

Environmental Goods and Services Series



Facilitating Trade in Services Complementary to Climate- friendly Technologies



By **Joy Aeree Kim**,
Independent Consultant

ICTSD Global Platform on Climate Change, Trade and Sustainable Energy



International Centre for Trade
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ICTSD welcomes feedback on this document. These can be forwarded to Joachim Monkelbaan, jmonkelbaan@ictsd.ch

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LIST ABBREVIATIONS AND ACRONYMS

AFV	Alternative Fuel Vehicles
APEC	Asia-Pacific Economic Co-operation
CCS	Carbon Capture Storage
CHP	Combined Heat and Power
CPC	Centralized Product Classification
CTE SS	Committee on Trade and Environment Special Session
CTS SS	Committee on Trade in Services Special Session
DHC	District Heating and Cooling
EU	European Union
EuroStat	The Statistical Office of the European Community
GATS	General Agreement on Trade in Services
GHG	Green House Gases
GPA	Government Procurement Agreement
ICT	Information and Communication Technology
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
MFN	Most-Favoured Nations Treatment
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RECs	Renewable Energy Certificates
UNCTAD	United Nations Conference on Trade and Development
WTO	World Trade Organization

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FOREWORD

Addressing climate change and energy security effectively will require a fundamental transformation of our economies and of the ways in which we generate and use energy. This in turn will impact significantly the what, where and how of our production and trade. If international co-operation on climate change is to be effective, international regulatory frameworks will need to support this effort.

Climate change mitigation and energy security require massive and rapid deployment of cleaner, more efficient goods and complementary services that promote clean growth and economic gain. To support action on climate change, therefore, comprehensive trade reform may be necessary, both at the level of the global trade regime through the World Trade Organization (WTO) and at that of regional trading arrangements.

This paper builds on the results of recent ICTSD studies that map and classify climate-friendly goods and analyse trade patterns, drivers and barriers in such goods. Despite the significant economic and environmental benefits of liberalizing trade in environmental services that address climate change and the goods that are indispensable for delivering them in tandem, there remain many challenges to realizing such benefits.

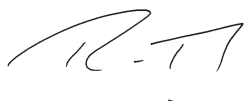
Identifying and classifying climate-related services, for instance, has proven to be difficult. This study attempts to address such challenges by identifying services that are directly linked to climate-friendly goods, and by analysing specific commitments made by the countries that are most heavily involved in trade in these services. Liberalizing trade in these services could not only facilitate the diffusion of associated climate change mitigation technologies, but also enable countries to easily get access to such services.

The paper covers multiple key mitigation sectors identified by the Intergovernmental Panel on Climate Change (IPCC): energy supply, transport, buildings, industry, agriculture, forestry, and waste. In doing so, the paper goes beyond the issue of market access and national treatment and points to a variety of domestic laws and regulations, such as those regarding government procurement.

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The views expressed in this paper are those of the author and do not necessarily reflect the views of her current employer or ICTSD and its funding institutions.

The paper is part of a series of issue papers commissioned in the context of ICTSD Global Platform on Climate Change, Trade and Sustainable Energy. One of the objectives of the Platform is to provide options for identifying and liberalizing trade in climate-friendly environmental goods and services that effectively contribute to sound environmental management while preserving developing countries' ability to promote industry and economic development. We hope you will find this paper to be stimulating and informative reading and useful for your work.



Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

EXECUTIVE SUMMARY

A vast range of services across multiple sectors appears to be related to implementing climate change policies. Despite the widely touted potential benefits of liberalizing trade in environmental goods and services for the fight against climate change, any attempts to realize such benefits are bound to face many challenges. The first of these challenges lies in identifying a reasonable set of climate change related services that could be subject to a negotiation on trade liberalization; given that these services are spread across multiple sectors, identifying such services is sure to be a daunting task.

Another challenge comes from the current disconnect between negotiations on environmental goods and negotiations on environmental services in the framework of the WTO, since certain climate friendly goods are indispensable for delivering these associated services, and vice versa. In addition, a lack of progress on environmental services negotiations with regards to the issue of classification does not help Members schedule meaningful commitments in supporting action on climate change.

This study attempts to address these challenges by identifying services that are directly linked to the diffusion of climate change mitigation technologies¹ (hereafter ‘services complementary to climate change mitigation technologies’) and analyzing specific commitments made by the major trading countries of these services. Given that some of the key services required for mitigation options, ranging from energy efficiency projects to utility-scale wind power projects, are often unavailable in the countries hosting the projects, liberalizing trade in these services could not only facilitate the diffusion of associated climate change mitigation technologies, but also enable countries to easily get access to such services.

‘Complementary services of climate change mitigation technologies’ that cut across multiple key mitigation sectors identified by the Intergovernmental Panel on Climate Change (IPCC) - i.e. energy supply, transport, buildings, industry, agriculture, forestry and waste - largely fall into the following Centralized Product Classification (CPC) groups: other professional, technical and business services; construction services; and sewage and waste collection treatment and disposal and other environmental protection services. Among the 17 major trading countries of these services, the EU and the USA are the biggest exporters, followed by Japan and Canada. Meanwhile, a few emerging economies, as well as economies in transition such as India, China, the Russian Federation and Chinese Taipei, are quickly becoming major exporters in some of these services sectors.

A review of major trading countries’ specific commitments to liberalize trade in these services shows that only a handful of the countries have made a full commitment. The principal Modes of supply for the complementary services of climate change mitigation technologies are ‘commercial presence’ (Mode 3) and ‘movement of natural persons’ (Mode 4). Yet these Modes of supply appear to be largely limited, as the majority of countries concerned have put specific as well as horizontal limitations on them. Members’ commitments on ‘Cross-border supply’ (Mode 1) across all three CPC groups are becoming increasingly important for the facilitation of trade in these services, as the provision of services through Mode 1 is increasing together with new channels of electronic supply. Yet the majority of trading countries concerned left this Mode of supply unbound, as they considered it inapplicable, particularly in the case of construction services.

No discernable progress seems to have been made on Members’ new commitments across the three CPC groups of services in either their initial or revised offers during the Doha Round. In both offers the nature of horizontal limitations in the services sectors concerned and their limitations regarding Modes of supply also remain largely the same.

It should be kept in mind that facilitating trade in ‘services complementary to climate change mitigation technologies’ goes beyond the boundaries of the General Agreement on Trade in Services (GATS), as it is not limited to the issue of market access and national treatment. Domestic legislation, regulatory measures and administrative rules could also affect trade in these services. In particular, regulations concerning government procurement could have a significant impact on trade in these services, given that the public sector is the largest client in these sectors. It is crucial, therefore, to address the issue of trade liberalization in complementary services of climate change mitigation technologies alongside a discussion on the WTO’s plurilateral Government Procurement Agreement (GPA).

1. SETTING THE SCENE

Since the Copenhagen conference on climate change in 2009, the World Trade Organization (WTO) negotiations on environmental goods and services (EGS) have witnessed a renewed sense of engagement. In particular, the issue of climate change has increasingly taken centre stage in the negotiations on EGS.

Proponents of trade liberalization in climate-friendly goods and services often cite the contributions that this liberalization could make in the fight against climate change.² According to a World Bank report for instance, removing tariff and non-tariff barriers to clean energy technologies alone could result in a seven to fourteen percent increase in their trade volumes (World Bank, 2007a).

Successful deployment of low-carbon technologies and related services, however, requires a variety of domestic policy reforms, ranging from reduced fossil fuel subsidies, renewable energy policy and research and development (R&D) for low-carbon technologies, to improving energy efficiency standards, building codes and government procurement practices. Therefore, the potential benefits of liberalizing trade in climate-friendly goods and services should be understood in this overall context.

In realizing a successful diffusion of climate-friendly goods and services, it is crucial to understand the links between the two, as certain climate friendly goods are indispensable for delivering the associated services and vice versa. For instance, an Organisation for Economic Co-operation and Development (OECD) analysis on environmental goods associated with service contracts demonstrates that many of these environmental goods are used in the performance of environmental services (OECD, 2005).³ In addition, an empirical study shows that trade in climate change mitigation technologies is often impeded by restrictions on in the negotiations on EGS. associated services (Steenblik and Kim, 2008). Furthermore, several empirical studies reveal that some of the key services required for climate change mitigation options, ranging from energy efficiency projects to utility-scale wind power projects, are often unavailable in the host countries (Steenblik and Geloso Grosso, 2011; Sterk et al., 2007).

Against this backdrop, this paper aims to identify services that are directly related with and complementary to the diffusion of climate change mitigation technologies (hereafter 'services complementary to climate change mitigation technologies') and to analyze specific commitments by major trading countries of these services.

2. STATE OF PLAY: CURRENT NEGOTIATIONS ON SERVICES RELATED TO CLIMATE CHANGE

Over a period of nearly eight years, the Uruguay Round undertook a long process of multilateral rule-making and liberalization of trade in services; the process was finalized in 1994. As Members agreed on successive rounds of negotiations on trade in services at the subsequent Doha Round of trade talks - which began in 2001 and is still ongoing - the WTO Council for Trade in Services set the request-offer approach in negotiating specific market access commitments in services. Accordingly, Members submitted their initial offers by 31 March 2003 in response to initial requests, followed by new or revised offers submitted by May 2005 (Geloso Grosso, 2005). By April 2011, 71 initial offers and 31 revised offers were submitted to the WTO.

The issue of climate change is increasingly taking centre stage in the process of negotiation on environmental goods and services. Currently, the negotiations on environmental goods and services are taking place in parallel in two different WTO forums: negotiations on environmental goods at the Special Session of the Committee on Trade and Environment (CTE SS) and negotiations on environmental services at the Special Session of the Committee on Trade in Services (CTS SS). The progress of negotiations at both forums has been slow, as each forum is facing different challenges.

While the session negotiating on environmental goods is struggling with identifying a list of goods that are of interest to the majority of Members, the negotiations on environmental services are facing the challenge of updating the current General Agreement on Trade in Services (GATS) classification, as it does not reflect the evolving structure of the industry. In particular, the current classification (W/120) of environmental services largely focuses on infrastructural services, despite “non-infrastructural” services such as air pollution control or environmental consulting emerging as important activities in recent years, primarily due to increasingly demanding environmental regulations (Cossy, 2011; Cottier and Baracol-Pinhao, 2009; Nartova, 2009).

Several proposals on the classification are under scrutiny of Members (Table 1). Some Members have based their proposals on the classification developed by the OECD/the Statistical Office of the European Community (EuroStat), which includes three categories of environmental services: pollution management, cleaner technologies, and resource management.⁴ The European Union (EU) proposed seven sub-sectors based on the environmental media (air, water, soil, waste, noise etc.) to comprise the classification, in order to preserve the mutually exclusive character of the W/120 list.

Table 1. Comparison of various classifications on environmental services

GATS	OECD	EU
Sewage Refuse/Disposal Sanitation Other	Pollution management Cleaner technologies Resource management	Water/Waste management Air/climate protection Remediation/Clean up Noise/Vibration Biodiversity Other

Despite several proposals regarding the development of a more comprehensive classification system for environmental services, a ‘dual use’ problem persists as a serious challenge: certain environmental services overlap increasingly with services classified within

other services sectors. Several proposals are being put forward to address the issue of dual-use services. The EU, for instance, proposed a ‘cluster’ approach in which services used for environmental as well as other purposes (dual-use services) would be classified separately

and be subject to a 'checklist' during the other sectoral negotiations. Canada supports EU's 'cluster' approach, encouraging liberalization in all Modes of delivery. In particular, Canada distinguishes between the present list of environmental services (core services) and other related services (non-core or dual-use services) and stresses the importance of liberalizing both services at the sub-sectoral level. The proposals by the US and Switzerland are largely in line with the classification of 'core' versus 'non-core' services (Nartova, 2009).

Services related to climate change could exacerbate the issue of 'dual use', since these particular services appear to spread across multiple sectors classified in W/120. Opinions, however, are divided as to whether an appropriate classification is a pre-requisite for scheduling meaningful commitments in supporting climate change. For instance, Cossy (2011) argues that the absence of an appropriate classification does not prevent Members from negotiating on climate change related services. What is more important, she stresses, is to ensure that each schedule is internally coherent by avoiding overlap among sectors and defining the scope of the commitments clearly and precisely.⁵

In fact, the GATS allows ample flexibilities for specifying the scope of commitments in Members' schedule.⁶ Under the GATS, all WTO members are subject to general obligations,

including most-favoured nation (MFN) treatment and transparency, which apply to all service sectors. However, the main GATS obligations, namely market access and national treatment, apply only in sectors where Members undertake "specific commitments" which are listed in their national schedule. Members can select the sectors and Modes of supply for which they are ready to undertake specific commitments, with various types of limitations in order to meet national policy objectives. The US, for instance, limits its sewage and refuse disposal commitments, under the environmental services sector, to services contracted by private industry only. Korea also specifies the terms of its refuse disposal services commitments as 'collection, transport and disposal services of industrial refuse only'.

Thus, once agreed on the scope of services that support climate change, Members are free to specify their commitments on climate change-related services across different sectors in their schedules within the current structure of classification. For instance, Members, in their schedules under the 'engineering services' could specify 'engineering services for power projects or industrial projects that aim at mitigating climate change through energy efficiency improvement; 'building projects that aim at improving energy performance'; or 'transportation projects that are based on modal shifts from road transport to public transport only'.

3. METHODOLOGY AND SCOPE

This study first sketches out a variety of climate change mitigation technologies and practices identified in seven economic sectors (energy supply, transport, buildings, industry, agriculture, forestry and waste) in the IPCC fourth assessment report.

Given the vast range of services that could be related to addressing climate change, this study takes the following steps to narrow down the scope of services that are subject to the analysis of the major trading countries and their specific commitments:

Firstly, this study focuses on services that could directly influence the diffusion of climate change mitigation technologies (“complementary services of climate change mitigation technologies”). Given the inseparable links between climate change mitigation technologies and services, it is important to prioritize trade

in services that are directly linked to climate change mitigation technologies.

