a misaligned exhaust fan. But intervention on the basis of a wrong guess can be costly. For that reason, the monitoring and abatement of noise has developed into a specialised service.

Nature and landscape protection services

This category of services refers to a diverse range of activities related to the protection and restoration of individual populations, species or ecosystems, and of 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; and

- landscape protection services not elsewhere classified.

6 http://www.mustangdyne.com/pdfs/LT_corp-broch.pdf

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").[7]

Governments are not the only clients of these services, and in fact may be less important than private firms. One growing client base for these services is golf courses. In the United States, for example, the U.S. Golf Association is supporting research to find ways to use native plants in golf courses so as to improve habitat for plant and wildlife while reducing irrigation and fertilizer 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 have been ignored. Today, most large hotel chains understand the value to their businesses 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 the remediation of water are normally two distinct types of services, though often 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. But, 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 developed in OECD countries during the 1970s typically 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 various OECD countries, many of them less than a hectare in size. Owners of affected properties, whether themselves responsible for the contamination or not, 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. To help them in their plight, numerous firms have emerged that are able to come onto a property and decontaminate it, or at least ensure that the existing contamination does not spread.

Another form of remediation service is mine-site rehabilitation.[8] 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. Even though such requirements are not yet

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7 Under the Provisional CPC there exist 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 U.N. Statistics Division's explanatory notes (UN, 1998) to the 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."

8 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 another environmental services category, "nature and landscape protection services".

universal, many mining and petroleum companies are expected by their shareholders to apply these high 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 still in its infancy. Scientists were usually brought in after the disturbance had already 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 the mining or construction takes place, in order to determine what impact such activities will have on the environment or how to mitigate potential impacts. Thus, 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 for quicker and more-effective responses to spills when they occur. Compared with soil remediation, cleaning up after oil spills employs rather simple technologies. Usually, long, floating barriers (called booms) are 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.[9]

In Europe and North America, the 1979 Convention on Long-range Transboundary Air Pollution[10] has been an important framework for efforts to address the 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. These 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.

The monitoring of emissions of acidifying compounds is performed using techniques that are 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 involves, basically, setting up

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

10 http://www.unece.org/env/lrtap/lrtap_h1.htm

rainfall gauges and then measuring the precipitation's pH and analysing the concentration of different acids. These types of services may be provided by a wide range of firms, from small laboratories to large, integrated environmental-service 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 (2004), neither the W/120 nor the Provisional CPC (commonly abbreviated as "CPC Prov.") contain 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 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 of 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 into the CPC Version 1.0, except that it is more specific on the quality of water delivered — i.e., the water 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 the water for human use as an environmental service, and 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 some cases of contracts involving separate ownership and operation of water-supply facilities are starting to emerge.

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, water drawn from a river, especially if the river is polluted (the normal

situation for large cities), can require a treatment and purification process that is as complex as any found in the most sophisticated chemical factories before the water is fit for human or even industrial use.

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 can, and usually are, 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 which 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 OECD, 2003).

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 of 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 by OECD (2003), 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.[11] Finally, the OECD list includes also 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 II tallies all the goods found on the APEC and OECD product lists, in order of the six-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. Where an "X" appears in a cell, the good in question is used in the performance of the corresponding environmental service.

It is clear from the table that there are certain goods, or clusters of goods, that 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)

[11] Examples are biological oxidation systems, or biodetergents, which are used in the supply and pre-treatment of water, and in the remediation and clean-up of soil, surface water and groundwater.

- Erosion-control matting (ex outs[12] of 4601.20 and 5911.90)
- Laboratory refractory equipment (ex outs of 6903.10 through 6903.90)
- Laboratory ceramic and glasswares (6909.19, 7017.10, 7017.20 and 7017.90)
- 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 photo-sensitive 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 for 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 will still be required.

Related to the monitoring side of all environmental services are instruments (selected items between HS 9027.20 and HS 9032.20). Wastewater management service providers use numerous 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 solid waste. Noise abatement services could not function without sound-level meters, nor could nature protection and landscape services without surveying instruments. But instruments are not just for monitoring. For example, refuse-collection vehicles now employ, in some places, GPS and route-optimization software systems similar to those used by express-package delivery services.

Another category of goods that cuts across several service sub-sectors is catalysts. 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 being 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

[12] 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 at the harmonised, six-digit level.

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 from one section of the treatment plant to another, as well as any chemicals in solution used in the treatment process. 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 2).

Box 2. Choice of technology in soil and groundwater remediation

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

Pump-and-treat (P&T) systems are the most commonly applied remediation technologies at most sites contaminated by petroleum products.[†] 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, hence 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.

[†]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 people inhaling the vapour.

