Policy landscape of trade in environmental goods and services

Jacob, Arun and Møller, Anders K

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Arun Jacob and Anders K. Møller*

Abstract

This paper analyses the trends in trade flows and trade policies in environmental goods (EGs) and related services, with a focus on the Asia-Pacific Economies. The paper finds that the region is a dominant player in both exports and imports of EGs in the world, contributing to 42% and 44%, respectively. Renewable energy related goods dominate both the export and import basket of EGs in the region. The paper warns that even though specific environmental goods in general face very low tariffs, many other goods that are however required for environmental projects still face high tariffs, especially in least developed countries. Hence, the paper calls for a 'holistic approach' for tariff liberalization. The paper highlights the role of services in environmental sectors. The paper estimates an augmented gravity model of trade flows that integrates non-tariff measures (NTMs) and services trade restrictions. The estimations find that while tariffs have had an insignificant impact on environmental goods trade, NTMs have a strong negative impact. The impact of NTMs is more strongly felt by exports from low income countries when compared with middle income and high-income ones. The services trade restrictions also have a significant negative impact on the EG trade. The results point to the need for integrating NTMs and service sector policies within the

* Arun Jacob is a staff member of the Trade, Investment and Innovation Division, United Nations Economic and Social Commission for Asia and the Pacific. He can be contacted at jacoba@un.org. Anders K. Møller was an intern in the Trade, Investment and Innovation Division, United Nations Economic and Social Commission for Asia and the Pacific. He can be contacted at akm1990@gmail.com .The paper was presented at the 2016 Green Trade Conference which took place in 6-7 December 2016 in Beijing (http://www.cgep.org/e-index.html). The authors are indebted to participants in that conference, Ms.Mia Mikic and other peer reviewers for useful feedback and comments, and to the Asia Pacific Research Network on Trade (ARTNeT) secretariat for the technical support in issuing this paper. The views expressed here are personal and do not represent the views of the United Nations or its Member States.

framework of environmental goods negotiations to expedite the process of liberalizing global trade in EGs.

Key words: environmental goods, environmental services, non-tariff measures, services restrictiveness; environmental impact of trade, green trade

JEL codes: Q56, F18, F1

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1. Introduction

Environmental goods and services (EGS) broadly refer to goods and services that have an environmentally beneficial outcome. Examples of EGS range from solar panels and wind turbines to pollution control and monitoring devices. The 2030 agenda for sustainable development recognizes the environment as one of the three pillars of sustainable development. Trade in environmental goods is considered to be an important enabler of many of the environmental dimension of the 2030 Agenda for Sustainable Development and associated SDGs. For example, in realizing SDG no. 7 on ensuring “access to affordable, reliable, sustainable and modern energy for all,” freer flow of renewable energy related goods across borders will be crucial. As greater trade in these goods will promote transfer of renewable energy technologies as well as promote usage of cleaner energy sources.

The OECD/Eurostat working group in 1998 defined EGS as “[consisting] of activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use” (Steenblik et al., 2005, p. 5). The ability for economies to adopt green technology innovations is vital to switching to a green-growth strategy and achieving the ambitious targets set by the COP21 Paris agreement in December 2015. Acceleration in the reduction of barriers to EGS trade is necessary to decrease the cost of importing environmental technologies, which would increase trade and stimulate innovation as well as technology transfers (De Melo and Vijil, 2014, p. 3).

Most of the discussions at the multi-lateral level in this area have focused on environmental goods (EGs). Not surprisingly, the general lack of a universally accepted definition of which goods constitute EGs has itself been a hindrance for progress in multilateral negotiations (Ibid, pp. 4-6).There are several issues with classifying EGs. For one, the Harmonized System (HS) used to draw up agreements on tariff reductions on industrial goods does not classify goods according to end-use, and it is only internationally harmonized at the six-digit level which can at times be very broad. For example, water heaters fall under HS code 8419, but a solar water heater would have to be defined (nationally) at the eight-digit level, such as 841919-10 in China. Moreover, some goods may have dual or multiple uses which can be considered environmentally desirable depending on context, which has led to some WTO members proposing a project-based approach for tariff liberalization[1]. Furthermore, the HS system does not distinguish between manufacturing methods, yet goods that are produced with lower-than-average resource use can be considered environmentally friendly. This led to a variety of classification approaches, including United Nations ESCAP (2011, pp. 36-37) which defined 64 goods (of which 43 were earlier on a list developed by the World Bank) as ‘climate smart goods’ which foster climate-smart development.