Secondly, building on the “complementary services of climate change mitigation technologies” discussed in the seven sectors, corresponding services categories in terms of the UN CPC (version 2) are identified.⁷

Thirdly, in analyzing the major trading countries’ specific commitments on the services concerned, this study further narrows down the scope of services by focusing on services groups that most frequently appear across multiple economic sectors.

Given the data limitations on trade in these services, the major trading countries of these services are identified at the CPC group level. The major trading countries’ specific commitments are analyzed at class or sub-class levels within each CPC group.

4. IDENTIFYING SERVICES THAT ARE COMPLEMENTARY TO THE DIFFUSION OF CLIMATE CHANGE MITIGATION TECHNOLOGIES

Mitigating climate change requires that a wide range of policy measures be employed in order to restructure economies, redirect investment, and reshape production and consumption patterns. Not surprisingly, climate change mitigation activities cut across almost all economic sectors, ranging from agriculture and fisheries to energy, transport, water, waste, and tourism. A variety of services across multiple sectors classified in W/120 also appear to be related to such mitigation activities.⁸ For instance, telecommunication services are relevant to saving energy and improving energy efficiency in sectors such as utilities, transport, and buildings, as smart Information and Communication Technologies (ICT) applications are emerging as useful cornerstones for ‘smart buildings’, ‘smart grids’, ‘smart transportation’, and ‘smart industrial processes’.

“Climate-conscious” urban planning and management services could also be connected to climate change mitigation at the city level, as such services stimulate innovation and advance clean energy systems, sustainable transportation, spatial development, and waste management strategies to reduce greenhouse gases. Travel and tourism related services or education services could also be relevant in mitigating climate change by promoting eco-tourism or educating consumers on low-carbon consumption patterns. Research and development (R&D) services on natural sciences are related to a variety of mitigation technologies across almost all sectors, as technological innovation is an integral part of accelerating GHG reduction.

In order to narrow down the scope of services in this study, this section discusses key climate change mitigation technologies in seven economic sectors identified in the fourth IPCC assessment report, along with the associated services that could be complementary to the diffusion of such technologies.

4.1 Energy Supply

The mitigation potential of the energy supply sector very much lies in the application of a wide range of available low- and zero-carbon technologies, including the widespread use of hydropower, bioenergy, other renewables, nuclear, and carbon capture and storage (CCS). Improved power plant efficiency and fuel switching from coal to gas would also contribute to mitigation in this sector.

Several services are related to implementing these mitigation options. For instance, pre-construction power plant services include ‘technical testing and analysis services’ for a feasibility study, as well as services related to site selection. In the case of CCS, site selection is particularly crucial as it involves analyzing the characteristics of the geological site to ensure that it is adequate for injecting compressed CO₂ (IEA, 2010; IPCC, 2007).

Improved power plant efficiency through technologies such as combined heat and power (CHP) would require both ‘construction services for facilities’ and ‘engineering services for power projects’ that optimize the environmental performance of energy facilities.⁹ Engineering services for power projects would also be needed not only to build facilities that generate electrical power from various energy sources (e.g. nuclear energy, solar power, wind power, geothermal power), but also to build so-called “capture-ready” new power plants (Gibbins et al., 2006).¹⁰

Once constructed, most of the renewable energy power plants are likely to require monitoring services, which eventually reduce the operation and maintenance costs. The General Electric Company (GE) for instance, provides remote wind-turbine monitoring services in order to increase the reliability and capacity of wind farms (Steenblik and Geloso Grosso, 2010).

As a measure to promote the use of renewables, governments could require producers or distribution companies and retail suppliers to buy 'renewable energy credits or certificates (RECs)', which prove a minimum share of the electricity generated or supplied to the retail consumer comes from renewable energy sources (Delimatsis and Mavromat, 2009). RECs are considered intangible financial assets, which could be tradable in order to comply with the minimum quota obligation relating to renewables.¹¹ Trading in RECs therefore involves various intermediary financial services such as brokerage, banking, and insurance services.

Smart grids could improve energy efficiency from both electricity generation and use by integrating both electricity and thermal storage technologies and reducing transmission and distribution losses (IEA, 2010). Successful

application of smart grids, however, requires modifications in the design, operation, and deployment of electricity networks - a process that involves engineering services as well as services related to energy distribution.

The services involved in the technical testing and analysis of air are useful both for assessing the carbon-offset resulting from improved energy efficiency of power plants and for transporting CO₂ for storage. In the latter case, this testing ensures that the possible rupture or leaking of pipelines will not lead to the accumulation of a dangerous level of CO₂ in the air.

In addition, building nuclear power plants would require engineering-related services and the operation of disposal facilities for radioactive waste, such as hazardous waste management services.

Table 2. Examples of key sectoral mitigation technologies and complementary services

Sector	Key mitigation technologies	Complementary services
Energy supply	CCS	Pre-construction power plant services (e.g. technical testing and analysis services for a feasibility study'; services related to site selection)
	CPC	Construction services for facilities; engineering services for power projects
	Renewable energy power plants	Monitoring services
Transport	Alternative fuel vehicles	Services related to fuel delivery systems (e.g. recharging facilities for electric vehicles)
	Energy efficient passenger jet aircraft	Design and engineering services
Buildings	Energy efficient operation of buildings (smart buildings)	Architectural and engineering services to design and construct 'smart buildings'; information technology and telecommunication services; electrical installation (e.g. smart sector network); energy performance contracting services
Industry	Energy efficient motor systems	Engineering services for industrial projects; installation and operation; design and modification
Waste	Incineration and industrial co-combustion for waste to energy	Engineering services for waste management projects; design of equipment for handling, storing and transporting solid, liquid or hazardous waste;
	Landfill gas recovery	Sanitary landfill services
	Waste-water treatment plants	Engineering services for water, sewerage and drainage projects; design, management and operation services of waste-water treatment plants

4.2 Transport

More petroleum-based fuel-efficient vehicles and alternative fuel vehicles (AFVs), such as hybrid vehicles or cleaner diesel vehicles, could contribute to GHG mitigation in the transport sector, as would the increased use of certain biofuels. Improving energy efficiency in operating transport systems also provides a greater opportunity to reduce GHG. The introduction of more fuel-efficient light-duty vehicles and flexfuel vehicles, which allow any mixture of gasoline and ethanol, are such examples. Greater efficiency gains of passenger jet aircraft will depend on potential novel designs such as the blended wing body, or propulsion systems such as the unducted turbofan (IPCC, 2007).¹²

In this regard, engineering services - including design services for transportation projects - are critical to improving fuel-efficiency and reducing GHG emissions in the transport sector. The successful operation of a transport system using alternative fuel vehicles often requires complementary services, such as fuel delivery systems. One particular instance of this is the need for a comprehensive system of recharging facilities for electric vehicles.

In addition, given that road transport accounts for 74 percent of total transport CO₂ emissions, modal shifts from road transport to rail (with lower CO₂ emissions per km travelled) and improved public transport systems help reduce CO₂ in this sector (IEA, 2010). In this regard, public transport services, such as rail transport services of passengers and freight and the supporting services for rail transport, are essential for mitigating climate change. Services related to the operation of vehicles, particularly in the public transport sector, using alternative energy sources such as biofuels, electricity, and hydrogen could also contribute to de-carbonizing transport systems, though it largely depends on the way in which the biofuels, electricity and hydrogen are produced (IPCC, 2007).

Services based on achieving such modal shifts are often provided as 'eco-travelling and eco-logistics services'. Examples of this

include R&D, consulting, and engineering for transport network optimization; training for changing driving behaviour; operation of transport services using alternative vehicles; and information services for "eco-tourism.". Typically the operation of these services is provided by local subsidiaries of multinational corporations such as TNT and Green Logistics Consultants Group. While public authorities remain a principal urban mass transport service provider, international corporations such as Veolia and Transdev are now delivering eco-logistics services as well (Steenblik and Gross Gelloso, 2011).

Services related to the installation and operation of pollution abatement equipment and systems at stationary and mobile pollution sources would also be necessary for assessing the CO₂ reductions in this sector.

4.3 Buildings

Substantial reductions in CO₂ emissions, including indirect emissions from the use of electricity, could be achieved in the buildings sector by using mature existing technologies for energy efficiency and renewable sources of energy. Buildings are complex systems when it comes to energy consumption, involving the building envelope and its insulation, space heating and cooling systems, water heating systems, lighting, appliances and consumer products (e.g. refrigeration), and business equipment (e.g. information technology equipment) (IEA, 2010). A broad array of technologies could be used to improve energy efficiency, including passive solar design, high-efficiency lighting and appliances, highly efficient ventilation and cooling systems, solar water heaters, insulation materials and techniques, high-reflectivity building materials and multiple glazing (IPCC, 2007).

In particular, 75 percent or higher energy savings could be seen with new buildings (IPCC, 2007). In order to maximize such energy savings potential, a complete systems of designing and operating buildings are required. In this regard, an integrated design process involving

architects, engineers, contractors, and clients is crucial; 'architectural and engineering services' to design and construct so-called 'smart buildings' are particularly pertinent.

The energy efficient operation of buildings also requires services related to electrical installation, including smart sensor networks, along with information technology and telecommunication services (OECD, 2009). 'Energy performance contracting services', for instance, involve a comprehensive set of measures from the initial building energy audit to long-term monitoring and verification of project savings to improve the energy performance of buildings. Key service providers include Siemens Building Technologies, Schneider Electric, Johnson Controls, ABB Building Technologies, Cofely (GDF-Suez) and Dalkia (Veolia Environment). These providers mostly operate through local subsidiaries. Increasingly, independent small and medium-sized enterprises (SMEs) are emerging as alternate suppliers of these services (Steenblik and Gross Gelosso, 2011).

For the existing building stock, retrofitting and purchasing new technologies are essential for achieving energy and CO₂ savings; these processes are related to building renovation services. For space and water heating, for instance, highly efficient heat pumps, solar thermal systems, and combined heat and power (CHP) systems with hydrogen fuel cells could play an important role in achieving cost-effective CO₂ emissions reductions in the short run (IEA, 2010).

4.4 Industry

Great potential exists in the industry sector for improving energy efficiency and thereby reducing GHG emissions, mainly through the employment of the best technologies currently available as well as a range of new technologies such as CCS, smelting reduction, separation membranes, and black liquor gasification (IEA, 2010). More efficient electric motors and motor-driven systems, high efficiency boilers and process heaters, fuel switching including

the use of waste materials, and recycling are some of such options. Successful application of CCS could play a key role in achieving deep cuts of CO₂ emissions in a number of energy-intensive industrial sectors (e.g. iron and steel, cement, chemical, and petrochemical and pulp and paper) (IEA, 2010; IPCC, 2007).

Successful application of these technologies requires various services, including, among others, engineering services for industrial projects, along with the installation and operation of energy efficiency related technologies such as energy efficient motor systems. Substantial amounts of CO₂ emissions could be reduced from operating procedures by controlling steam and compressed air leaks, reducing air leaks into furnaces, and optimum use of insulation (IPCC, 2007). Realizing such smart industrial processes would require services related to design and modification of systems for energy efficiency, electrical installation - including smart sensor networks - as well as information technology and telecommunication services.

4.5 Agriculture

A variety of mitigation options exist in agriculture. The most prominent options, among others, include improved crop and grazing land management (e.g., improved agronomic practices, nutrient use, tillage, and residue management), and the restoration of degraded land and organic soils that are drained for crop production (IPCC, 2007).

Given that around 18 percent of the world's croplands now receive supplementary water through irrigation (Millennium Ecosystem Assessment, 2005), using more effective irrigation measures can enhance carbon storage in soils through enhanced yields and residue returns (Follett et al., 2001; Lal, 2004a).¹³

To implement these options, 'landscape architectural services', 'support services to crop production' including 'tilling of fields preparatory to planting', and 'operation of irrigation systems for agricultural purpose' are required.

4.6 Forestry

Mitigation options in the forestry sector include reduced deforestation, forest management, afforestation and agro-forestry. Other important mitigation practices in this sector include extending carbon retention in harvested wood products, product substitution, and producing biomass for bio-energy (IPCC, 2007).

Various mitigation technologies are employed in the forestry sector. For instance, mechanized forest machines such as harvesters, processors, and forwarders are widely used around the world as part of sustainable forest management strategies; these are considered effective for promoting mitigation options, including product and energy substitution (Karjalainen and Asikainen, 1996).

Implementing mitigation options such as afforestation, reforestation and forest management requires techniques in forestry including planting, regeneration, thinning, and harvesting. As an integrated forest management strategy, thinning and tree pruning for fuel wood and fodder are regularly practiced in many developing countries.

Among others, ‘support services to forestry and logging’ are required to implement mitigation options in this sector as these services are related to forestry production, such as transplanting, replanting, thinning, forestry inventories, timber evaluation, and fire protection. ‘Forest and damage assessment and abatement services’ are also key components of sustainable forest management.

4.7 Waste

A wide range of mature, environmentally effective technologies is available for mitigating emissions in the waste sector. For instance, CO₂ emissions could be directly reduced through landfill gas recovery, improved landfill practices and engineered wastewater management. Controlled composting of organic waste,

state-of-the-art incineration, and expanded sanitation coverage could also allow significant mitigations of GHG emissions (IPCC, 2007).

Indirectly, recycling and waste minimization and re-use help reduce GHG emissions through the conservation of raw materials, improved energy and resource efficiency, and fossil fuel avoidance. In addition, incineration and industrial co-combustion for transforming waste to energy provides significant renewable energy benefits. Currently, more than 130 million tonnes of waste per year are incinerated at over 600 plants (IPCC, 2007).

Mitigation efforts through waste management require various services related to waste treatment and disposal such as ‘sanitary landfill services’, ‘other landfill services’, and ‘incineration of non-hazardous waste’. Services related to waste treatment and disposal need to be provided together with ‘engineering services for waste management projects’ (hazardous and non-hazardous), which would involve designing equipment for handling, storing and transporting solid, liquid, or hazardous waste as well as designing, managing, and operating waste-water treatment plants. Indirect mitigation efforts through recycling would also involve ‘collection services of non-hazardous recyclable materials’ as well as ‘waste preparation, consolidation and storage services’.