One reason for the commonality of certain goods across sub-sectors is the borrowing that takes place from one industry to another. Waste-to-energy plants, 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 involved in the treatment of wastewater may recommend its use to their clients, if the factories or power plants they are treating are encountering 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 will be important, but in many cases it will not be what drives the market for those goods. By contrast, there are some goods that are quite closely associated with a particular environmental service — so much so that one

could say 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 corn cobs contained in a textile covering (HS 2302.10 ex) and pollution protection booms (HS 8907.90 ex) are used in cleaning up oil spills and little else. Similarly, trash compactors (HS 8479.89 ex) are a technology 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 HT chapter 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 — by an industrial plant's occupational-safety officers, for example. But certainly 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 subheadings 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, in solving its problem it will often turn to good, 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 headings 84.07 or 84.08; suitable for use solely or principally with spark-ignition internal combustion piston engines. (extended heading: industrial mufflers); or
- HS 8409.99 — parts suitable for use solely or principally with the engines of HS headings 84.07 or 84.08; other (extended heading: industrial mufflers).

Case histories of environmental goods and services trade with developing countries

This section draws on actual 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 I. Governments are also major consumers of environmental services, through a variety of contractual arrangements (OECD, 2001, p. 110). But in order to avoid possible cases of public procurement, only case histories involving business-to-business trade were chosen for the purposes of this study. 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, often 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 attached combined APEC and OECD product list (see Annex II) — either to the service provider, or to the service provider's client following the provision of the service. The cases attempt — for goods from the combined APEC and OECD list — to identify whether the 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 the demand by businesses in developing countries to outsource environmental services. The first is environmental requirements, whether imposed by governments domestic or foreign, or demanded by shareholders of the companies themselves, striving to uphold a high standard of corporate social responsibility. The second is the general tendency of manufacturing companies to contract for those services that do not form part of their core business.

As a series of national case studies carried out for the OECD, UNCTAD and UNDP have documented (Kennettt, 2005), developing countries are catching up with developed countries in the area of environmental protection. Over the last decade, many (especially rapidly industrialising countries) have consolidated their previous, piece-meal environmental legislation, and increased their regulatory capacity.

In a number of developing countries, however, environmental laws are still 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. The approach taken towards environmental management by multinational firms increasingly strives for a consistently high level of environmental responsibility and sustainability across all operations, regardless of the regulatory sophistication or commitment to enforcement in any particular country.

Many companies have decided that environmental services are outside their core competencies, and are better left performed by professionals. Thus, in 2001, Hynix Semiconductor Inc. decided to divest itself of its water-treatment facilities, and to turn over that activity 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 through the years in handling a wide range of materials and transforming them through chemical, physical and even biological processes. It was a natural decision, therefore, for it to establish an Environmental Division specialising in the treatment of wastes. A half-owned subsidiary of that Division, Tribel, is now treating 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[13] 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 waste-water 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 I 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 cases 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 without such basic goods. At the same time, the case histories show that environmental-service providers also 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 do the number of local suppliers, and the range and sophistication of the products they can offer — not just to service providers operating in their own countries, but also to buyers in other lands. Often, these local suppliers are the results of joint ventures between foreign companies with specialised knowledge of the EG&S service 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 Hong Kong based New World Group) has established an equipment manufacturer which produces membrane-technology equipment for water treatment, including microfiltration units (capable of treating 100 to 50 000 m^3/day) and, using of ultra-filtration techniques introduced from France and reverse osmosis techniques from the USA, additional equipment in a capacity range of up to 45 000 m^3/day. This equipment was not used for the SCIP project discussed in the case study (Annex I), but has been used in other water plants in China and for exports outside of China.

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

The ability of local suppliers of environmental goods to be able to meet the needs of environmental-service providers will vary, 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 for treating and managing urban water and wastewater can already be purchased locally in rapidly industrialising countries such as Brazil, Korea or even China. Similarly, above-ground diaphragm pumps, which are used for soil and water remediation in areas with shallow groundwater tables (Box 2), are widely available in many developing countries.

However, some segments of the environmental service 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 are catered to by a limited number of global suppliers. Tube-well diaphragm pumps (required when for remediation of soil and water in areas with groundwater tables) are another example of devices that often are not available locally, and therefore 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 this report is of a general nature.

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 have to be borne by the industrial clients, making it more difficult for them to compete in the markets for their final goods. 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 LDCs around 10%.[14] (In developed countries the average is less than 2%.)

In some countries, including several examined for the purposes of this report, 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, the administrative processes to obtain these waivers or rebates are often long and difficult, thereby substantially reducing their net benefit to the importer. 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 therefore ship by air wherever possible. However, unless the item being shipped 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.

[14] Robert Teh and Bijit Bora, "Tariffs and Trade in Environmental Goods", Presentation to the WTO Workshop on Environmental Goods (Geneva, 11 October 2004), http://www.wto.org/english/tratop_e/envir_e/wksp_goods_oct04_e/teh_wto_e.ppt

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 the tenants of corporate social responsibility.