In September 2012, the 21-member Asia-Pacific Economic Cooperation (APEC) group concluded the first-ever trade agreement on environmental goods which mandated members to voluntarily reduce tariffs on a list of 54 environmental product categories to 5% or less by 2015. This list forms the basis for the analyses carried out in this paper. Inspired by the APEC list, a group of 16 economies and the European Union have been engaging in open plurilateral negotiations towards an Environmental Goods Agreement (EGA). The EGA group is currently considering 300 tariff lines, and a final deal is expected by December 2016. As the deal being negotiated is “open,” it is expected that the benefits of this plurilateral initiative will be applied to all WTO members using the Most-Favoured Nation (MFN) principle, subject to a critical mass reaching an agreement. If this is achieved, the EGA agreement will increase trade, reduce the cost of environmental goods, and lower global CO2 emissions (European Commission, 2016). Although the EGA group held many productive discussions with an intent to reach an agreement by the end of 2016, negotiators have so far been unable to bridge the remaining gaps. However, participants have reiterated their commitment to the EGA

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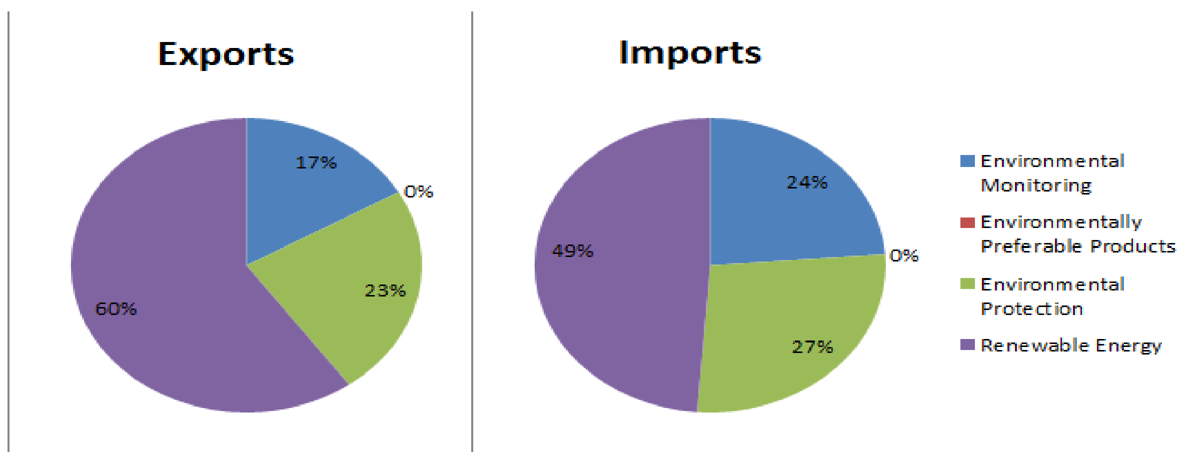
[1] Special Session of the Committee on Trade and Environment, Environmental Project Approach - Compatibility and Citeria: Submission by India, TN/TE/W/67 (June 13, 2006) available at http://commerce.nic.in/trade/wtopdfs/tn_te_W67.pdf

and will continue working towards reaching an agreement (Government of Canada, 2017).

The APEC list consists of 54 product groups at the HS six-digit level. However, for analytic clarity, these product groups may be categorized as Renewable Energy (which includes 15 sub-headings), Environmental Monitoring, Analysis and Assessment Equipment (17 sub-headings), Environmental Protection such as solar water heaters and waste-water management (21), and Environmentally Preferable Products (only one sub-header, i.e. bamboo flooring) according to Vossenaar (2013).[2] It is noteworthy that sub-headers include several products which may have different uses or could belong in multiple environmental categories, but for the purpose of this paper the categorization used by Vossenaar (2013) has been adopted.

The figure 1-1 gives the composition of the exports and imports of the Asia-Pacific region for environmental goods in 2014. Both in terms of value of exports and imports, renewable energy category clearly dominate, followed by environmental protection goods and environmental monitoring goods. Environmentally preferable product category, which consists of only one HS6 product group, constitute less than 1% of the total export and import volume of environmental goods.