There are numerous mature technologies available for wastewater treatment, collection, transport, re-use, recycling, and residuals management as well. If efficiently applied, these technologies could reduce GHG generation and emissions. Services that are relevant to wastewater treatment include ‘engineering services for water, sewerage and drainage projects’, as well as ‘sewerage and sewage treatment and septic tank cleaning services’.

Based on the “complementary services of climate change mitigation technologies” identified in this section, Table 3 below shows some of the examples of corresponding services categories (in terms of the UN CPC).

Table 3. Key sectoral mitigation technologies, policies and measures and the examples of corresponding services categories that are related to the implementation of climate change policy measures (in terms of the CPC)¹⁴

Sector	Key mitigation technologies and practices currently commercially available*	Corresponding Division in the CPC (ver.2)	Related services at UN CPC (ver.2) class and sub-class levels
Energy supply	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power; early applications of carbon dioxide capture and storage (CCS) (e.g. storage of removed CO ₂ from natural gas)	Construction services [54]	<ul style="list-style-type: none"> - General construction services of power plants [54262] - Site preparation services [543] - Installation services [546]
		Financial and related services [71]	<ul style="list-style-type: none"> - Financial services, except investment banking, insurance services and pension services [711] - Services auxiliary to financial services other than to insurance and pensions [715] - Services auxiliary to insurance and pensions [716] - Services of holding financial assets [717]
		Other professional, technical and business services [83]	<ul style="list-style-type: none"> - Management consulting and management services; information technology services [831] - Engineering services for power projects [83324] - Surface surveying services [83421] - Composition and purity testing and analysis services [83441] - Other technical testing and analysis services; radiological inspection of welds [83449] - Other professional, technical and business services n.e.c.[839]
		Telecommunications, broadcasting and information supply services [84]	<ul style="list-style-type: none"> - Private network services [8414] - Data transmission services [8415] - Internet communication services [842] - On-line content [843]
		Sewage and waste collection, treatment and disposal and other environmental protection services [94]	<ul style="list-style-type: none"> - Hazardous waste treatment and disposal services [9432]

Table 3: *Continued*

Sector	Key mitigation technologies and practices currently commercially available*	Corresponding Division in the CPC (ver.2)	Related services at UN CPC (ver.2) class and sub-class levels
Transport	More fuel-efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning	Construction services [54]	- General construction services of railways [54212]
		Other professional, technical and business services [83]	- Engineering services for transportation projects [83323] - Composition and purity testing and analysis services [83441]
		Passenger transport services [64] Supporting transport services [67]	- Interurban railway transport services of passengers [64210] - Supporting services for railway transport (6730)
Buildings	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycling of fluorinated gases	Construction services [54]	- General construction services of residential buildings [5411] - General construction services of non-residential buildings [54112] - General construction services of local pipelines and cables and related works [5425] - Installation services [546]
		Other professional, technical and business services [83]	- Management consulting and management services; information technology services [831] - Engineering services for building projects [83321] - Architectural services and advisory services [8321] - Surface surveying services [83421] - Composition and purity testing and analysis services [83441]
		Telecommunications, broadcasting and information supply services [84]	- Private network services [8414] - Data transmission services [8415] - Internet communication services [842] - On-line content [843]

Table 3: *Continued*

Sector	Key mitigation technologies and practices currently commercially available*	Corresponding Division in the CPC (ver.2)	Related services at UN CPC (ver.2) class and sub-class levels
Industry	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO ₂ gas emissions; and a wide array of process-specific technologies	Construction services [54]	<ul style="list-style-type: none"> - General construction services of mines and industrial plants [5426] - Installation services [546]
		Other professional, technical and business services [83]	<ul style="list-style-type: none"> - Management consulting and management services; information technology services [831] - Engineering services for industrial and manufacturing projects [83322] - Surface surveying services [83421] - Composition and purity testing and analysis services [83441]
		Telecommunications, broadcasting and information supply services [84]	<ul style="list-style-type: none"> - Private network services [8414] - Data transmission services [8415] - Internet communication services [842] - On-line content [843]
Agriculture	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH ₄ emissions; improved nitrogen fertilizer application techniques to reduce N ₂ O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency	Other professional, technical and business services [83]	<ul style="list-style-type: none"> - Composition and purity testing and analysis services [83441]
		Support services to agriculture, hunting, forestry, fishing, mining and utilities [86]	<ul style="list-style-type: none"> - Other support services to crop production [86119]

Table 3: *Continued*

Sector	Key mitigation technologies and practices currently commercially available*	Corresponding Division in the CPC (ver.2)	Related services at UN CPC (ver.2) class and sub-class levels
Forestry/ Forests	Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use; Mechanized forest machines such as harvesters, processors and forwarders	Other professional, technical and business services [83]	- Support services to forestry and logging [86140] - Composition and purity testing and analysis services [83441]
		Sewage and waste collection, treatment and disposal and other environmental protection services [94]	- Other environmental protection services n.e.c.: forest and damage assessment & abatement services [94900]
Waste	Landfill CH4 recovery; waste incineration with energy recovery; composting of organic waste; controlled wastewater treatment; recycling and waste minimization	Construction services [54]	- General construction services of sewage and water treatment plants [54253]
		Other professional, technical and business services [83]	- Management consulting and management services; information technology services [831] - Engineering services for waste management projects (hazardous and non-hazardous) [83326] - Engineering services for water, sewerage and drainage [83327] - Surface surveying services [83421] - Composition and purity testing and analysis services [83441]
		Sewage and waste collection, treatment and disposal and other environmental protection services [94]	- Sewerage and sewage treatment services [9411] - Collection services of non-hazardous recyclable materials [9422] - Waste preparation, consolidation and storage services [9431] - Hazardous waste treatment and disposal services [9432] - Non-hazardous waste treatment and disposal services [9433] - Other environmental protection services n.e.c. [9490]

Source: Derived from the IPCC 4th report by author.

* Although IPCC report includes key mitigation technologies and practices projected to be commercialized before 2030, they are excluded from this table on purpose given that such technologies are unlikely to be subject to immediate trade liberalization. 'Research and experimental development services in natural sciences and engineering' [CPC 811] are largely related to mitigation technologies that are not yet commercialized. Hence, they are excluded from the scope of services in this study.

** Inclusion of other passenger transport as well as supporting transport services depends on the source and type of vehicles used.

5. TRADE IN SERVICES THAT ARE COMPLEMENTARY TO THE DIFFUSION OF KEY CLIMATE CHANGE MITIGATION TECHNOLOGIES

According to Table 3, ‘other professional technical and business services [83]’ and ‘construction services [54]’ are the two services categories (CPC group level) that appear the most frequently across all seven key sectors. ‘Telecommunication, broadcasting and information supply services [84]’ also appear in the energy supply, buildings, transport, and industry sectors. ‘Sewage and waste collection, treatment and disposal and other environmental protection services [94]’ are directly linked to the delivery of mitigation technologies in the waste sector, but also appeared in the energy supply and the forestry sector. ‘Passenger transport services

[64]’ and ‘supporting transport services [67]’ appear only in the transport sector; ‘Financial and related services [71]’ appear only in the energy supply sector; and ‘Support services to agriculture, hunting, forestry, fishing, mining and utilities [86]’ are only found in the agriculture sector.

In analyzing the major trading countries of the ‘complementary services of climate change mitigation technologies’ and their commitments on these services, this section focuses on three services categories (CPC group level) that most frequently cut across multiple mitigation sectors (Table 4).

Table 4. Three services categories that most frequently cut across multiple mitigation sectors

CPC (ver.2) Division	Services Category (CPC Group Level)	Key mitigation sectors
83	Other professional, technical and business services	Energy supply Transport Buildings Industry Agriculture Forestry/Forests Waste
	831-Management consulting	
	832-Architectural services and Advisory services	
	833-Engineering services	
	834-Scientific and other technical services	
54	Construction services	Energy supply Transport Buildings Industry Waste
	541-General construction services of buildings	
	542-General construction services of civil engineering works	
	543-Site preparation services	
	546-Installation services	
94	Sewage and waste collection treatment and disposal and other environmental protection services	Energy supply Forestry/Forests Waste
	941-Sewage, sewage treatment and septic tank cleaning services	
	942-Waste collection services	
	943-Waste treatment and disposal services	
	949-Other environmental protection services	

Source: Author

Given the data limitations on trade in services at sub-sectoral level, this paper uses data on major importers and exporters of services at the CPC group level, and

reviews their specific commitments on these services.¹⁵ Some trade barriers to services at the group level are also discussed in the following section.

5.1 Other Professional, Technical and Business Services

Among ‘other professional, technical and business services’, engineering services together with construction services are key to delivering effective public services such as wastewater treatment, transportationsystems, and electricity generation and transmission. Engineering services, which predominantly entail advisory, design, consulting, and project management functions, complement construction services. Therefore, many firms provide integrated packages of engineering and construction services together. As new channels of electronic supply are creating new business opportunities and the international sourcing of engineering services is becoming

increasingly common, developing country exports of engineering services are on the rise. (Cattaneo et al., 2010).

Emerging markets are expected to provide 14-20 percent of the industry’s estimated 1 trillion USD turnover in 2020 (Booz Allen Hamilton, 2006). While trade data on this group of services at the national level is hard to come by, some existing data reveals that countries such as those of India, Brazil, the Russian Federation, Singapore and the Republic of Korea are large exporters of ‘other professional, technical and business services’. As an importer, Kazakhstan appears to be a big player in this area, in addition to the afore-mentioned emerging markets (Table 5).

Table 5. Major exporters and importers of architectural, engineering and other technical services (millions USD)

Exporters	Value	Importers	Value
European Union (27)	39,212	European Union (27)	25,169
Extra-European Union (27) exports	22,657	Extra-European Union (27) exports	10,331
India	7,360	India	2,746
United States	5,020	Canada	2,560
Canada	4,066	Brazil	1,708
Brazil	3,033	Russian Federation*	1,616
Norway	2,144	Kazakhstan*	1,289
Russian Federation*	1,571	Singapore	977
Singapore	1,398	Norway	579
Australia	955	Korea, Rep.	531
Korea, Rep.	253	Australia	370

Source: Cattaneo et al. (2010) derived from WTO (2007).

Note: * Not a WTO Member

Most of the services included in this sector are provided in all four Modes (Box 1 on the next page), although the predominant Modes of

supply are through ‘commercial presence’ (Mode 3) and ‘movement of natural persons’ (Mode 4) followed by ‘cross-border trade’ (Mode 1).

Box 1. Four Modes of supply and examples of ‘other professional, technical and business services’ that are complementary to the diffusion of climate-mitigation technologies

According to the GATS, service suppliers are either natural or legal persons. The Modes of supply differ depending on the location of the service provider and the location of the service consumer. The GATS defines the four modes of supply in the trade in services as follows:

Cross-border supply (Mode 1):

Non-resident service suppliers deliver services cross-border into a client’s territory. For example, a Norwegian engineer sends a design sketch of a ‘capture-ready’ power plant to a client in Brazil via the Internet.

Consumption abroad (Mode 2):

Residents in Country A purchase services inside the territory of country B. For example, a US construction company established in Australia buys services from a local engineering firm.

Commercial presence (Mode 3):

Foreign suppliers of services establish, operate, or expand their commercial presence in a client’s territory, such as a branch, agency, or wholly owned subsidiary. For instance, a French architectural consulting firm opens an office in China to provide advisory services on building a smart energy efficient exhibition centre.

Movement of natural persons (Mode 4)

This involves the entry and temporary stay in a client’s territory of foreign individuals to supply a service. For example, an Indian renewable energy professionals travels to Bangladesh to provide after-sales services.

Source: Derived from Cattaneo, O. et al. (2010);

Overall, a review of the sectoral commitments made by nine key exporters and importers¹⁶ (see Table 5) during the Uruguay Round in this area shows that although all nine countries have scheduled commitments in this sector,¹⁷ only Australia has made full commitments across all sub-sectors. Seven out of nine countries have excluded ‘services incidental to energy distribution’

from their commitments schedules.¹⁸ Brazil, the EU, India and Singapore have also excluded ‘related scientific and technical consulting services’ from their commitments schedules. Several countries have also not made any commitment on ‘integrated engineering services’ and ‘technical testing and analysis services’ (Table 6).

Table 6. Sectoral commitments on other professional, technical and business services¹⁹

Major Exporters/ Importers	Architectural services	Engineering services	Integrated engineering services	Other business services;				m. Related scientific and technical consulting services
				c. Management consulting services	e. Technical testing and analysis services	j. Services incidental to energy distribution		
Australia (E/I)*	J	J	J	J	J	J	J	J
Brazil (E/I)	O	O	X	J	X	X	X	X
Canada (E/I)	O	O	O	O	J	X	O	O
EU ** (E/I)	O	O	O	O	O	X [O]	X	X
India (E/I)	X	O	X	X	O	X	X	X
Korea, Rep. (E/I)	O	J	J	J	O	X	J	J
Norway (E/I)	J	J	J	J	J	X	J	J
Singapore (E/I)	J	O	X	X	X	X	X	X
United States (E/I)	O	O	O	O	X	J	J	J

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

Note: J =Unrestricted commitment, x=No commitment, O=Limited commitment

[J]= A new commitment included in the EU's 'revised offer' during the Doha Round.

* E/I=Major exporters as well as major importers

** Among the EC member states, Cyprus and Malta have not made any commitment on "other professional, technical and business services" group.