Economies of scale

The benefits to the businesses that engage outside experts to carry out environmental services are manifold. Outsourcing allows them to concentrate on their core activities, and to shift some of the liability of meeting environmental regulations to other companies. Often, especially when the service involves treatment of water or wastes, it allows the facilities involved to be built to an optimal scale, which may be larger than that required for a single client. The resulting economies of scale allow costs to be reduced, and, because several clients may 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 the price of goods and helps make their supply more reliable.

Increased access to the latest know-how

Specialist service providers also typically 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 are operating, but 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 cases histories listed in Annex I, the great majority of the staff involved in providing the environmental service has been hired locally.

Improved environment for investment

The case studies suggest also that the availability of environmental goods and services in a country or a region of a country remove a barrier to investment by companies whose stockholders require that they apply high standards of environmental performance at their plants. This phenomenon can be seen 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, as well as companies engaged in the transport of materials, engineering, maintenance, computer science and cleaning services.[15]

Investment and commerce discount uncertainty, however, and place a value on predictability. One way for national governments to remove an element of 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 on such goods, but also bind their tariffs at those low (or zero) rates. Currently, among countries that are 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 actual applied rates. Moreover, while the share of environmental-good tariff lines bound by developing-country WTO members is around 80%, for LDCs it

15 http://www.bayer.com.br/ContentPI/home.nsf/0/03256B030050870F03256B35006EED6A?OpenDocument&nav=PSPA-5MJGCV

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 a recent OECD document acknowledges (Geloso Grosso, 2005), 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 can potentially affect access to them. Identifying and removing barriers to commercial presence (Mode 3) and movement of natural persons (Mode 4) are clearly key 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 concerning trade facilitation. Improving customs procedures could, in particular, address several of the non-tariff barriers mentioned in the case studies.

The main point of this paper, however, is that 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 increase 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.

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ANNEX I. CASE HISTORIES OF EG&S TRADE WITH DEVELOPING COUNTRIES

Note: Some of the following information was provided by private service providers and should be treated as indicative. The market for technologies using micro-electronics is very dynamic, and the processes and the techniques used are permanently being adapted. Financial data could 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.[16] Built at a cost of USD 420 million, it employs 300 people and is credited with generating an additional 250 indirect jobs. Final completion of the project is expected some time 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;
- and maximize 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 agreements allow Arcelor to de-consolidate the utilities and environmental service assets from other industrial assets of the Vega do Sul plant.

16 The plant can be expanded to 1 400 000 tonnes.

The service supplier

The group Veolia Environnement was selected to supply these services. Veolia Environnement operates in 84 countries, and some 55% of its sales turnover (€ 29 billion in 2003) is generated outside of its home country, France. For the contract of Vega do Sul, Veolia Environnement created a new company, SPC CLE Brazil. Veolia Environnement 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.[17]

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 any investment in capital on behalf of the customer. The contract scope 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, waste-water management, and the provision of water (process water, water for fire-fighting, demineralised water, hot water, cooling water and potable water).

With respect to solid-waste management, Veolia Environnement provides on-site collection and organises external treatment of some 3000 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 all the other utility and environmental services it provides, Veolia Environnement operates all the on-line equipment, employing about 60 people, most locally recruited. For the procurement and the financing of equipment used to produce industrial gases, however, Veolia Environnement 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 subheadings 9026.10 and 90 28 30), part of the instruments used for process control, and all the following products and heavy equipment:

- active chemicals•;
- tanks (HS subheadings 7309.00• and 7310.10•);
- pumps for liquids (HS subheadings 8413.60▲• to 8413.70▲•);
- compressors (HS subheadings 8414.30• to 8414.90•);
- filters (HS subheadings 8421.21▲• to 8421.29▲•);
- valves and fittings (HS subheadings 8481.10• to 8481.80•);

[17] http://www.veoliaenvironnement-finance.com/

Veolia Environnement estimates that approximately 25% (in value terms) of the equipment used in installations relating to water were imported. These imports — 70% of which came 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 waste waters 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 subheading 9032.89▲•), which are provided by ABB. These types of contacts are currently manufactured only in Norway.

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

Import barriers

The custom tariffs on some equipment imported by Veolia Environment for the Vega do Sul plant was 25% or even 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. Such a concentration of industries generates huge volumes of solid and liquid wastes. Many of those wastes are now treated at a central facility operated by a company called 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 reestablished it as Bayer do Brasil Indústrias Químicas S.A. (Chemical Industries). Today, Belford Roxo is today 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 the wastes from industrial facilities in the area (some of which are located in an industrial park established by Bayer in 1997), and that there were economies of scale in the provision of such services, 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 cubic meters per hour. Physical and chemical treatment includes equalization, 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, while 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 cubic meters. Solid wastes are dumped onto 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 with the technical capability 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, 1000 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 website (www.tribel.com.br). However, judging from the description of facilities, it appears that many goods from the combined APEC and OECD list have been or are being used, such as:

- tanks (HS subheadings 7309.00• and 7310.10•)
- pumps (HS subheadings 8413.60▲• to 8413.70▲•)
- waste incinerators (HS subheading 8417.80▲•)
- filtering or purifying machinery and apparatus (HS subheadings 8421.21▲•, 8421.29▲• and 8421.39▲•)

- measuring and monitoring equipment for use in laboratories (various subheadings under HS headings 90.15, 90.22, 90.25, 90.26, 90.27, 90.28, 90.30, 90.31, 90.32 and 90.33▲•)

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 semi-conductors, 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 treatment plants for waste-water.