Figure 1-1: Composition of Asia-Pacific environmental goods exports and imports, 2014

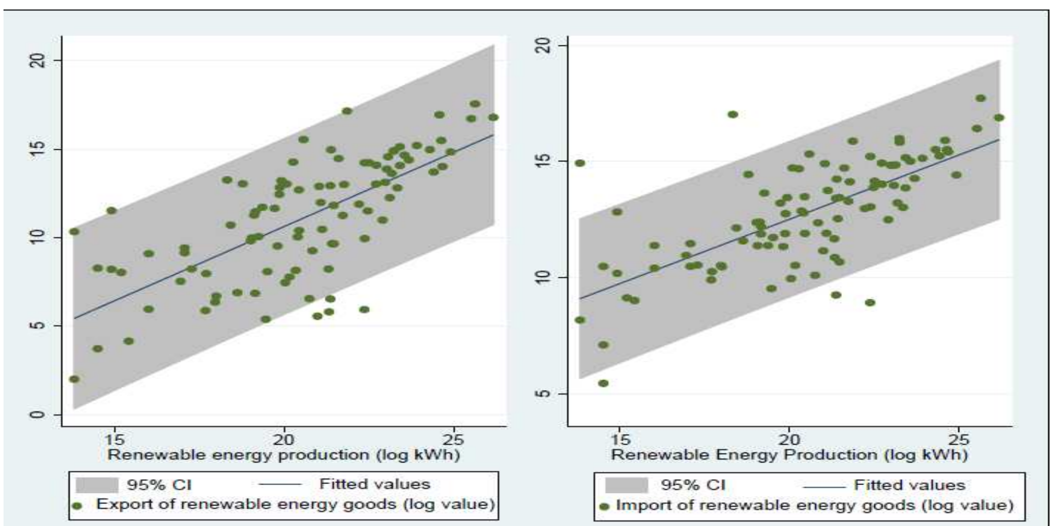


[2] See Annex table A2 for the full list of 54 EGs and their classification.

Source: UN COMTRADE Data accessed through WITS

These goods are classified as EGs because of their use in environmental projects such as solar power projects or wind energy. Easier trade of these goods is therefore expected to facilitate environmental projects or the reduction of negative environmental impacts of existing production and consumption processes. The figure 1-2 gives an example of such linkages. It provides the correlation between export and import of 15 products (which fall under the 'Renewable Energy' category within the APEC list) with the actual renewable energy production, excluding hydroelectricity, in a sample of 184 countries in 2014. The figure shows that there is a strong positive correlation between the trade of these renewable energy related products and actual production thereof, demonstrating the positive correlation between trade liberalization of EGs and the achievement of environmentally beneficial outcomes.

Figure 1-2: Correlation between renewable energy production and renewable energy related goods trade in a sample of 184 countries in the world (export and imports)



Source: Authors' calculation.

Notes: Data on renewable energy production is taken from the World Bank World Development Indicators and excludes hydroelectricity production. Data on export and import of the 15 APEC-listed renewable energy goods is taken from UN COMTRADE data accessed through WITS.

The rest of this paper is divided into five sections. Section two begins with an analysis of recent trends in the environmental goods market which highlights key statistics such as export growth rates, intra-regional trade, and the top players and products in the global EG market. Section three provides an analysis of trends in trade policies for environmental goods based on average tariffs and non-tariff measures. Section four looks at what constitutes environmental services, their complementarity with environmental goods, and their role in environmental projects which is illustrated by three brief case studies. This is followed by section five, which provides an analysis on how tariffs, non-tariff measures and services restrictiveness affect the trade flow of environmental goods using a gravity model. Section six concludes with summarizing the three key policy messages of the paper which can be incorporated into EGA or other bilateral and multilateral trade agreements covering EGs.