Most of the major exporting and importing countries have scheduled commitments in all four Modes, except for India and Brazil, which have both left Mode 1 and 2 largely unbound. Several EU member states have also left Mode 1 across all sub-sectors largely unbound; that number has recently increased, according to the revised offer that the EU submitted to the WTO (Table 7). The importance of cross-border supply in this area is growing, however, as mass communications systems (e.g. fax, post,

internet) are being increasingly used for the transmission of architectural and engineering specifications, design plans for environmental projects, reports of specialist environmental consultants, environmental quality testing and analysis results, and computer modeling simulations. Among the key countries in this sector, Canada has made limited commitments on Mode 1 in almost all sub-sectors by requiring a commercial presence and residency for accreditation from certain service providers.²⁰

Table 7. Market access and national treatment limitations on Mode 1: other professional, technical and business services

Major Exporters/ Importers	Sub-sectors	Limitation
Market Access		
Canada	Architectural services	[Citizenship requirement for accreditation (architects)]
	Engineering/ Integrated engineering services	Requirement of a commercial presence for accreditation (Engineers): [Requirement of a commercial presence for accreditation (consulting engineers)] Requirement of permanent residency for accreditation (engineers); [Citizenship requirement for accreditation (engineers)]
	Other business services: c. Management consulting services	Permanent residency requirement for accreditation (Agrologists): [Citizenship requirement for accreditation (Professional administrators and certified management consultants or Professional corporation of administrators); Citizenship requirement for use of title (Industrial Relations Counselors)]
	Other business services: m. Related scientific and technical consulting services	Requirement of permanent residency and citizenship (Free miner); Requirement for a commercial presence, Permanent residency and citizenship for accreditation (Canadian corporation or a partnership of the foregoing Land surveyors); Citizenship requirement for accreditation (Subsurface surveying services, Professional technologist, Chemists)
EU	Architectural services	BE, [GR] CY, EL, IT, MT, PT, PL, SI: Unbound
	Engineering services	[GR] , CY, EL, IT, MT, PT: Unbound
	Integrated engineering services	CY, EL, IT, MT, PT, PL [GR] : Unbound.
	Other business services: e. Technical testing and analysis services	IT: Unbound for the profession of biologist and chemical analyst. CY, CZ, MT, PL, SK, SE: Unbound
	Other business services: j. Services incidental to energy distribution	All Member States except HU, LV, LT, SI; Unbound (HU, LV, LT, SI: Unbound)

Table 7. Continued

Major Exporters/ Importers	Sub-sectors	Limitation
Korea	Architectural services	Requirement of commercial presence; Acquirement of Korean architectural license by passing an examination; Supply of services by foreign architects through joint contracts with architects licensed in Korea
National Treatment		
Canada	Architectural services	Residency requirement for accreditation (Architects; Landscape architects)
	Engineering services	Engineers: Residency requirement for accreditation (Engineers)
	Other business services: m. Related scientific and technical consulting services	Differential tax measures (Federal and sub-national) treatment for expenditures of services performed in Canada related to the exploration and development of a mineral resource, petroleum or natural gas (Mineral and Petroleum Exploration and Development); Residency requirement for accreditation (Applied Science Technologist/ Technician); Residency requirement for accreditation (Cadastral surveying); Residency requirement for accreditation (Geoscientists, Land Surveyors; Requirement of training for accreditation (Land surveyors)
EU	Architectural services	DE (Application of the national rules on fees and emoluments for all services which are performed from abroad); BE, [GR] , CY, EL, IT, MT, PT, PL: Unbound
	Engineering services	AT, SI for pure planning services; [GR], CY, EL, IT, MT, PT: Unbound
	Integrated engineering services	AT, SI: for pure planning services; CY, EL, IT, MT, PT, PL [GR]: Unbound.
	Other business services: e. Technical testing and analysis services	IT: Unbound for the profession of biologist and chemical analyst; CY, CZ, MT, PL, SK, SE: Unbound
	Other business services: j. Services incidental to energy distribution	All Member States except HU, LV, LT, SI: Unbound

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

Note: Bold=Added in the revised offer submitted to the WTO (As of April 2011).

[Bold]=Removed from the revised offer submitted to the WTO (As of April 2011).

EU Member States: AT (Austria), BE (Belgium), CY (Cyprus), CZ (Czech Republic), DE (Denmark), EE (Estonia), EL (Greece), ES (Spain), FI (Finland), FR (France), HU (Hungary), IE (Ireland), IT (Italy), LT (Latvia), LV (Lithuania), LU (Luxembourg), MT (Malta), NL (Netherlands), PL (Poland), PT (Portugal), SE (Sweden), SI (Slovenia), SK (Slovak Republic), UK (United Kingdom).

Six out of nine countries scheduled their commitments on 'engineering services' with market access limitations largely on Mode 3. The majority of market access limitations in 'architectural services' were also on Mode 3. Specific limitations on Mode 3 that restrict market access are summarized in Table 8. For instance, Brazil and Canada restrict foreign architectural services suppliers from forming legal entities by specifying that the suppliers must 'join Brazilian service suppliers in a specific type of legal entity' and must 'take the form of a sole proprietorship or partnership'. India allows market access of foreign engineering services suppliers only through 'incorporation with a foreign equity ceiling of 51 percent'. Korea requires an 'economic needs test' for the establishment of a commercial presence.

Canada has made a specific limitation on national treatment, requiring non-resident firms to have both a 'higher percentage of practitioners in a partnership' in architectural services and 'residency and training for accreditation of certain service providers' in 'related scientific and technical consulting services' (e.g. Cadastral surveying, geoscientists and land surveyors). Some EU member states in their revised offer - in particular Estonia - have added their limitations on the national treatment in most of the sub-sectors by requiring residency of 'at least one responsible person'.²² The majority of EU member states have still left 'services incidental to energy distribution' unbound, while only a few member states have left 'technical testing and analysis services' unbound (Table 8).

Table 8. Market access and national treatment limitations on Mode 3: Other professional, technical and business services

Major Exporters/ Importers	Sub-sectors	Limitation
Market Access		
Brazil (E/I)	Architectural services	Foreign service suppliers must join Brazilian service suppliers in a specific type of legal entity (consórcio); the Brazilian partner shall maintain the leadership. The contract establishing the consórcio must clearly define its objective
	Engineering services	Same conditions as in Architectural services
Canada (E/I)	Architectural services	Commercial presence of architects must take the form of a sole proprietorship or partnership
	Other business services: m. related scientific and technical consulting services	Permanent residency and citizenship requirement for a commercial presence for accreditation of subsurface surveying Services, Professional Technologist and Chemists

Table 8. *Continued*

Major Exporters/ Importers	Sub-sectors	Limitation
EU (E/I)	Architectural services	Restrictions on access of certain natural persons (ES: Access is restricted to natural persons. FR: Provision through SEL (anonyme, à responsabilité limitée ou en commandite par actions) or SCP only. IT, PT: Access is restricted to natural persons. Professional associations. (no incorporation) among natural persons permitted. LV: Practice of 3 years in Latvia in the field of projecting and university degree required to receive the licence enabling to engage in business activity with full range of legal responsibility and rights to sign a project
	Engineering services	ES: Access is restricted to natural persons. IT, PT: Access is restricted to natural persons. Professional association (no incorporation) among natural persons permitted.
	Integrated engineering services	ES: Access is restricted to natural persons. IT, PT: Access is restricted to natural persons. Professional association (no incorporation) among natural persons permitted.
	Other business services: e. technical testing and analysis services	ES: Access for chemical analysis through natural persons only. IT: Access for the profession of biologist and chemical analyst through natural persons only. Professional association (no incorporation) among natural persons is permitted. PT: Access for the profession of biologist and chemical analyst through natural persons only. CY, CZ, MT, PL, SK, SE: Unbound
	Other business services: j. Services incidental to energy distribution	All Member States except HU, LV, LT, SI: Unbound (HU, LV, LT, SI: None)
	Other business services: m. Related scientific and technical consulting services	All Member States except ES, FR, IT, PT: None: ES: Access to profession of surveyors and geologists through natural persons only. FR: "Surveying": Access through a SEL (anonyme, à responsabilité limitée ou en commandite par actions), SCP, SA and SARL only. IT: For certain exploration services activities related to mining (minerals, oil, gas, etc.), exclusive rights may exist. IT: Access to profession of surveyors and geologists through natural persons only. Professional association (no incorporation) among natural persons permitted. PT: Access restricted to natural persons.
India (E/I)	Engineering services	Only through incorporation with a foreign equity ceiling of 51 per cent
	Other business services: e. technical testing and analysis services	Only through incorporation with a foreign equity ceiling of 51 per cent

Table 8. *Continued*

Major Exporters/ Importers	Sub-sectors	Limitation
Korea, Rep. (E/I)	Other business services: e. (Composition and purity testing and analysis services)	Requirement of economic needs test for the establishment of a commercial presence Main criteria: the number of and impact of existing domestic suppliers, protection of public health, safety and environment*
Singapore (E/I)	Engineering services	Limited Corporations - Only registered Professional Engineers or allied professionals (registered Architects or Land Surveyors) shall be director of the corporations
United States (E/I)	Architectural services	Two-thirds of the officers, partners, and/or directors of an architectural firm in Michigan must be licenced in Michigan as architects, professional engineers and/ or land surveyors
National Treatment		
Canada (E/I)	Architectural services	Non-resident firms are required to maintain a higher percentage of practitioners in a partnership
	Other business services: m. related scientific and technical consulting services	Residency and training requirement for accreditation of cadastral surveying, geoscientists, land surveyors
EU	Architectural services	EE: None except that at least one responsible person (project manager or consultant) must be resident of Estonia
	Engineering services	EE: None except that at least one responsible person (project manager or consultant) must be resident of Estonia
	Integrated engineering services	EE: None except that at least one responsible person (project manager or consultant) must be resident of Estonia
	Other business services: e. technical testing and analysis services	All Member States except CY, CZ, MT, PL, SE, SK: None (CY, CZ, MT, PL, SE, SK: Unbound)
	Other business services: j. Services incidental to energy distribution	All Member States except HU, LV, LT, SI: Unbound (HU, LV, LT, SI: None)
	Other business services: m. Related scientific and technical consulting services	All Member States except EE, FR: None: EE: None except that at least one responsible person (project manager or consultant) must be resident of Estonia. FR: "Exploration and prospection services" subject to authorization.

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

Note: Bold=Addition from the revised initial offer submitted to the WTO (As of April 2011).

E/I=Major exporter as well as importers.

While most of the major trading countries have left Mode 4 unbound, except as indicated in the horizontal commitments, these nine countries have horizontal limitations on Mode 4, predominantly concerning 'restrictions on entry and temporary stay of various services providers', including 'intra-corporate transferees', 'contractual service suppliers', 'business visitors', 'services salespersons', and 'independent professionals'. Other limitations, although fewer than those previously mentioned, include 'limited recognition of diplomas in third-countries required to practice regulated professional services'; 'restrictions on foreign nationals' or foreign companies' acquisition of land and real-estate'; 'restrictions of foreign service providers on public monopolies'; and 'limited eligibility of foreign nationals for subsidies including tax benefits'.²³

A few countries have put specific limitations on Mode 4. Canada, for instance, restricts market access by requiring 'permanent residency and citizenship for accreditation of certain types of services suppliers (e.g. agrologists, free miners and land surveyors)'.²⁴ Several EU member states have also put specific limitations on market access concerning 'academic and professional qualification requirements and membership requirements of the relevant professional body in the home country for certain service providers'.²⁵

Canada has also placed limitations on national treatment, requiring residency for accreditation of landscape architects and other relevant service providers 'related to scientific and technical consulting services'. A few EU member states also have limitations on the national treatment, such as a 'residency requirement' for certain service providers in architectural and other business services. In the case of engineering and integrated engineering services, almost all member states require 'residency' for certain types of service providers.

In the case of engineering services, trade barriers are not limited to the issues of market access and national treatment (Cattaneo et al., 2010). Trade opportunities for engineering firms largely hinge on a variety of laws, regulations,

and administrative rules at home and abroad that could have a substantial impact on the firms' financial options and operation. Their trade performance in the global market also depends on the quality of the services, including professional, process, and product standards. For instance, national or sub-federal rules that limit engineering firms' legal entity or joint venture structure, e.g. arbitrary equity limitations, could create trade barriers for engineering firms by reducing their financing options.

The engineering industry with a three to four percent profit margin requires a high demand for competitive financing typically through credit extension (Tulacz, 2008). However, limited access to finance in many developing countries often puts engineering firms at a competitive disadvantage. In addition, double taxation, excessive capital controls, and limits on foreign equity put financial limitations on engineering firms. Limited credit extension based on their physical assets rather than a series of variables, such as forward contracts, intellectual property, and probable returns on investment also imposes financial limitations on engineering firms. Tunisia, for instance, limits credit to five percent of the engineering firm's output, while ten percent of the output is allowed for credit in other sectors such as tourism and manufacturing (World Bank, 2007b).

Rules concerning public procurement also affect trade in engineering services.²⁶ For instance, distorted administrative practices, such as a lack of publicly available information about project requirements and the bidding process, hamper the integrity and transparency of the procurement process, thereby negatively affecting engineering firms' performance. The WTO Government Procurement Agreement (GPA) prohibits the use of measures discriminating against foreign providers and addresses various aspects of procurement procedures, including 'criteria for the qualification of suppliers and technical specifications of products and services; tendering procedures; and the provisions for transparency'.

Rules governing the nationality and residency requirements for service providers, as well as

their qualification and recognition procedures, could also influence trade in services in this area. While professional qualification requirements are fundamental drivers in the service industry, arduous qualification requirements and licensing

procedures could hamper the delivery of services (Cattaneo et al., 2010). Excessively restrictive visa fees or unpredictable and time-consuming work permit procedures could also create trade barriers to services in this area.

Box 2. Examples of trade barriers related to border measures in the ‘other professional, technical and business services’

Most renewable energy power plants require monitoring services. The manufacturers of energy efficient technologies such as the Combined Heat and Power (CHP) system or the District Heating and Cooling (DHC) system are also required to provide after-sales services. An empirical study shows that border measures (*i.e.* visa requirements) for service providers are frequently raised as barriers to delivering the least cost and fastest services in this

Source: Steenblik and Kim (2008).

5.2 Construction Services

As shown in Tables 3 and 4, construction services are involved with implementing various mitigation options across multiple sectors, including energy supply, transport, buildings, industry, and waste. The construction services sector is one of the major service sectors in most economies in terms of employment and value added. In 2005, global spending on construction has exceeded four trillion USD, representing nine to ten percent of world gross domestic product (GDP) (Tulacz, 2005). The most important driver for the development of services in this sector, particularly in the developed world, is increased spending on infrastructure and non-residential development (Butkeviciene, 2005).