The contract

In 2001 Veolia Water, in association with Korean financial organisations, acquired the whole 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 this Veolia Water subsidiary. Veolia Water's 20 manufacturing units produce each day 83 500 cubic metres (m^3) of ultra-pure water, and treat 45 500 m^3 of waste water — 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 the services (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 subheadings 7309.00• and 7310.10•)
- pumps (HS subheadings 8413.60▲• to 8413.70▲•)
- compressors (HS subheadings 8414.30 to 8414.90)
- valves (HS subheadings 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 for producing ultra-pure water at the Hynix sites, including membrane-based filtration (micro-filtration) and resin-based demineralisation through ion exchangers (HS subheading 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).

The majority 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. They are available from only a limited number of suppliers, and currently there is 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 these 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 calls upon 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, to that for the units for producing ultra-pure water. Recycling requires less imported equipment, but greater 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 USA 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 control and monitoring instruments integrated in the water facilities at the Hynix sites is imported. The breakdown per geographical origin is roughly 1/3 of these imports coming from factories located in Europe, 1/3 from the United States and 1/3 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 needed, highly specialised equipment. It is thus probable that the share of the 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 waste-water 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 10th Five-year Plan period. Within its total planning area of 29.4 square kilometres, 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 and 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 the Shanghai Chemical Industry Park development and construction, 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 10 long-term water contracts in China.

The contract

A joint venture has been formed between Sino French Water Development Co. Ltd (a 50-50 subsidiary of Ondeo and the Hong Kong based New World Group) 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.

On the water-supply side, 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. On the waste-water treatment side, SCIP projects include designing, financing and managing installations and services for the park's industrial effluents. The duration of the waste-water contract is for 50 years. Total investment is expected to reach € 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, are expected to be fully operational by 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•
- tanks (HS subheadings 7309.00• and 7310.10•)
- valves (HS subheadings 8481.10• to 8481.80•)
- various types of monitoring instruments:

photogrammeterical 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 subheadings 8413.60▲• and 8413.70▲•) : 20% imported
- Compressors (HS subheadings 8414.30• to 8414.90•) : 30% imported
- Filters (HS subheadings 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 subheading 3914.00•) or catalysts (HS subheading 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 fully 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 cubic meters of treated water a day, and is forbidden from discharging any wastewater into the local river. The contract involves pumping water from deep, on-site wells; producing drinking and process water; treating sanitary wastewater (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.[18] In 1997, the industrial solid waste unit of the "Point Source Emissions Control Program" (*Programa de Control de Emisiones de Fuentes Fijas*, or PROCEFF) of the Metropolitan Environmental Health Service (*Servicio de Salud Metropolitano del Ambiente*, or SESMA began to regulate this waste. This coincided with the inauguration of the first authorized waste treatment companies, 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.[19] Because its first facility was built before the Chile-U.S. Free Trade Agreement, it had to pay duties on equipment it purchased from abroad. It is believed that tariffs were on 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 the name of its client 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, from which it 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 was using in its cement 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

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

19 http://www.bravoenergy.com/page7.html

110 000 tonnes/year of pulverised petcoke would be hauled from one of the company's plants to the other, using 12 to 15 specialised trucks ("capsules"), each with a capacity of 20 to 25 tonnes.

The client had applied to the Government of Jordan 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 impacts of the plants' operation, local land 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 that an environmental assessment and audit be carried out by an international consultant, one 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 performed work in more than 50 countries, for both public- and private-sector clients. The company has an associate in Jordan, which provided technical and logistical support to 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 with the site investigation included:

- filter assemblies (HS subheading 8421.39▲•);
- particulate samplers (ex HS subheadings 9027.10▲•);
- pre-weighed and prepared particulate filters (ex HS subheading 9027.10▲•);
- NO_X absorbers (ex HS subheading 9027.10▲•);
- SO_2 absorbers (ex HS subheading 9027.10▲•); and
- sound-level meters (HS subheading 9027.80▲•)

The particulate samplers, power pack, spare batteries, and associated equipment were shipped as checked-in 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 would remain in Jordan only temporarily, no import duties were due. However, certain 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 their 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 750 Jordanian dinars (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 750-dinar security deposit still 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 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 a "tools of the trade". The solution turned out to require a modification of some ducts, which work was carried out locally, and successfully.