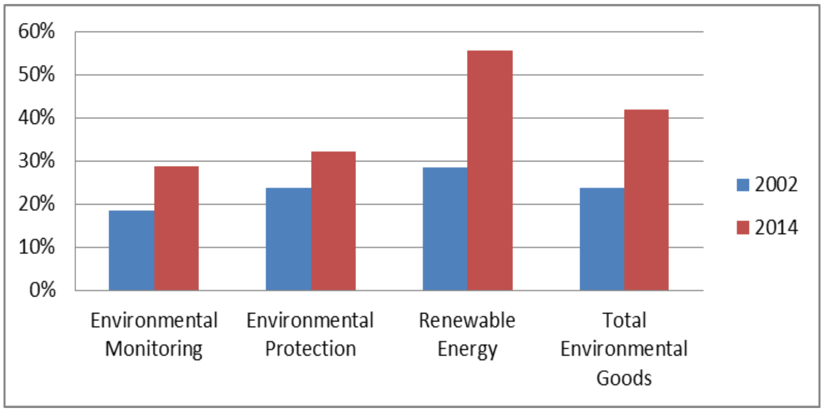
2. Trends in Environmental Goodstrade in Asia and the Pacific

2.1. Trends in overall export and imports

Overall, environmental goods have become an important trade opportunity for Asia-Pacific in terms of both exports and imports (as shown in figures 2-1 and 2-2). The Asia-Pacific region holds a substantial share of exports across all EG categories and these shares have been increasing significantly since 2002. The region increased its share in total world export of EGs from 24% in 2002 to 42% in 2014. The increase in market share was observable across each category during this period, with the regional share of world trade of renewable energy goods increasing from 29% to 56%, shares in environmental protection goods increasing from 24% to 32%, and share of environmental monitoring goods increasing from 18% to 29%). It is clear that the main contributor to this growth was the renewable energy (RE) category, which has been dominated by China (accounting for 51% of Asia-Pacific exports) followed by the Republic of Republic of Korea, Japan, Singapore and Malaysia. The import share of the

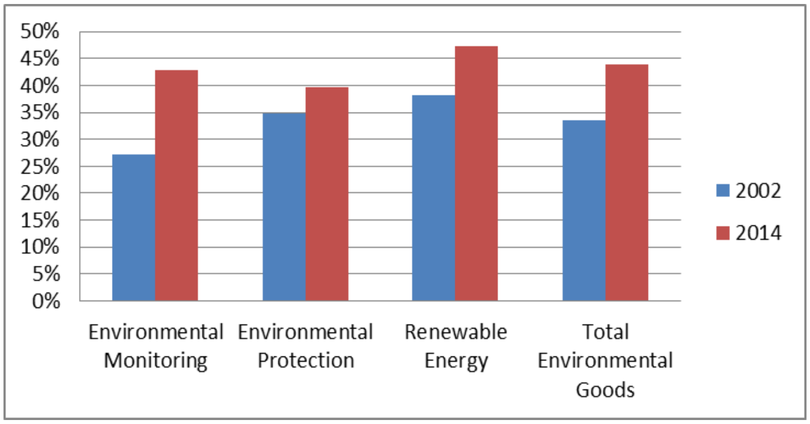
Asia-Pacific region also saw a substantial increase, with the region contributing to 44% of world imports in 2014, up from 34% in 2002.

Figure 2-1: Asia-Pacific exports as a share of total world exports in corresponding environmental goods category (in %)



Source: UN COMTRADE Data accessed through WITS

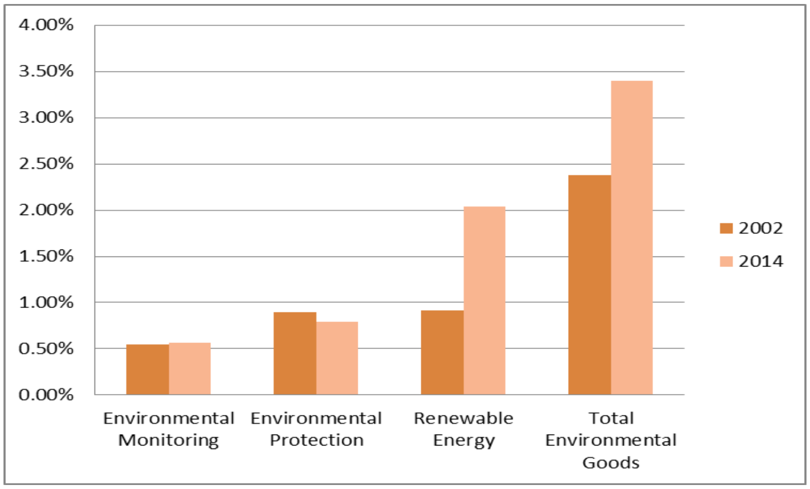
Figure 2-2: Asia-Pacific imports as a share of total world imports in corresponding environmental goods category