With transportation (25.6 percent), building (23.8 percent) and petroleum extraction (25.8 percent) making up three-fourths of the global construction market in 2008 (ENR, 2008), the public sector is clearly the largest client segment for the construction sector. In many developing countries, almost 50 percent of construction expenditures are through government procurement (Mburu, 2008).²⁷

While many developing countries largely remain importers of construction services, several emerging economies as well as economies in transition, are quickly becoming successful exporters of these services. The EU, Japan, and the United States, appear to be major exporters in this sector, followed by countries such as China and the Russian Federation (Table 9).

Table 9. Major exporters and importers of construction services (million USD)

Exporters	Value	Importers	Value
European Union (25)	26,142	European Union (25)	18,743
Extra-European Union		Extra-European Union (25)	7,957
(25) exports	14,171	imports	4,765
Japan	7,224	Japan	4,034
United States	4,139	Russian-Federation*	1,941
China	2,593	Kazakhstan*	1,619
Russian Federation*	2,209	China	1,499
Turkey	882	Azerbaijan*	1,323
India (estimated)	828	Angola	1,087
Malaysia	811	Malaysia	1,039
Singapore	566	United States	774
Egypt, Arab Rep.	503	India (estimated)	

Source: Engman (2010) derived from WTO (2008)

Note: * Not WTO Members yet.

European Union (25)=member states of the European Union before January 2007: Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom.

The construction sector is characterized by a limited number of large international companies and a large number of local small- and medium-sized companies. In 2007, 310 billion USD out of 827 billion USD revenues generated by the top 225 international contractors represented exports (ENR, 2008). Fifty-one out of the 225 companies were Chinese, and 23 were Turkish. Other countries, such as Brazil, China Egypt, India, Israel, Kuwait, Lebanon, the former Yugoslav Republic of Macedonia, Mexico, Pakistan, the Russian Federation, Saudi Arabia, Serbia, Taiwan, and the United Arab Emirates have between one and three companies on the top 225 list (Engman, 2010).

Table 10 summarizes the sectoral commitments made by the major exporting and importing countries of construction services during the Uruguay Round.²⁸ A review of these sectoral commitments reveals that, excluding three non-WTO Members (Azerbaijan, Kazakhstan, and the Russian Federation), all nine countries in Table 10 have scheduled commitments in this sector,²⁹ but none of them have made full commitments. India has excluded several sub-sectors from their commitments and Egypt and Turkey have also made no commitments in one of the sub-sectors. Countries that have made commitments in this sector have placed limitations across all sub-sectors.

Table 10. Sectoral commitments on construction services

Major exporters/ importers	General construction work for buildings	General construction work for civil engineering	Installation and assembly work	Other: site investigation work
China (E/I)	O	O	O	O
EU** (E/I)	O	O	O	O
Egypt, Arab Rep. (E)	X	O	O	O
India (E/I)	X	O	X	X
Japan (E/I)	O	O	O	O
Malaysia (E/I)	O	O	O	O
Singapore (E)	O	O	O	O
Turkey (E)	O	O	O	X
United States (E/I)	O	O	O	O

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

Note: X=No commitment, O=Limited commitment

E/I=Major exporter as well as importer

* Among the new EU member states, Cyprus, Hungary and Malta have not submitted their commitments schedules on the construction services sector. Finland has made a partial commitment on this sector.

Being highly intensive in both labour and materials, construction projects require local production. Such local characteristics of the construction business imply that 'commercial presence' (Mode 3) is the preferred Mode of supply, which is complemented by 'temporary movement of natural persons' (Mode 4).

In general, restrictions on commercial presence are the most common barriers to trade in the construction service sector. Limitations on market access take the form of restrictions on foreign investment (e.g. ownership rules); the type of legal entity for a foreign company (e.g. mandatory local incorporation); the number

of suppliers; and the value of transactions or assets. Restrictions on national treatment in Mode 3 include registration and authorization requirements; performance and technology transfer requirements; licensing, standards and qualification; and nationality and residency requirements (WTO, 1998).

Limitations on the temporary movement of natural persons, which are often included in labour market regulations, could impede trade in construction services, given construction's intensive use of labour. These restrictions take different forms, ranging from 'bans and quotas' to 'economic needs

tests' and 'residency requirements'. Such restrictions could result in project delays, increasing operating costs and making project execution unpredictable. The significance of Mode 4 in the construction sector, however, depends largely on the entry strategy used, as the entry strategy of construction firms varies depending on the duration of projects (Gelosso Gross et al., 2008). The pattern that has been evolving since 1990 seems to be one of market establishments aiming at a more permanent presence. Empirical evidence shows, however, that contractors facing high entry restrictions in the host market tend to resort to short-term rather than permanent entry (Chen, 2008).

Differential treatment of subsidies, along with other incentive schemes that are often provided for export promotions, could also have a discriminatory effect on trade in construction services. Restrictions on the movement of capital equipment and building materials could negatively affect trade in construction services, as they may give rise to

unnecessary costs for imports of construction machinery (Gelosso Gross et al., 2008).

A review of specific commitments and limitations by the major exporting and importing countries in this area reveals that, with the exception of Singapore and Turkey, all countries have left Mode 1 unbound. While Singapore has made full commitments in Mode 1, Turkey has placed extensive limitations on Mode 1 in both market access and national treatment.³⁰

The majority of the limitations concerns market access on Mode 3 (Table 11). While Egypt, India, and Malaysia restrict the formation of legal entity and foreign capital equity, China restricts the types of construction projects that foreign-owned enterprises can carry out. The EU excludes rights for construction, maintenance and management of highways and airports in certain member states. China has also made a specific limitation in national treatment, lowering registered capital requirements for joint venture construction enterprises.

Table 11. Market access and national treatment limitations on Mode 3: construction services

Major exporters/ Importers	Limitations
Market Access	
China	Restrictions on the types of construction projects by foreign-owned enterprises* (1. Construction projects wholly financed by foreign investment and/or grants. 2. Construction projects financed by loans of international financial institutions and awarded through international tendering according to the terms of loans. 3. Chinese-foreign jointly constructed projects with foreign investment equal to or more than 50 per cent; and Chinese-foreign jointly constructed projects with foreign investment less than 50 per cent but technically difficult to be implemented by Chinese construction enterprises alone 4. Chinese invested construction projects which are difficult to be implemented by Chinese construction enterprises alone can be jointly undertaken by Chinese and foreign construction enterprises with the approval of provincial government)
EU	Exclusive rights granted for construction, maintenance and management of highways and the airport in a few member states; Nationality condition for managers of the board of directors of construction companies supplying in the public sector.
Egypt, Arab Rep.	Restrictions on the formation of legal entity (only through joint venture); Restrictions on foreign capital equity (ceiling of 49 per cent of the total capital required for the project)
India	Restrictions on the formation of legal entity (Only through incorporation); Restrictions on foreign equity (ceiling of 51 per cent)

Table 11. *Continued*

Major exporters/ Importers	Limitations
Malaysia	Restrictions on the formation of legal entity (only through a representative office, regional office, or locally incorporated joint-venture corporation with Malaysian individuals or Malaysian-controlled corporations or both): Restrictions on foreign shareholding in the joint-venture (ceiling of 30 per cent)
Turkey	Approval requirement of establishing ordinary partnership under Civil Code (which is not a legal entity) excluding the ordinary partnership formed for international tenders in Turkey by the non-residents by the Ministry to which the Undersecretariat of Treasury [and Foreign Trade (UTFT)] is attached.
National Treatment	
China	Differential treatment of registered capital requirements for joint venture construction enterprises: Joint venture construction enterprises have the obligation to undertake foreign-invested construction projects.**

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

* Restrictions on the formation of legal entity existed until 2004, which needs to be verified (e.g. Only in the form of joint ventures, with foreign majority ownership). Within three years after China's accession to the WTO, wholly foreign-owned enterprises will be permitted should be 'had been permitted).

** This obligation doesn't apply once within three years after China's accession to the WTO.

The major importing and exporting countries in this sector have also chosen to keep Mode 4 unbound and rely on their horizontal commitments to provide access. A review of horizontal commitments made by these countries shows that almost all countries have put horizontal market access limitations on Mode 4 by restricting the entry or temporary stay of service providers (e.g. intra-corporate transferees, contractual service suppliers, business negotiators and independent professionals). In terms of national treatment limitations, frequently there is limited eligibility of foreign nationals for subsidies, including tax benefits; limited recognition of services providers' qualifications from third-countries; and restrictions on foreign nationals' acquisition of land and real estate. Restrictions on land and real estate use or ownership, among others, could have a significant impact on the provision of construction services, as these restrictions prevent property developers from acquiring real estate under construction until the completion of the project (Geloso Gross et al., 2008).

Many types of domestic regulatory measures could affect trade in construction services if these measures are discriminatory or unnecessarily burdensome. For instance, building regulations and associated technical requirements, as well as regular inspection requirements for safety, are related to the provision of construction services. Rules on the temporary admission of construction equipment could also hinder the market entry of foreign companies (Geloso Grosso et al., 2008).

Regulations concerning the administration of construction permits could also affect trade in construction services. According to Engman (2010), administrative performance of construction permits tends to vary across countries in terms of the construction's duration, procedure, and cost (Box 3). Opaque, expensive, and bureaucratic administrative processes of construction permits increase transaction costs and business risks, resulting in lower investment in new infrastructure and buildings.

Box 3. Discrepancy in administrative performance of construction permits in terms of its duration, procedure and cost

China and the Russian Federation appear to have relatively expensive and bureaucratic processes. In order to get a construction permit in the Russian-Federation, it takes, on average, 23 months to go through 54 procedures-the worst record among all the exporting markets- and cost 2,600 percent of Russian income per capita. In China, constructors must wait 11 months to go through 37 procedures at a cost of 700 percent of income per capita. The Indian administration is more rapid (224 days), but more expensive.

Source: Derived from Engman (2010)

Government procurement practices are also crucial to trade in construction services, given that the large client segment is the public sector. In Germany and the UK, for instance, government procurement accounts for around 35 percent of the share of construction activity and this number is almost 50 percent in the US (Geloso Grosso et al., 2009).

Preferential treatment for local companies or minimum requirements for financial support that are favourable to local companies often hinder market entry for foreign providers, creating trade barriers. Excessively strict standards applied to government procurement also tend to exclude many of the small- and medium-sized enterprises from developing countries (Tulacz, G.J., 2000). Some foreign companies have experienced difficulty in entering the US market, as they are required to register and be licensed in each individual state, often with strict liability implications on equipment failure (Teljeur and Stern, 2002).

5.3 Sewage and Waste Collection Treatment and Disposal and Other Environmental Protection Services³¹

Services in this sub-sector also appear to be directly linked to the diffusion of climate change mitigation technologies in several other sectors, such as energy supply, forestry, and waste (see Tables 3 and 4). While trade data that precisely corresponds to this sub-sector is scarce, the existing data covers the following sub-sectors, which according to W/120 or Provisional CPC classification constitute the 'environmental services' sector: sewage service (9401), refuse disposal services (9402), sanitation and similar services (9403), and other services (9409).

The global services market covering this sector has increased rapidly. The value of the environmental services sector was approximately 270 billion USD in 2000 (Zarrilli, 2003) and grew continuously, reaching 640 billion USD in 2010.³² In 2002, solid waste management and wastewater treatment services accounted for 141 billion USD and 80 billion USD respectively (Geloso Grosso, 2004).

The structure of the environmental services industry varies across its sub-sectors. A few large firms dominate infrastructure services, such as sewage, water, and wastewater treatment services, as these require large-scale investment. On the other hand, small- and medium-scale operations provide analytical services and consulting services. The global market reflects this industry structure: most of the large multinational corporations are based in the US, the EU, and Japan; and the market value of these three regions accounts for 81 percent of the world market value in 2007 (Qutub, 2004).

While developing economies are catching up fast, the market in developing countries is largely comprised of small- and medium-sized enterprises (APEC, 2010). In 2006, developing countries' share of total environmental revenues generated, including that of economies in transition, was only 14 percent, though high rates of growth are expected in developing countries in such areas as water and wastewater treatment, waste management, air pollution control, and environmental monitoring and instrumentation (Dihel, 2010).

Developing countries' export potentials lie in professional and other support services. such

as engineering, testing and analysis, research and development and specialized consultancy. (Gelosso Grosso, 2007). A United Nations Conference on Trade and Development (UNCTAD) study also shows that a number of Asian and Latin American companies are increasingly acquiring environmental technological and service capacities through joint ventures in their home countries, increasing the participation of developing countries in infrastructure and non-infrastructure environmental services (UNCTAD, 2003).

The precise trade volume of environmental services is difficult to approximate, given data limitations. The only data currently available comes in the form of rough estimates for the environmental industry that include both goods and services. The existing data reveals that 90 percent of total exports in this area in 2002 were from the EU, the United States, and Japan (Table 12). They are followed by Australia, New Zealand, and Canada, although they do not account for a large share of the global market (Gelosso Gross, 2005).

Table 12. Major exporters of the environmental industry in 2002³³

Exporters	Value (USD billions)
European Union (27)	36
United States	22
Japan	16
Australia/NZ	1.7
Canada	1.6

Source: *Environmental Business International*, cited in *Gelosso Grosso (2005)*.

The principal Mode of supply for environmental services is 'commercial presence' (Mode 3) complemented by 'the movement of natural persons' (Mode 4). These two Modes of supply are particularly relevant for the delivery of infrastructure services, such as sewage and waste treatment. Cross-border supply (Mode 1) is also increasingly being used for such environmental support services as information technology-enabled services. The physical presence of service providers is still required, however, to deliver a significant segment of sewage treatment and waste management services (Mitchell and Rae, 2009).

A review of sectoral commitments made by the major trading countries in the environmental services sector reveals that all key exporting countries have scheduled commitments in this sector, with the exception of New Zealand (Table 13).³⁴ Canada and Chinese Taipei have made full commitments across sub-sectors. Initially, Australia excluded all three sub-sectors under 'other environmental services' during the Uruguay Round, but offered full commitments in these sub-sectors during the Doha Round.