Import barriers

It took a day or two after the agent arrived before a community noise monitor cleared 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 (see http://www.auduboninternational.org/programs/acss/golf.htm and http://www.usga.org/turf/environmental_programs/audubon_sanctuary_program/audubon_sanctuary_program.html). Already, nearly 2 000 golf courses from around the world have joined this programme — among which are three in Costa Rica[20], three in the Philippines[21] and one in Singapore[22] fulfil requirements in all six of the programme's categories, including the one relating to "Wildlife and Habitat Management". This requirement places an emphasis on maintaining the best possible habitat for wildlife on the non-playing areas of golf courses.

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

Remediation and clean-up 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 activities in Indonesia, but still sells its products (health and beauty aids) in Indonesia to retail outlets.

The service provider

Environmental Resources Management (ERM) is an environmental consulting 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 USFilter. The company provides the 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 of these individuals is Indonesian. The primary target clients in the country come from the oil and gas industry, but ERM serves many other industries there.

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

[21] Forest Hills Golf & Country Club, Las Piñas City; Manila Southwoods Golf & Country Club, Carmona; and Santa Elena Golf Club, Makiti.

[22] National Service Resort & Country Club.

The contract

The client retained ERM to take over the pollution monitoring duties at a production facility that, during the period of the work, the client sold as part of its decision to close down manufacturing operations in Indonesia. The site is moderate in extent, but it is potentially contaminated by particularly dangerous hydrocarbons that could pose a serious threat to groundwater supplies serving nearby communities, which use the supplies for washing and bathing, if not directly for drinking.

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

The work, which began in 2002, involved ERM taking over the operation of three existing groundwater monitoring wells on the site. The company found the construction of the wells unsatisfactory and installed three additional 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, although it is not the client for the job, 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 subheading 2851.00•)
- textile products for the construction of the new wells (HS subheading 5911.90▲)
- filters (HS subheading 8421.29▲•)
- passive sorbent collection devices (sorbers)
- bottles for samples

The pumps were rented from a company in Australia. The filters and textile products were purchased from Australian suppliers, while the diffusion bags and sorbers were purchased from W.L.Gore, a U.S. supplier, which also performed the analysis of 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 1200 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 have heretofore had to be sourced from Australian suppliers are therefore now becoming available from Malaysia at lower prices.

ENSR-Brazil Case History

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. 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 their pollution issues is growing increasingly 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 in gross revenues annually. 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 nations, including a number of developing nations 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 subheading 3802.10•)
- pumps (HS subheadings 8413.60▲• to 8413.70▲•);
- filters (HS subheadings 8421.21▲• to 8422.20▲•);
- valves and fittings (HS subheadings 8481.10• to 8481.80•);
- instrumentation (HS subheadings 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 the majority 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 U.S., 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-market 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 markups 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 having 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 and delineate a suitable site for the facility. The data would also 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 monitoring equipment. But, considering the distance required to ship this equipment, and the relative high costs of doing so, it initially decided to use only its own noise-level meters, as they 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 subheading 7017.10▲)
- filter assemblies (HS subheading 8421.39▲•)
- particulate samplers with appropriate filters, vacuum pumps and accessories (ex HS subheading 9027.10▲•);
- NO_X absorbers (ex HS subheading 9027.10▲•)
- SO_2 absorbers (ex HS subheading 9027.10▲•)
- sound-level meters (HS subheading 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 — initially — the sound-level meters, which were brought into India from Canada in the project managers' hand-carried luggage.

Import issues

The project manager carried appropriate letters to indicate that the noise 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 for taking the equipment inside the country. Once the equipment was re-exported (returned to Canada), these duties could be claimed by the Canadian company by filling out the appropriate forms.

The company's project manager expected that it would take a substantial time to get the refund. (Box 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 the less-sophisticated equipment that was 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 3. Non-tariff barriers to imports of environmental goods and services in India

In early 2003, the U.S.-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 actual sale takes place, the technology to be imported often becomes obsolete, and the supplier may be wrongly accused of trying to supply obsolete technology.

Certification requirements: Raising finances for infrastructure projects, such as waste-to-energy, water and sanitation projects, poses great problems, because the technology to be imported 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 in three months. A company that has worked on several waste-to-energy projects reported that getting clearances from the MOEF takes months. The company imports gas turbines, and the MOEF takes months to give clearance on these types of equipment.