Source: UN COMTRADE Data accessed through WITS

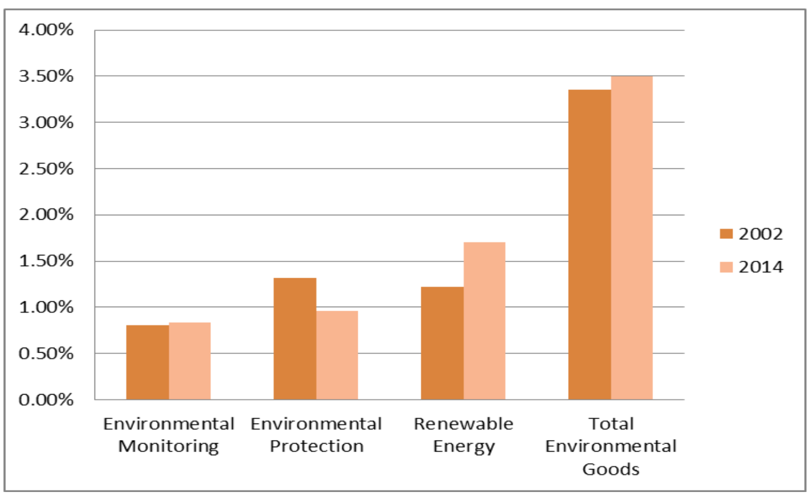
However, as mentioned earlier, this list only includes 54 goods and so in terms of the proportion of total world trade, this share is not very substantial. Nevertheless the proportion of environmental goods within the total exports for the Asia-Pacific region has been steadily climbing from 2.37% in 2002 to 3.40% in 2014, while imports have marginally increased from 3.35% to 3.50% over the same period (figures 2-3 and 2-4, respectively).

Figure 2-3: Asia-Pacific environmental goods exports to the world (as % of total exports)



Source: UN COMTRADE Data accessed through WITS

Figure 2-4: Asia-Pacific environmental goods imports from the world (as % of total imports)



Source: UN COMTRADE Data accessed through WITS

Significantly, developing countries make up 78.6% of Asia-Pacific's EG exports and these countries have seen the biggest relative growth in their EG export share, which increased from 1.3% to 3.16% of their total exports over 2002-2014. Further trade liberalization outside Asia-Pacific via the EGA negotiations is therefore particularly good news for exporters from developing countries in the region. For least developed countries in Asia-Pacific, EG trade is also rising but still makes up only a very small component of their exports at 0.15% in 2014 (with over 90% of it being in renewables) compared with 0.09% in 2002.

2.2. Share of environmental goods in intra-regional trade

The share of intra-regional trade of EGs has seen a steady increase as well. In 2014, 63% of total EG exports of the region were intra-regional while 54% of the imports were sourced from within the region (Tables 2-1 and 2-2, respectively). This signifies the increasing emergence of the region as a market for environmental goods. In terms of intra-regional trade, environmental goods are also taking a steadily increasing role in Asia-Pacific's total goods trade. Between 2002 and 2014, intraregional exports of EGs (by value) rose from 2.79% to 4.11% of total exports while imports increased from 2.63% to 3.65%

Table 2-1: Share of intra-regional export in total export of environmental goods of the Asia-Pacific region

	Environmental Monitoring	Environmental Protection	Renewable Energy	Total Environmental Goods
2002	41.47%	56.35%	58.30%	53.49%
2014	52.13%	61.09%	66.56%	62.87%

Source: UN COMTRADE Data accessed through WITS

Table 2-2: Share of intra-regional import in total import of environmental goods of the Asia-Pacific region

	Environmental Monitoring	Environmental Protection	Renewable Energy	Total Environmental Goods
2002	27.05%	46.80%	55.10%	41.71%
2014	38.29%	55.10%	64.89%	53.61%

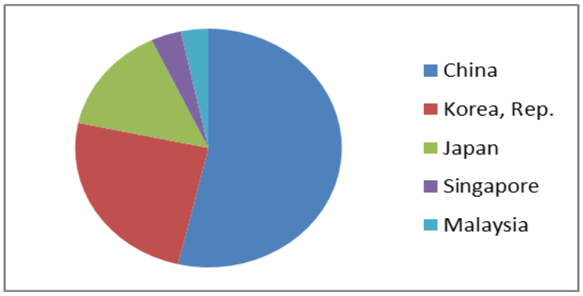
Source: UN COMTRADE Data accessed through WITS