Table 13. Sectoral commitments on environmental services excluding sanitation and similar services³⁵

Major Exporters	Sewage services	Refuse disposal services	Other		
			Cleaning services of exhaust gases	Nature and landscape protection services	Other environmental services
Australia	✓	✓	X [✓]	X [✓]	X [✓]
Canada	✓	✓	✓	✓	✓
China	0	0	0	0	0
Chinese Taipei	✓	✓	✓	✓	✓
EU*	0	0	0	0	0
Japan	✓	0	✓	✓	✓
Korea, Rep.	0	0	0	0	0
New Zealand**	0	0	0	0	0
United States	0	0	✓	✓	✓

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

Note: ✓=Unrestricted commitment, X=No commitment, 0=Limited commitment

* Among the EU member states, Cyprus and Malta have not made any commitment on this services sector.

** Based on New Zealand's revised offer during the Doha Round.

[✓]=New commitments included in the revised offer during the Doha Round.

Some of the major exporting countries have specified services that are excluded from their commitments. The EU, for instance, completely excluded public service functions, whether owned and operated or contracted out by local, regional, or central governments, from their environmental services commitments. Korea appears to have carefully carved out any related non-infrastructure environmental services, as well as support services, by specifying its sewage services commitments as 'collection and treatment of industrial waste waters only'. Similarly, Korea also specifies its refuse disposal services commitments as 'collection, transport and disposal services of industrial refuse only'. The US also limits its sewage and refuses disposal services commitments to services contracted only by private industry (Michelle and Rae, 2009).

During the ongoing Doha Round negotiations, Australia added an exemption across all sub-sectors by excluding the 'provision of water for human use, including water collection,

purification and distribution through mains'. New Zealand has, for the first time, made commitments across all sub-sectors, but limited them to only 'consultancy related to the provision of environmental services'. Chinese Taipei has also limited its commitments in the 'nature and landscape protection services' to 'consulting services incidental to remediation and clean up of soil and water and nature and landscape'.

Across sub-sectors, most limitations were on 'commercial presence'. Initially, Korea put an absolute limit on the number of suppliers allowed in the sewage services sector and required an 'economic needs test' for refuse disposal services and environment testing and assessment services. Japan also put a limit on the number of licenses conferred to service suppliers of refuse disposal. In their revised offers, however, both Korea and Japan removed these restrictions. China, on the other hand, maintained its requirements that foreign service suppliers operate as a joint venture (Table 14).

Table 14. Market access limitations on Mode 3: environmental services

Major exporters	Sub-sector	Limitations
China	All	Restrictions on the formation of foreign services suppliers (e.g. joint venture requirement)
Korea	Sewage services	[Limitations on the number of suppliers (e.g. Maximum of 25 service suppliers)]
	Refuse disposal services	[Requirement of economic needs test. Approval requirement of refuse collection and transport services operation within the jurisdiction of the respective regional environmental office]
	Environment testing and assessment services	[Requirements of economic needs test]
Japan	Refuse disposal services	[Limitations on the number of licenses conferred to service suppliers of waste oil disposal at sea from vessels]

Source: Derived from the WTO Services Data base on Members' Commitments Schedule and Initial Offers as well as Revised Offers (TN/S/O and TN/S/O rev.1).

Note: [Bold] = limitations that were removed in the revised initial offers submitted by the corresponding countries to the WTO (As of April 2011).

Initially, with the exception of the US, all eight countries left Mode 1 and Mode 4 unbound, with Mode 4 to abide by their horizontal commitments. China left Mode 1 unbound except for environmental consultation services. In their initial offers however, the majority of countries have removed their limitations on Mode 1, except for the EU and China. A few EU member states excluded 'advisory services' from their commitments on Mode 1.

Given that the provision of sewage services and refuse disposal is capital intensive, restrictions on commercial presence such as limits on foreign ownership of specific assets (e.g. landfills, sewage systems), requirements to incorporate locally and the application of economic needs tests could create significant trade barriers in these sub-sectors.

An Asia-Pacific Economic Co-operation (APEC) study reveals that restrictions on Mode 3 for environmental services tend to differ between developed and developing countries.

Most developed countries require professional qualifications; however, a lack of mutual recognition of such qualifications appears to create trade barriers. In addition, nationality and/or residency are required for the establishment of foreign companies providing professional services such as architecture and/or engineering. In the US, professional certifications are required for employees in this sector, forcing foreign suppliers of cross-border environmental services to hire state-certified personnel and resulting in higher management and operational costs (APEC, 2010).

On the other hand, most developing countries in the APEC region appear to impose equity limitations, limiting financial options for the suppliers of environmental services (Box 4). The participation takes the form of using local professional manpower, transferring know-how and technology to local professional manpower for sewage, refuse disposal and sanitation services (APEC, 2010).

Box 4. Examples of trade barriers related to Mode 3 in the waste water management sector

A Korean firm in the waste water management sector reported that, despite the fact that the company has a local branch in China, any contract with the private sector should be done through a local Chinese company. The payments can be made only through the importing company, which prolongs the time of receiving the payment.

An Indian firm operating in the waste water management sector reported that small foreign firms are often denied tax breaks in importing markets, while these tax breaks are available for domestic producers. This situation was seen predominantly in Middle Eastern markets.

Source: Fleiss and Kim (2008).

Restrictions on temporary presence or cross-border movement of professionals (e.g. environmental engineers, consultants, and auditors) due to their qualifications or more specialized licensing requirements could equally create significant trade barriers in this area (Qutub, 2004).³⁶ In addition, restrictions on work permits and visa requirements could negatively affect trade in environmental services. Some APEC member countries have work permits and visa quotas to limit foreign services providers (APEC, 2010).

Since a large part of environmental services concerns infrastructure services such as sewage, water and wastewater treatment, regulations concerning government procurement also

appear to be important to trade in these services. An empirical study has identified the following prohibitive trade barriers concerning the regulation of government procurement that some of the key exporting companies of environmental goods and associated services have encountered: a 'non-transparent decision making process or arbitrary enforcement of requirements'; 'a lack of timely information about tender requirements'; 'preferential treatment of domestic producers'; 'frequent change of local contents provisions (e.g. use of local labour, inputs, R&D required) that results in unexpected costs for foreign providers'; 'lack of independent appeals procedures'; and 'non-compliance with decisions made by the arbitration authority' (Fleiss and Kim, 2008).

Box 5. Example of government procurement related trade barriers in the water and waste water treatment sector

A Japanese exporter of water treatment/solid waste treatment plants was requested by the Malaysian government to raise local contents from the initially agreed 20 percent to 60 percent. This request was made in the middle of the project implementation, and the exporter was told by the Malaysian government that if the local contents were not raised to 60 percent, the government would cancel the contract. In order not to lose their government contract, the Japanese firm decided to comply.

Source: Fleiss and Kim (2008)

6. KEY FINDINGS

As examined in this study, complementary services of climate change mitigation technologies largely concern the following CPC groups: ‘other professional, technical and business services’; ‘construction services’; and ‘sewage and waste collection treatment and disposal and other environmental protection services’.

The predominant Modes of supply for are Mode 3 and Mode 4, since providing services to construct and engineer power production projects, energy efficient buildings, or industrial plants and wastewater treatment plants requires the establishment of a commercial presence. The provision of such services also needs to be complemented by a range of relevant professional, technical, and business services, which are supplied by a temporary movement of qualified service providers.

The provision of services through Mode 1 is also increasing thanks to new channels of electronic supply, particularly in ‘other professional, technical and business services’ and in ‘environmental services’ sectors. Therefore, WTO Members’ commitments on Mode 1 across all three CPC groups are increasingly becoming important to facilitate trade in these services.

Across all three groups of services, the EU and the USA, of the 17 major trading countries, are the biggest exporters, followed by Japan and Canada. A few emerging economies as well as economies in transition are also becoming major exporters in some of these services sectors. They include India (i.e. other professional, technical and business services), China (i.e. construction services and environmental goods and services), the Russian Federation (i.e. construction services), and Chinese Taipei (i.e. environmental goods and services).

An analysis of major trading countries’ specific commitments on these services groups reveals that only a handful of the countries have made a full commitment. Australia, for instance, has made a full commitment across the selected

sub-sectors of ‘other professional, technical and business services’. Canada and Chinese Taipei have done so on relevant ‘environmental services’, excluding ‘sanitation and similar services’. None of the major trading countries has made a full commitment on relevant construction services.

It appears that the principal Modes of supply (Mode 3 and 4) for the complementary services of climate change mitigation technologies are largely limited, as the majority of trading countries concerned have put specific as well as horizontal limitations on Mode 3 and horizontal limitations on Mode 4 across the three groups of services.³⁷ Among others, common specific limitations on Mode 3 take the form of:

- Restrictions on the formation of foreign companies’ legal entity;
- Requirement of an ‘economic needs test’ for the establishment of a commercial presence;
- Restriction on foreign investment (e.g. foreign capital equity);
- Nationality or residency requirements for accreditation of certain types of service providers (in terms of national treatment limitations).

Commonly seen forms of horizontal limitations on Mode 3 include:

- Restrictions on the acquisition of land and real estate;
- Limited eligibility for subsidies including tax benefits.

While the majority of trading countries concerned left Mode 4 unbound except as indicated in the horizontal commitments, most of them have put horizontal limitations on Mode 4. The most frequent form of such limitations is:

- Restrictions on entry and temporary stay of various services providers, including ‘intra-corporate transferees’, ‘contractual service suppliers’ ‘business visitors’, ‘services salespersons’, and ‘independent professionals’.

In terms of national treatment, the following limitations appeared frequently:

- Limited recognition of third-country diplomas required to practice regulated professional services;
- Restrictions on foreign nationals’ or foreign companies’ acquisition of land and real-estate;
- Restrictions of foreign service providers on public monopolies;
- Limited eligibility of foreign nationals for subsidies, including tax benefits.

The degree of commitments on Mode 1 appears to vary across the three groups of services. While the majority of trading countries considered Mode 1 inapplicable to construction services, and hence left it unbound, a few countries (India, Brazil and a few EU member states) have left Mode 1 unbound in ‘other professional, technical and business services’ and ‘environmental

services’, with the exclusion of ‘sanitation and similar services’ in the latter case.

Few countries appear to have offered new commitments across the three groups of services in their initial or revised offers during the Doha Round. The only new commitments made in the initial or revised offers are the EU’s limited commitments on ‘services incidental to energy distribution’ and Australia’s new commitments on ‘other environmental services’.

No discernable progress seems to have been made on horizontal limitations in the initial or revised offers as well. The review of the initial or revised offers in this area shows that the nature of horizontal limitations and where the limitations lie in terms of the Modes of supply remain largely the same. Notably, however, many countries that initially left Mode 1 unbound in the environmental services sector have since put limited commitments in their offers. Given the increasing importance of Mode 1 in providing complementary services of climate change mitigation technologies, improved commitments particularly on ‘other professional, technical and business services’ could help facilitate trade in these services. The complementary nature of Mode 3 and Mode 4 in supplying the interlinked services also deserves due consideration when addressing the limitations on these Modes of supply.

7. CONCLUDING WORDS

The potential benefits of liberalizing trade in low-carbon technologies and services have been widely touted. Yet given the inseparable linkages between a successful diffusion of climate change mitigation technologies and the delivery of the associated services, it is crucial to identify services that could be complementary to the diffusion of climate change mitigation technologies and to understand the current level of market access for such services.

Specific commitments made under the GATS may have a stronger impact on regulatory competence than tariff bindings do in goods trade, creating favourable conditions for investment and access to technology as long as an adequate regulatory framework is provided (Cossy, 2011).³⁸ Analysis of the major trading countries' specific commitments on the complementary services of climate change mitigation technologies reveals that the principal Modes of supply for these groups of services are heavily limited and that so far little progress has been made in WTO Members' initial or revised offers in this area.

In addition, several empirical studies reveal that some of the key services required for mitigation options, ranging from energy efficiency projects to utility-scale wind power projects, are often unavailable in the host countries (Steenblik and Geloso Grosso, 2011; Sterk et al., 2007). Liberalizing trade in these services, therefore, might not only facilitate the diffusion of associated climate change mitigation technologies, but also give countries a ready access to such services. Although concerns have been raised that the 'complementary services of climate change mitigation technologies' discussed in this paper might exacerbate the persistent problem of 'dual use', as the services cut across multiple sectors, the GATS allows ample flexibility for specifying the scope of commitments in Members' schedules.

If Members wish to increase the market access of climate change related services through multilateral trade negotiations, they could specify their commitments on such services in their schedules within the current structure of classification.

It should be kept in mind that facilitating trade in 'complementary services of climate change mitigation technology' goes beyond the boundary of the General Agreement on Trade in Services (GATS), since trade barriers to these services are not limited to the issue of market access and national treatment. For instance, given that the public sector appears to be the largest client across all three groups of services, regulations concerning government procurement could have a significant impact on trade in these services. An empirical study shows how some of the existing practices and limited transparency in this area could create barriers to trade in environmental goods and associated services.³⁹ It goes without saying that certain government regulations play an important role in the environmental goods and services market. Given the close links between the two, however, the issue of liberalizing trade in complementary services of climate change mitigation technologies must be addressed in conjunction with discussions on the plurilateral agreement on government procurement in the WTO.

Furthermore, domestic laws, regulatory measures, and administrative rules all have the potential to affect trade in these services. Examples of this include domestic regulatory measures, such as building regulations and associated technical requirements or regular inspection requirements for safety. In facilitating trade in complementary services of climate change mitigation technologies, therefore, relevant regulatory measures as well as administrative rules need to be addressed in tandem.