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

ANNEX II. 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*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
220100	Water, incl. natural or artificial mineral water		X					X	X		X
220710	Ethanol					X			X		
230210	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		
252100	Limestone flux					X		X	X		
252220	Slaked (hydrated) lime					X		X	X		X
280110	Chlorine		X								X
280110	Hydrogen peroxide		X								X
281410	Anhydrous ammonia		X								X
281511	Sodium hydroxide solid		X								X
281512	Sodium hydroxide in aqueous solution		X								X
281610	Magnesium hydroxide and peroxide		X			X			X		X
281830	Aluminium hydroxide		X								
282010	Manganese dioxide		X			X					
282090	Manganese oxides (other)		X								
282410	Lead monoxide		X								
283210	Sodium sulphites		X								X
283220	Other sulphites		X								X
283510	Phosphinates and phosphonates		X								
283521	Phosphates of triammonium		X								
283522	Phosphates of monosodium or disodium		X								X
283523	Phosphates of trisodium		X								
283524	Phosphates of potassium		X								X
283525	Calcium hydrogenorthophosphate		X								X
283526	Other phosphates of calcium		X								X
283529	Other phosphates (excl. polyphosphates)		X								X
285100	Distilled and conductivity water										X
290511	Methanol					X					

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
320910	Paints and varnishes, in aqueous medium, acrylic or vinyl					**X**					
320990	Other paints and varnishes, in aqueous medium					**X**					
380210	Activated carbon		**X**			**X**			**X**		**X**
380290	Activated earths					**X**					
381500	Catalysts		**X**	**X**		**X**			**X**		**X**
390690	Flocculating agents		**X**								**X**
391400	Ion exchangers (polymer)		**X**						**X**		**X**
392020	Polypropylene sheeting, etc.			**X**					**X**		
392490	Household & toilet articles of plastic		**X**								
392690	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**		
392690	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**		
460120	Mats, matting, and screens of vegetable materials	(1) Erosion control matting (biodegradable)	**X**					**X**	**X**		
560314	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**		
580190	Woven pile & chenille fabrics of other textile materials		**X**								
591190	Textile products and articles, for technical uses, specified in note 7 to this chapter; other	Environmental protection cloth	**X**					**X**			
681099	Other articles of cement, concrete		**X**	**X**							**X**
690210	Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of	Industrial incineration		**X**							

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
	siliceous fossil meals or similar siliceous earths; containing by weight, singly or together, more than 50% of the elements Mg, Ca or Cr, expressed a										
690220	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 (Al2O3), of silica (SiO2) or of a mixture or compound	Industrial incineration		**X**							
690290	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**							
690310	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 gr	Laboratory refractory equipment	**X**	**X**		**X**		**X**	**X**		**X**
690320	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 aby weight more than 50% of a	Laboratory refractory equipment	**X**	**X**		**X**		**X**	**X**		**X**
690390	Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those	Laboratory refractory equipment	**X**	**X**		**X**		**X**	**X**		**X**

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
	of siliceous fossil meal or of similar siliceous earths; other										
690919	Ceramic wares for laboratory, chemical or other technical uses; other	Laboratory equipment	**X**	**X**		**X**		**X**	**X**		**X**
700800	Multiple walled insulating units of glass					**X**					
701710	Laboratory, hygienic or pharmaceutical glassware, whether or not graduated or calibrated; of fused quartz or other fused silica		**X**	**X**		**X**		**X**	**X**		**X**
701720	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 - 300 C		**X**	**X**		**X**		**X**	**X**		**X**
701790	Laboratory, hygienic or pharmaceutical glassware, whether or not graduated or calibrated; other		**X**	**X**		**X**		**X**	**X**		**X**
701990	Other glass fiber products					**X**					
730900	Tanks, vats, etc. > 300 liters		**X**								**X**
731010	Tanks, drums, etc. >50 litres <300 litres		**X**								
731021	Cans < 50 liters, closed by soldering or crimping		**X**								
731029	Other cans < 50 liters		**X**								
732510	Articles of cast iron		**X**								**X**
780600	Other articles of lead		**X**	**X**							**X**
840410	Auxiliary plant for use with boilers of heading No. 8402 or 8403 (for example, economizers, super-heaters, soot removers, gas recoverers)			**X**		**X**			**X**		
840420	Condensers for steam or other vapour power units			**X**		**X**					
840510	Producer gas or water gas generators, with or without their purifier;	Include only those with purifiers.		**X**		**X**					

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
	acetylene gas generators and similar water process gas generator, with or without their purifiers										
840991	Parts suitable for use solely or principally with the engines of heading No. 8407 or 8408; suitable for use solely or principally with spark-ignition internal combustion piston engines.	Industrial mufflers					**X**				
840999	Parts for diesel or semi-diesel engines						**X**				
840999	Parts suitable for use solely or principally with the engines of heading No. 8407 or 8408; other	Industrial mufflers				**X**	**X**				
841000	Hydraulic turbines 00		**X**			**X**					**X**
841011	Hydraulic turbines and water wheels of a power not exceeding 1,000 kW					**X**					
841012	Hydraulic turbines and water wheels of a power exceeding 1,000 kW but not exceeding 10,000 kW					**X**					
841013	Hydraulic turbines and water wheels of a power exceeding 10,000 kW					**X**					
841090	Hydraulic turbines and water wheels; parts, including regulators					**X**					
841320	Root control equipment		**X**								**X**
841350	Positive displacement pumps, hand operated [centrifugal pumps]		**X**								**X**
841360	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**								
841370	Pumps for liquids, whether or not fitted with a measuring device; other centrifugal pumps	Centrifugal pumps lined to prevent corrosion; centrifugal sewage pumps	**X**								
841381	Pumps for liquids, whether or not fitted with a measuring device; other pumps	Wind turbine pump				**X**					