2.3. Top players

Interestingly, top five regional exporters of environmental goods remained the same across all three major categories of EGs. The Renewable Energy (RE) category is the most prominent among EGs in terms of the export and import volumes. In terms of exports, this sector is dominated by China (accounting for 51% of total regional exports) followed by Republic of Korea, Japan, Singapore and Malaysia. China's performance can be partly attributed to the major investments by the government in renewable energy sector. In 2009, China – with $39.1 billion investments in the renewable energy sector – replaced the United States ($22.5 billion) to emerge as the world's largest investor in renewable energy. China's investments are even more remarkable in terms of share of GDP: in 2010, renewable energy investments reached 0.55% of GDP, which was more than double that of the United States at 0.23% (Zhang, 2016). Currently China's solar panel production is estimated to account for some two-thirds of global production[3] – this boom in productive capacity has caused significant downwards pressure on global prices. As discussed in box 2.1, the emergence of China as a prominent player in the global renewable energy sector was strongly driven by public policy support ranging from national development strategy, national legislations and sector specific policies.

Figure 2-5: Top five renewable energy goods exporters in Asia-Pacific in 2014

[3] http://www.earth-policy.org/data_highlights/2014/highlights47

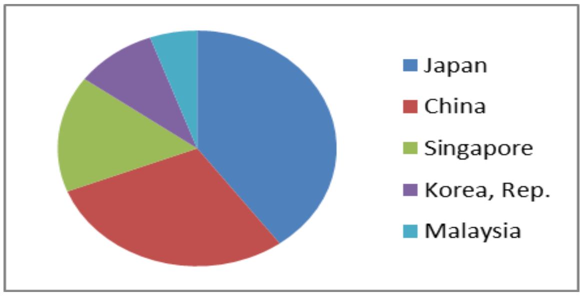


Source: UN COMTRADE Data accessed through WITS

Note: Shares are based on total accounting for 94.96% of total Asia-Pacific exports of renewable energy goods

Japan leads exports in both environmental monitoring equipment and environmental protection equipment, with China, Singapore, Korea and Malaysia rounding up the top five for both product groups (Korea coming ahead of Singapore in the latter).

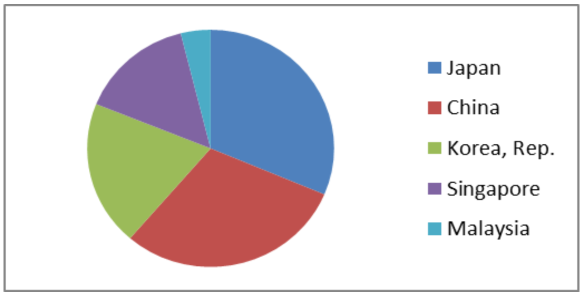
Figure 2-6: Top five environmental monitoring equipment exporters in Asia-Pacific in 2014



Source: UN COMTRADE Data accessed through WITS

Note: Shares are based on total accounting for 88.91% of total Asia-Pacific exports of environmental monitoring equipment.

Figure 2-7: Top five environmental protection equipment exporters in Asia-Pacific in 2014



Source: UN COMTRADE Data accessed through WITS

Note Shares are based on total accounting for 87.61% of total Asia-Pacific exports of environment protection equipment.

Box 2.1: Policy foundations of China's growth in renewable energy sector

The phenomenal growth in the renewable energy related goods in China can be traced back to the policy support received by the sector. This box outlines some of the major policies and strategic support given by the government since 2005:

Guided by national development strategies: The 11th five-year plan (FYP) expressed concern on the environmental costs of the development model followed by the country. It integrated several environment related targets, including, a set target of 20% reduction in energy consumption per unit of GDP over the five years of the plan. Building on this the 12th five-year plan (FYP) for 2011–15 adopted a carbon intensity target as a domestic commitment. Under the target, energy intensity was to be cut by 16 per cent nationwide and carbon intensity by 17% relative to 2010 levels.