ENDNOTES

- 1 Opinions seem to be divided on the definition or the scope of ‘technology’; whether the term includes only ‘goods’ (e.g. ‘equipment’ or ‘hardware’) or ‘services’ as well. In this paper, ‘technology’ only includes ‘goods’.
- 2 The potential contribution of liberalising trade in environmental goods and services for climate change is often measured by its role in facilitating their diffusion. Yet, the overall impact of trade liberalisation on GHG emissions remains unknown. According to an OECD study (2010), a 1 percent increase in trade volume results in 0.58 percent increase in CO₂ emissions for the average country. See ‘Globalisation, transport and the environment’ (OECD, 2010) for further details.
- 3 See Annex 5. A2 to Chapter 5. “Synergies between trade in environmental services and trade in environmental goods” in *Trade that Benefits the Environment and Development: Opening Markets for Environmental Goods and Services* (OECD, 2005).
- 4 ‘Pollution management’ group comprises activities that produce technology or services to treat or remove environment effects; ‘Cleaner technologies’ comprise any activity which continuously improves, reduces or eliminates the environmental impact of technologies, processes or products; and ‘Resource management’ group includes activities which prevent environmental damage to air, water and/or soil.
- 5 One issue that is important in relation to the classification of environmental services is how to classify “new” activities, particularly in the sector undergoing significant technological development. The field of carbon capture and storage may be a case in point (Cossy, 2011).
- 6 The GATS is also flexible enough to accommodate sector specific intentions. In the case of telecommunication services, for instance, Members specified ‘additional commitments’ in their schedules, which concerns a set of transparency requirements, competition disciplines and institutional obligations concerning the creation of an independent regulator in the sector (Adlung, 2009).
- 7 Although neither the W/120 nor the Centralized Product Classification (CPC) is a compulsory instrument in the WTO, this paper uses trade data based on these two systems for relevant services sectors due to data limitations.
- 8 See ‘OECD’s recent work on Climate Change’ for the spectrum of sectors related to addressing climate change. Obtained from <http://www.oecd.org>
- 9 The EU and the US proposed this as ‘energy-related services’.
- 10 According to IPCC 4th assessment report (2007), detailed reports on Carbon Capture and Storage (CCS)-ready plant-design studies are not yet in the public domain.
- 11 While a debate on whether ‘renewable energy certificates (RECs) are to be classified as ‘goods’ or ‘services’ is still on-going, many argue that it should be considered as ‘financial services’ as international trade applies to certificates, not the energy (Howse, 2005; Cottier and Baracol-Pinhao, 2011; and Delimatsis and Mavromati, 2011).
- 12 Most WTO Members apply zero tariffs to airplanes under the WTO plurilateral agreement on trade in civil aircraft.

- 13 It should be noted that some of these gains might be offset by CO₂ from energy used to deliver the water (Schlesinger 1999; Mosier et al., 2005) or from N₂O emissions from higher moisture and fertilizer inputs (Liebig et al. 2005).
- 14 The classification of these services is based on the UN CPC version.2. For further explanations of services included in Table 2, see Annex I.
- 15 Overall, data on trade in services is very limited. Currently, readily available trade data on services is largely at the aggregated level (the sectoral level based on the W/120 classification or the CPC group level).
- 16 Data on the commitment schedules of Kazakhstan and the Russian Federation is unavailable since they are not WTO Members. Hence, nine countries in total are subject to the analysis of commitments schedules and limitations.
- 17 The EU's national schedule submitted during the Uruguay Round only covers 12 original member states. 15 new member states (Austria, Cyprus, Czech Republic, Estonia, Finland, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, Slovenia and Sweden) have submitted their individual schedules separately. The European Community certified in 2006 a new schedule of commitments that covers all 25 member states. Among the EU member states, Cyprus and Malta have not made any commitment on this group of services.
- 18 The EU in its 'revised offer' has made a limited, yet new commitment in this sub-sector.
- 19 The classification of sub-sectors in all the tables is based on W/120.
- 20 According to Canada's revised offer, limitations on Mode 1 in architectural services and on Mode 1 and 2 in engineering and integrated engineering services were removed.
- 21 The term 'economic need test' is not defined in the GATS, but it comprises four types of quantitative restrictions on foreign service suppliers to limit their market access. See [S/CSS/W/118] for more details.
- 22 EU's initial and revised offers include commitments schedules of its all 25 member states.
- 23 The review of the revised offers by nine major trading countries in this sector reveals that the nature of horizontal limitations and where the limitations lie in terms of Modes of supply remain largely the same, although some countries clarified their criterion applied to relevant limitations or loosened the language to a limited extent. For instance, Canada has increased the minimum value of Canadian business that could be subject to foreign acquisition 'no less than 153 million CD (157 USD) to 250 million CD (256 USD). (TN/S/O; TN/S/O rev.1).
- 24 Canada removed 'residency requirement for accreditation of landscape architects' in its revised offer submitted to the WTO (TN/S/O; TN/S/O rev.1).
- 25 Overall, the number of EU member states that put specific limitations on Mode 4 has decreased in its revised offer (TN/S/O rev.1).
- 26 It should be noted that the issue of government procurement goes beyond the scope of the GATS. So far, 38 WTO Members have signed the Government Procurement Agreement (GPA) and adopted disciplines on procurement regulations. None of 38 Members are developing countries.
- 27 The market share of constructions services by relevant sectors is as follows: Power (5.5 percent); Industrial (4.9 percent); Water/sewer/waste (4.4 percent); and Manufacturing (2.3 percent).

- 28 Data on the commitment schedules of Azerbaijan, Kazakhstan and the Russian Federation is unavailable since they are not WTO Members.
- 29 Among the new EU member states, Cyprus, Hungary and Malta have not submitted their commitment schedules on this group of services. Finland has made a partial commitment on this group of services.
- 30 The market access limitations on Mode 1 concern 'approval requirements by the government of foreign specialists involved with engineering or architecture-related works and qualification requirements of foreign engineers or architects (e.g. temporary member of the related Union of Chambers)'. Turkey, in its revised initial offer, removed this limitation though.
- 31 Given the data limitations on trade in 'sewage and waste collection treatment and disposal and other environmental protection services' at the group [CPC 94] level, this study uses the major exporting countries of environmental goods and services and examines their specific commitments on 'environmental services' based on W/120.
- 32 Given that the environmental services sector overlaps with activities in sectors as diverse as architecture services, construction and related engineering services, technical analysis services, auditing and risk assessment, research and development and consulting services, the value of this sector might be inflated (Zarrilli, 2003).
- 33 Data presented here is based on best estimates derived from interviews with companies, researchers and government agencies (Geloso Grosso, 2005).
- 34 New Zealand has submitted its initial offer for the first time in this sector during the Doha Round. Among the new EU member states, Cyprus and Malta have not made any commitment on this group of services.
- 35 According to Sawhney, A. and R. Chanda (2003), in addition to five top exporting countries listed in Table 11, China, Taiwan and Korea accounted for two percent of global exports on environmental goods and services respectively in 1999. Given the data limitations on key exporting and importing countries of environmental services, this study reviews the commitments and limitations of these eight countries.
- 36 There appears to be more such requirements in industries dealing with pollution control and handling and disposal of specified hazardous substances.
- 37 Many of the specific limitations on Mode 3 for environmental services were removed in the revised offers by countries such as Korea and Japan.
- 38 In GATS terms, the concept of market access is narrow as it entails six quota-type and other specified restrictions (Article XVI) (Cossy, 2011).
- 39 See Fleiss and Kim (2008) for detailed examples.
- 40 The inclusion of this group of services depends on the source and types of vehicles.
- 41 Transport technology related, but not climate-friendly technologies services that are directly related to the diffusion of CC technologies.
- 42 Transport technology related, but not climate-friendly technologies services that are directly related to the diffusion of CC technologies.
- 43 Could also be related to the DHC system.

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ANNEX I. FURTHER EXPLANATION OF SERVICES RELATED TO CLIMATE-MITIGATION TECHNOLOGIES THAT ARE CLASSIFIED BASED ON THE CENTRALIZED PRODUCT CLASSIFICATION (CPC) VER.2

Section: 5 - Constructions and construction services

Division: 54 - Construction services

Group: 541 - General construction services of buildings

This Group is divided into the following Classes:

5411 - General construction services of residential buildings

5412 - General construction services of non-residential buildings

Group: 542 - General construction services of civil engineering works

Class: 5421 - General construction services of highways (except elevated highways), streets, roads, railways and airfield runways

Subclass: 54212 - General construction services of railways

Explanatory note

This subclass includes:

- construction, repair, alteration and restoration services for:
 - railway roadbeds for long-line and commuter rails, street tramways and underground or elevated urban rapid transit systems;
 - railway electrification structures.
- laying services of ballast and rails
- installation services of switch gear, points and crossings
- construction services of control and safety systems for railway tracks

- construction services of funicular railways and cable car systems

Class: 5425 - General construction services of local pipelines and cables and related works

Sub-class: 54253 - General construction services of sewage and water treatment plants

Explanatory note

This subclass includes:

- construction, repair, alteration and restoration services for:
 - sewage disposal plants;
 - water treatment and purification plants.

This subclass does not include:

- construction services of pipelines and of water and sewer mains, cf. 54241 (long-distance) and 54251 (local), respectively

Class: 5426 - General construction services of mines and industrial plants

Subclass: 54262 - General construction services of power plants

Explanatory note

This subclass includes:

- construction, repair and alteration services for heavy electrical generating plants and equipment, including plants and equipment for nuclear-powered generating stations

Class: 5426 - General construction services of mines and industrial plants

Subclass: 54269 - General construction services of other industrial plants

Explanatory note

This subclass includes:

- construction, repair and alteration services for:
 - manufacturing facilities of basic chemicals, compounds, pharmaceuticals and other chemicals;
 - chemical and related manufacturing facilities such as blast furnaces and coke ovens;
 - iron foundries;
 - specialized facilities for manufacturing, not elsewhere classified.

This subclass does not include:

- construction services of industrial buildings, cf. 54121

Group: 546 - Installation services

This Group is divided into the following Classes:

- 5461 - Electrical installation services
- 5462 - Water plumbing and drain laying services
- 5463 - Heating, ventilation and air conditioning equipment installation services
- 5464 - Gas fitting installation services
- 5465 - Insulation services
- 5469 - Other installation services

Section: 6 - Distributive trade services; accommodation, food and beverage serving services; transport services; and electricity, gas and water distribution services

Division: 64 - Passenger transport services

Group: 641 - Local transport and sightseeing transportation services of passengers⁴⁰

This Group is divided into the following Classes:

- 6411 - Urban and suburban land transport services of passengers
- 6412 - Local water transport services of passengers
- 6413 - Sightseeing transportation services

Group: 642 - Long-distance transport services of passengers

Class: 6421 - Interurban railway transport services of passengers

Subclass: 64210 - Interurban railway transport services of passengers

Explanatory note

This subclass includes:

- passenger transportation services provided by railway between non-contiguous cities, regardless of the distance covered and the class used, with service being available to all users
- transport of accompanying vehicles, luggage, animals and other items

This subclass does not include:

- passenger transportation services by railway within the confines of a single city or group of contiguous cities, available to all users, cf. 64111
- sleeping car services, cf. 63290
- dining car services, cf. 63310

Division: 67 - Supporting transport services

Group: 673 - Supporting services for railway transport

This Group is divided into the following Classes:

- 6730 - Supporting services for railway transport

Section: 7 - Financial and related services; real estate services; and rental and leasing services

Division: 71 - Financial and related services

Group: 711 - Financial services, except investment banking, insurance services and pension services

This Group is divided into the following Classes:

7111 - Central banking services

7112 - Deposit services

7113 - Credit-granting services

7114 - Financial leasing services

7119 - Other financial services, except investment banking, insurance services and pension services

Group: 715 - Services auxiliary to financial services other than to insurance and pensions

This Group is divided into the following Classes:

7151 - Services related to investment banking

7152 - Brokerage and related securities and commodities services

7153 - Portfolio management services except pension funds

7154 - Trust and custody services

7155 - Services related to the administration of financial markets

7159 - Other services auxiliary to financial services

Group: 716 - Services auxiliary to insurance and pensions

This Group is divided into the following Classes:

7161 - Insurance brokerage and agency services

7162 - Insurance claims adjustment services

7163 - Actuarial services

7164 - Pension fund management services

7169 - Other services auxiliary to insurance and pensions

Group: 717 - Services of holding financial assets

Class: 7170-Services of holding financial assets

This Class is divided into the following Subclasses:

71701 - Services of holding equity of subsidiary companies

71702 - Services of holding securities and other assets of trusts and funds and similar financial entities

Section: 8 - Business and production services

Division: 83 - Other professional, technical and business services

Group: 831 - Management consulting and management services; information technology services

This Group is divided into the following Classes:

8311 - Management consulting and management services

8312 - Business consulting services

8313 - Information technology (IT) consulting and support services

8314 - Information technology (IT) design and development services

8315 - Hosting and information technology (IT) infrastructure provisioning services

8316 - IT infrastructure and network management services

8319 - Other management services, except construction project management services

Group: 832 - Architectural services, urban and land planning and landscape architectural services

Class: 8321 - Architectural services and advisory services

Subclass:

83211 - Architectural advisory services

83212 - Architectural services for residential building projects

83213 - Architectural services for non-residential building projects

Explanatory note

This class includes:

- advisory and pre-design services
- preparation of designs and construction documents
- plans, studies and other advisory services related to the design of buildings

The architectural services may be provided in a bundle covering all stages of a building project, including the advisory, pre-design and design stages, or they may be provided individually.

Class: 8322 - Urban and land planning services⁴¹

Subclass: 83221 - Urban planning services

Explanatory note

This subclass includes:

- development of plans concerning land use, site selection, control and utilization, road systems and servicing of land with a view to creating and maintaining systematic, coordinated urban development, such as:
 - comprehensive urban plans;
 - community urban plans;
 - element urban plans for specific amenities or objectives such as transportation, utilities, etc.
- feasibility studies
- studies of environmental impact and economic assessments of urban development plans
- urban planning advisory services, such as:
 - expert witness, policy and programme evaluation.

Class: 8322 - Urban and land planning services⁴²

Subclass: 83223 - Project site master planning services⁴³

Explanatory note

This subclass includes:

- providing plans for a construction site, showing the proposed location of buildings, roads, parking lots and other features, for:
 - residential building projects;
 - non-residential building projects;
 - recreational and open-space projects.