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
841410	Vacuum pumps		**X**	**X**		**X**			**X**		**X**
841430	Compressors of a kind used in refrigerating equipment		**X**	**X**		**X**			**X**		
841440	Air compressors mounted on a wheeled chassis for towing				**X**	**X**			**X**		
841459	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**					
841480	Other air or gas compressors or hoods		**X**	**X**		**X**					
841480	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**					
841490	Parts for air or gas compressors, fans or hoods		**X**	**X**		**X**					
841780	Industrial or laboratory furnaces and ovens, including incinerators, non-electric; other than bakery ovens and furnaces for treatment of ores	Waste Incinerators		**X**							
841790	Parts of Industrial or Laboratory Furnaces and Ovens, Including Incinerators, Non-electric	Parts of waste incinerators		**X**							
841911	Instantaneous gas water heaters					**X**					
841919	Other instantaneous or storage water heaters, non-electric	Solar Water Heaters				**X**					
841940	Distilling or rectifying plant										**X**
841950	Heat exchange units		**X**	**X**		**X**					
841960	Machinery for liquefying air or other gases					**X**					
841989	Other machinery for treatment of materials by change of temperature					**X**					
841990	Parts for heat exchange equipment		**X**	**X**		**X**					
842119	Centrifuges, including centrifugal dryers, other than cream separators and clothes-dryers		**X**	**X**		**X**					**X**

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
842121	Filtering or purifying machinery and apparatus for liquids: for filtering or purifying water		**X**								**X**
842129	Filtering or Purifying Machinery and Apparatus For Liquids; other		**X**						**X**		**X**
842139	Filtering or Purifying Machinery and Apparatus For Gases; other			**X**		**X**					
842191	Parts of centrifuges		**X**								
842191	Parts of Centrifuges, Including Centrifugal Dryers	Centrifuges, Accessories & Parts; except clothes dryers and clothes dryer furniture	**X**	**X**		**X**					**X**
842199	Parts of filtering or purifying machinery and apparatus for liquids or gases			**X**		**X**					
842220	Machinery for cleaning or drying bottles or other containers			**X**							
842381	Weighing machines capacity <30 kg		**X**								
842382	Weighing machines capacity >30 kg <500 kg		**X**								
842389	Weighing machines		**X**								
842490	Parts for sprayers for powders or liquids					**X**					
842833	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**							
843680	Other agricultural, horticultural, forestry, poultry-keeping or bee-keeping machinery	Hot water weed killing system	**X**					**X**			
846291	Machine tools for working metal, other than punching or notching and combined punching and shearing; hydraulic presses	Shredders/balers for metals; hydraulic		**X**							
847290	Other office machines	Paper shredders		**X**							
847410	Sorting, screening, separating or washing machines	Machines of a kind for use in screening and washing coal		**X**		**X**					
847410	Sorting, screening, separating or washing	Waste foundry sand reclamation		**X**							

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
	machines	equipment									
847432	Machines for mixing mineral substances with bitumen	Asphalt recycle equipment		**X**							
847439	Other mixing or kneading machines for earth, stone, sand, etc.			**X**							
847982	Mixing, kneading, crushing, grinding, screening, sifting, homogenizing emulsifying or stirring machines	Agitator for wastewater treatment	**X**								
847982	Mixing, kneading, crushing, grinding, screening, sifting, homogenizing emulsifying or stirring machines	Other than kneading machinery		**X**							
847989	Machines and mechanical appliances having individual functions, not elsewhere specified or included in this chapter, other	Trash compactors		**X**	**X**						
847989	Machines and mechanical appliances having individual functions, not elsewhere specified or included in this chapter, other	Radioactive waste press		**X**							
847990	Parts of Machines and mechanical appliances having individual functions, not elsewhere specified or included in this chapter, other	Parts of trash compactors		**X**	**X**						
848110	Valves, pressure reducing		**X**								**X**
848130	Valves, check		**X**								**X**
848140	Valves, safety		**X**								**X**
848180	Other taps, cocks, valves, etc.		**X**								**X**
850231	Generating sets, electric, wind-powered					**X**					
850590	Electro-magnets; other, including parts	Electromagnet		**X**							
851410	Industrial or Laboratory Furnaces and Ovens; electric, resistance heated	Waste incinerators or other waste treatment apparatus		**X**							
851420	Industrial or Laboratory Furnaces and Ovens; electric, induction or dielectric	Waste incinerators or other waste treatment		**X**							