Group: 833 - Engineering services

Class: 8332 - Engineering services for specific projects

Subclass: 83321 - Engineering services for building projects

Explanatory note

This subclass includes the application of physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems for building projects.

This subclass includes:

- provision of designs, plans, and studies related to residential building projects, such as:
 - new and existing homes
 - row housing, apartments, etc.
 - mixed-use buildings that are predominantly used for residential housing
- provision of designs, plans, and studies related to new and existing commercial, public and institutional building projects, including mixed-use buildings that are predominantly used for commercial, public, or institutional purposes, such as:
 - office buildings;
 - shopping centres;
 - hotels and restaurants;
 - service stations and warehouses;
 - bus and truck terminals;
 - hospitals, schools, churches;
 - prisons, stadiums and arenas;
 - libraries and museums.

This subclass also includes:

- engineering advisory services that are related to specific residential, commercial, public or institutional building projects

This subclass does not include:

- engineering advisory services not related to a specific project, cf. 83310

Class: 8332 - Engineering services for specific projects

Subclass: 83322 - Engineering services for industrial and manufacturing projects

Explanatory note

This subclass includes the application of physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems for industrial and manufacturing projects.

This subclass includes:

- engineering services related to industrial facilities and processes:
 - mining and metallurgical facilities such as mines, smelters, mills, mineral refineries, including integrated facility and process engineering projects;
 - mining and metallurgical processes, such as mineral extraction, smelting, refining, metal forming;
 - petroleum and petrochemical facilities such as oil and gas platforms, refineries, petrochemical plants, including integrated facility and process engineering projects;
 - processes for the production of petroleum and petrochemicals, such as extraction, refining, formulation, mixing;
 - microelectronics facilities and processes, such as those that produce

microprocessors, silicon chips and wafers, microcircuits, and semiconductors;

- textile and clothing facilities and processes;
 - iron and steel facilities and processes;
 - other industrial and manufacturing facilities and processes, n.e.c.
- engineering services related to the design of industrial and manufactured products, such as:
- industrial machinery such as agricultural, construction, mining, metalworking, commercial and service industry, heating, ventilating and air-conditioning, power transmission machinery;
 - electronic equipment such as computers and peripheral equipment, communications equipment, audio and video equipment, semiconductors and other electronic components;
 - electrical equipment such as lighting, major and minor appliances and components thereof;
 - transportation equipment such as motor vehicles, aircraft, trains, marine vessels, space vehicles;
 - industrial and manufactured products not elsewhere classified.

This subclass does not include:

- research and development services in engineering, cf. 81129
- industrial design services, cf. 83912

Class: 8332 - Engineering services for specific projects

Subclass: 83323 - Engineering services for transportation projects

Explanatory note

This subclass includes the application of physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems for transportation infrastructure projects.

This subclass includes:

- engineering services (including provision of designs, plans, and studies) related to:
 - highways, roads and streets, including elevated highways used for motor vehicle traffic
 - bridges and tunnels
 - ancillary road transport facilities such as rest stops, weigh stations, toll booths
 - mass transit systems, such as light rail or subway systems
 - railways and related structures
 - railway bridges and tunnels
 - marine and inland ports
 - harbours, locks, canals, and dams primarily used for transportation purposes
 - airports, runways, hangars
 - other aviation facilities
 - space transportation projects
 - oil and gas transportation projects
 - other transportation projects n.e.c.

Class: 8332 - Engineering services for specific projects

Subclass: 83324 - Engineering services for power projects

Explanatory note

This subclass includes the application of physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems for electricity generation, transmission and distribution projects.

This subclass includes:

- engineering services related to facilities that generate electrical power from:
 - coal and other fossil-fuel energy such as oil and gas;
 - nuclear energy;
 - the energy in falling water;
 - other energy, such as solar power, wind power, geothermal power including cogeneration facilities.
- engineering services related to overhead or underground electrical power transmission and distribution lines

Class: 8332 - Engineering services for specific projects

Subclass: 83326 - Engineering services for waste management projects (hazardous and non-hazardous)

Explanatory note

This subclass includes the application of physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems for waste management projects.

This subclass includes:

- engineering services related to household garbage collection and disposal systems, such as:

- recycling facilities;
- composting facilities;
- transfer stations;
- resource recovery facilities;
- landfill sites.

- engineering services related to programmes for the collection, treatment, recycling, and disposal of industrial air, water and solid wastes, generally to a level such that the remaining waste stream can be safely released to the natural environment or ordinary municipal systems
- engineering services related to programmes for hazardous waste remediation, such as:
 - management of nuclear waste;
 - chemical agent destruction;
 - brownfield redevelopment;
 - ground water modeling;
 - contaminated site remediation.

This subclass does not include:

- engineering services for water, sewage treatment and drainage projects, cf. 83327

Class: 8332 - Engineering services for specific projects

Subclass: 83327 - Engineering services for water, sewerage and drainage projects

Explanatory note

This subclass includes the application of physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems for water treatment and distribution systems, sewer systems, sewage treatment plants and drainage projects.

This subclass includes:

- engineering services related to systems for the collection, distribution, treatment, and disposal of water such as:
 - drinking water distribution systems, pumping stations, reservoirs, water storage facilities, water transmission and distribution mains including dams used primarily for local drinking water distribution and desalination plants;
 - systems for storm water management, drainage and detention systems including dams used primarily for flood control;
 - systems for the collection, treatment, and disposal of waste water, except industrial waste water;
 - irrigation systems and water pipelines including dams primarily used for irrigation.

Group: 834 - Scientific and other technical services

Class: 8342 - Surface surveying and map-making services

Subclass: 83421 - Surface surveying services

Explanatory note

This subclass includes:

- gathering of information on the shape, position and/or boundaries of a portion of the earth's surface by different methods, including transit, photogrammetric and hydrographic surveying, for the purpose of preparing maps
- collection of data by satellite
- land surveying services (e.g., marking of property, boundary marking)

Class: 8344 - Technical testing and analysis services

Subclass: 83441 - Composition and purity testing and analysis services

Explanatory note

This subclass includes:

- testing and analysis of the chemical and biological properties of materials such as air, water, waste (municipal and industrial), fuels, metal, soil, minerals, food and chemicals
- testing and analysis in related scientific fields such as microbiology, biochemistry, bacteriology, etc.

This subclass does not include:

- medical and dental testing services, cf. 93195

Class: 8344 - Technical testing and analysis services

Subclass: 83449 - Other technical testing and analysis services

Explanatory note

This subclass includes:

- testing and analysis of a technical or scientific nature that does not alter the object being tested
- radiographic, magnetic, and ultrasonic testing of machine parts and structures in order to identify defects. These tests are often conducted on site.
- certification of ships, aircraft, dams, etc.
- certification and authentication of works of art
- radiological inspection of welds

- all other technical testing and analysis services not elsewhere classified

This subclass does not include:

- assessment of damages on behalf of insurance companies, cf. 71620
- technical inspection of automobiles, cf. 83444
- medical analyses and testing services, cf. 93195

Group: 839 - Other professional, technical and business services n.e.c.

This Group is divided into the following Classes:

8391 - Specialty design services

8392 - Design originals

8393 - Scientific and technical consulting services n.e.c.

8394 - Original compilations of facts/information

8395 - Translation and interpretation services

8396 - Trademarks and franchises

8399 - All other professional, technical and business services, n.e.c.

Division: 84 - Telecommunications, broadcasting and information supply services

Group: 841 - Telephony and other telecommunications services

Class: 8414 - Private network services

Subclass: 84140 - Private network services

Explanatory note

This subclass includes:

- provision of wired or wireless telecommunication links between specified points for the exclusive use of the client

This subclass does not include:

- provision of private links by a telecommunication carrier to a telecommunication service provider, cf. 84110

Class: 8415 - Data transmission services

Subclass: 84150 - Data transmission services

Explanatory note

This subclass includes:

- provision of access to wired or wireless facilities and services specifically designed for the efficient transmission of data on a pay-as-you-use basis

This subclass does not include:

- provision of wired or wireless telecommunication links between specified points for the exclusive use of the client, cf. 84140

Group: 842 - Internet telecommunications services

This Group is divided into the following Classes:

8421 - Internet backbone services

8422 - Internet access services

8429 - Other Internet telecommunications services

Explanatory note

This group includes:

- carrying of electronic signals (traffic) over the Internet
- providing access to the Internet
- providing telecommunications services on the Internet and similar distributed computer networks that rely on, but are not part of, the normal telecommunications network

Group: 843 - On-line content

This Group is divided into the following Classes:

- 8431 - On-line text based information
- 8432 - On-line audio content
- 8433 - On-line video content
- 8434 - Software downloads
- 8439 - Other on-line content

Division: 86 - Support services to agriculture, hunting, forestry, fishing, mining and utilities

Group: 861 - Support services to agriculture, hunting, forestry and fishing

Class: 8611 - Support services to crop production

Subclass: 86119 - Other support services to crop production

Explanatory note

This subclass includes:

- tilling of fields preparatory to planting
- planting, cultivation and fertilization of crops
- spraying, including from the air
- pest control for agriculture
- trimming of fruit trees and vines
- transplanting and thinning of crops
- harvesting
- provision of agricultural machinery with crew and operators
- operation of irrigation systems for agricultural purposes
- other services necessary for agricultural production

This subclass does not include:

- formation and clearance of agricultural land, cf. 54320
- services provided by agronomists and agricultural economists, cf. 83115
- other pest control services, cf. 85310
- water distribution services through mains (on a fee or contract basis), cf. 86330

Class: 8614 - Support services to forestry and logging

Subclass: 86140 - Support services to forestry and logging

Explanatory note

This subclass includes:

- forest tree nursery services
- services related to forestry production, such as:
 - transplanting, replanting, thinning, forestry inventories, timber evaluation, fire protection.
- services related to logging, such as:
 - felling, cutting, debarking, transport of logs within the forest.

This subclass does not include:

- planting, pruning or thinning of trees and bushes as part of landscaping, cf. 85970

Section: 9 - Community, social and personal services

Division: 94 - Sewage and waste collection, treatment and disposal and other environmental protection services

Group: 941 - Sewerage, sewage treatment and septic tank cleaning services

Class: 9411 - Sewerage and sewage treatment services

Subclass: 94110 - Sewerage and sewage treatment services

Explanatory note

This subclass includes:

- sewage removal services usually provided using equipment such as waste pipes, sewers or drains
- sewage treatment services using dilution, screening and filtering, sedimentation, chemical precipitation, etc.

This subclass does not include:

- collection or purification of water, cf. 18000
- construction, repair and alteration of sewers and sewer pipelines, cf. 54241, 54251
- distribution of water through mains on own account, cf. 69210
- distribution of water through mains on a fee or contract basis, cf. 86330

Group: 942 - Waste collection services

Class: 9422 - Collection services of non-hazardous recyclable materials

Subclass: 94221 - Collection services of non-hazardous recyclable materials, residential

Explanatory note

This subclass includes:

- waste collection specifically designed for the collection of non-hazardous recyclable materials:
 - whether presorted or commingled waste, such as cardboard, paper, plastic, glass, aluminium, steel and organic yard waste from residential locations, including curbside collection, back door collection

or automated collection on a flexible or regular schedule

Class: 9422 - Collection services of non-hazardous recyclable materials

Subclass: 94229 - Collection services of non-hazardous recyclable materials, other

Explanatory note

This subclass includes:

- waste collection specifically designed for the collection of non-hazardous recyclable materials:
 - whether presorted or commingled, such as cardboard, paper, plastic, glass, aluminium, steel, and other recyclable materials from non-residential locations, on a regular or flexible schedule.

Group: 943 - Waste treatment and disposal services

Class: 9431 - Waste preparation, consolidation and storage services

This Class is divided into the following Subclasses:

94311 - Hazardous waste preparation, consolidation and storage services

94312 - Ship-breaking and other dismantling of wrecks services

94313 - Non-hazardous recyclable materials preparation, consolidation and storage services

94319 - Other non-hazardous waste preparation, consolidation and storage services

Class: 9432 - Hazardous waste treatment and disposal services

Subclass: 94321 - Hazardous waste treatment services

Explanatory note

This subclass includes:

- treatment to reduce, eliminate, or transform hazardous waste

Processes include biological, chemical, and/or physical procedures or incineration. These procedures may lead to a disposable residual or result in the recovery of a recyclable material.

Class: 9432 - Hazardous waste treatment and disposal services

Subclass: 94322 - Hazardous waste disposal services

Explanatory note

This subclass includes:

- disposal services for hazardous waste at a facility that meets legal standards for the disposal of hazardous waste, such as at approved controlled containment facilities or landfills

Class: 9433 - Non-hazardous waste treatment and disposal services

Subclass: 94331 - Sanitary landfill services, non-hazardous waste

Explanatory note

This subclass includes:

- disposal of non-hazardous waste on or in a sanitary landfill which meets the sanitary landfill criteria specified by legislation or regulation, i.e. designed to prevent leaking etc.

Class: 9433 - Non-hazardous waste treatment and disposal services

Subclass: 94332 - Other landfill services, non-hazardous waste

Explanatory note

This subclass includes:

- disposal of non-hazardous waste on or in landfills other than a sanitary one

Class: 9433 - Non-hazardous waste treatment and disposal services

Subclass: 94333 - Incineration of non-hazardous waste

Explanatory note

This subclass includes:

- incineration of non-hazardous waste in a facility that meets legal standard and requirements for incineration of non-hazardous waste

Class: 9433 - Non-hazardous waste treatment and disposal services

Subclass: 94339 - Other non-hazardous waste treatment and disposal services

Explanatory note

This subclass includes:

- other non-hazardous waste disposal services, such as:
 - services of chemical or biological reduction of agricultural waste and similar treatment services.

Group: 949 - Other environmental protection services n.e.c.

Class: 9490 - Other environmental protection services n.e.c.

Subclass: 94900 - Other environmental protection services n.e.c.

Explanatory note

This subclass includes:

- acidifying deposition (i.e., acid rain) monitoring, controlling and damage assessment services
- other environmental protection services not classified elsewhere

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