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
		apparatus									
851430	Industrial or Laboratory Furnaces and Ovens, electric, other	Waste incinerators or other waste treatment apparatus		**X**							
851490	Parts of industrial or laboratory electric furnaces and ovens or other laboratory induction or dielectric heating equipment	Parts of waste incinerators		**X**							
851629	Other electric space heating and soil heating apparatus			**X**					**X**		
853931	Fluorescent lamps, hot cathode					**X**					
854140	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**		
854389	Electrical machines and apparatus, having individual functions, not specified or included elsewhere in this chapter; other	Ozone production system	**X**								**X**
870892	Silencers and exhaust pipes, motor vehicles						**X**				
890710	Inflatable rafts	Inflatable oil spill recovery barges							**X**		
890790	Other floating structures	Pollution protection booms							**X**		
901320	Lasers			**X**							
901540	Photogrammeterical surveying instruments and appliances		**X**	**X**		**X**	**X**	**X**	**X**		**X**
901580	Other surveying, hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances, excluding compasses		**X**	**X**		**X**	**X**	**X**	**X**		**X**
901590	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*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
902229	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**
902290	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**
902511	Thermometers and pyrometers, not combined with other instruments: liquid-filled, for direct reading		**X**								**X**
902519	Thermometers and pyrometers, not combined with other instruments: other than liquid-filled, for direct reading		**X**			**X**					**X**
902580	Hydrometers and similar floating instruments, thermometers pyrometers, barometers, hygrometers, and psychrometers, recording or not, and any combination of these instruments		**X**			**X**					**X**
902590	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**
902610	Instruments and apparatus for measuring or checking the flow or level of liquid		**X**								**X**
902620	Instruments and apparatus for measuring or checking pressure		**X**								**X**
902680	Other instruments and apparatus		**X**	**X**		**X**	**X**	**X**	**X**		**X**
902690	Parts and accessories for articles of subheading 9026		**X**								**X**
902710	Gas or smoke analysis apparatus					**X**					

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
902720	Chromatographs and electrophoresis instruments		X	X			X	X	X	X	
902730	Spectrometers, Spectrophotometers and Spectrographs Using Optical Radiations (Ultraviolet, Visible, Infrared)		X	X			X	X	X	X	
902740	Exposure Meters [including sound-level meters]		X	X			X	X	X	X	
902750	Other instruments and apparatus using optical radiations (UV, visible, IR)		X	X			X	X	X	X	
902780	Other instruments and apparatus for physical or chemical analysis		X	X			X	X	X	X	X
902790	Microtomes; parts and accessories		X	X			X	X	X	X	
902810	Gas Meters			X		X					
902810	Gas supply, production and calibrating meters					X					
902820	Liquid supply, production and calibrating meters		X	X							X
902830	Electricity Meters					X					
902890	Parts and accessories for articles of subheading 9028		X	X		X					X
903010	Instruments and apparatus for measuring or detecting ionising radiations			X		X			X		
903020	Cathode-ray Oscilloscopes and Cathode-ray Oscillographs		X	X			X	X	X	X	
903031	Multimeters		X	X			X	X	X	X	
903039	Other instruments and apparatus, for measuring or checking voltage, current, resistance or power, without a recording device		X	X			X	X	X	X	
903083	Other instruments and apparatus for measuring or checking electrical quantities, with a recording device		X	X			X	X	X	X	
903089	Other Instruments and Apparatus for Measuring or Checking Electrical Quantities		X	X			X	X	X	X	
903090	Parts and accessories (for nominated articles of		X	X			X	X	X	X	

HS sub-heading	Description of product	Additional product specification (if applicable)	*Four-sector environmental service classification*								
			Sewage	Refuse disposal	Sani-tation	Other environmental services					Water supply
			Seven-sector environmental service classification[1]								
			WWM	SHM		APC	N/V	BIO	R/C	Other	
	subheading 9030)										
903110	Machines for Balancing Mechanical Parts		X	X			X	X	X	X	
903120	Test Benches		X	X			X	X	X	X	
903130	Profile Projectors		X	X			X	X	X	X	
903149	Other optical instruments		X	X			X	X	X	X	
903180	Other Measuring or Checking Instruments, Appliances and Machines, not elsewhere specified in this chapter		X	X			X	X	X	X	
903190	Parts and accessories (for nominated articles of subheading 9031)		X	X			X	X	X	X	
903210	Thermostats		X	X				X	X	X	
903220	Manostats		X	X					X	X	
903281	Hydraulic and Pneumatic Instruments and Apparatus		X	X				X	X	X	X
903289	Automatic Regulating or Controlling Instruments, other		X	X			X	X	X	X	X
903290	Parts and accessories		X	X			X	X	X	X	
903300	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	
960310	Brooms, hand			X	X						
960350	Brushes as parts of machines, appliances			X	X						
960390	Hand-operated mechanical floor sweepers, not motorised			X	X						

1. Abbreviations :

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