Guaranteed grid connection and full purchase: The Renewable Energy Law, which was promulgated in 2005 and took effect as of 1st January 2006, and its 2009 amendments (together with other relevant regulations) obligate power grid companies to provide grid-connection services and related technical support, and to purchase and dispatch the entire amount of electricity generated from renewable energy projects when entering into interconnection agreements with projects.

Mandatory market share (MMS): China's Renewable Energy Law states that a "mandated market share" of renewable power should be required of the major national generating companies.

Government concession program: Under the concession program, investors and developers are selected for concession projects through a competitive bidding process. The government commits to coordinating the power grid connection and purchasing all electricity generated by the concession projects.

Government financial support for renewable energy projects: China's government supports renewable energy projects by providing financial subsidies. For example, in 2009 the government initiated two national solar PV subsidy programs to boost its domestic solar industry: the Solar Roofs Program, which provides upfront subsidy for building-integrated PV systems and a subsidy of 50% of the bidding price for the supply of critical components, and the Golden Sun Demonstration Program which provides subsidies for both on-grid and off-grid PV system.

Financial support for innovation and R&D: Consistent with the Medium- to Long-Term Plan for the Development of Science and Technology, the 11th FYP for Science and technology – which provides short-term targets and goals for China's R&D and innovation activities from 2006-2010 – lists energy technologies as a key area. Specific publicly funded science and technology programs were established to support innovation activities and R&D.

Financial support for renewable technology manufacturing: For the purpose of promoting self-sufficiency in the renewable energy equipment, China offers import tax exemptions for complete sets of foreign-made equipment as well as import tax exemptions for key foreign-made parts which are necessary for the development of key equipment to domestic enterprises. China's state-owned banks and local governments have also provided strong financial support for renewable manufacturing industry.

Note: This box is a brief summary of discussions in Zhang et al. (2015) and Zhang (2016).

2.4. Revealed comparative advantage

Based on trade flows, the Revealed Comparative Advantage (RCA) Index can be used to demonstrate the "relative trade performance" of a country for a given product (Balassa, 1977, p.327), in this case environmental goods. Introduced by Balassa (1965), the RCA index is the ratio of a product's share in a country's exports in relation to its share in world exports, and an RCA value > 1 is said to reveal a comparative advantage. China, for example, has a comparative advantage in the RE category because it exports a large amount of photovoltaic cells (and other RE goods) relative to its overall share in global exports. The table 2-3 shows a list of Asia-Pacific countries which have a revealed comparative advantage in any of the four environmental categories, together with the relevant RCA value.

Table 2-3: Asia-Pacific countries with an RCA index greater than one in any of the four environmental categories in 2014

Country	Env. Monitoring Equipment	Env. Protection Equipment	Renewable Energy
Asia Pacific Region	***0.804587***	***0.855791***	***1.523957***
China	X	X	2.11
Japan	2.58	2.24	1.94
Singapore	1.74	1.80	X
Korea	X	1.70	3.97
Malaysia	1.05	X	1.31
Russia	X	X	X
Philippines	1.12	X	1.87
Sri Lanka	X	X	X
Georgia	X	X	X
Palau	7.34	X	1.58

Source: Authors' calculation using data from UN COMTRADE Data accessed through WITS

Countries may also have what is termed an "Emerging RCA," in a specific category of goods, which refers to the scenario when their RCA index has shown an increase compared to a previous year. Countries which currently have an emerging RCA scenario based on the decade preceding 2015 – not including those already listed above – are summarized in table 2.4.

Table 2-4: Emerging RCA countries in Asia-Pacific (comparing 2005 and 2014)

Env. Monitoring Equipment	Env. Protection Equipment	Renewable Energy
Asia-Pacific Region	Armenia	*Asia-Pacific Region*
Armenia	China	Azerbaijan
Cambodia	Fiji	Cambodia
China	French Polynesia	French Polynesia
Hong Kong	Hong Kong	Georgia
India	India	Kazakhstan
Republic of Korea	Kyrgyz Republic	Kyrgyz Republic*
Mongolia	Malaysia	Mongolia
New Caledonia	Mongolia	Singapore
New Zealand	Russia	Thailand
Sri Lanka	Sri Lanka	Vietnam
Thailand	Thailand	
Turkey	Turkey	
Vietnam	Vietnam	

*Based on comparison with 2015 figure (2014 data N/A)

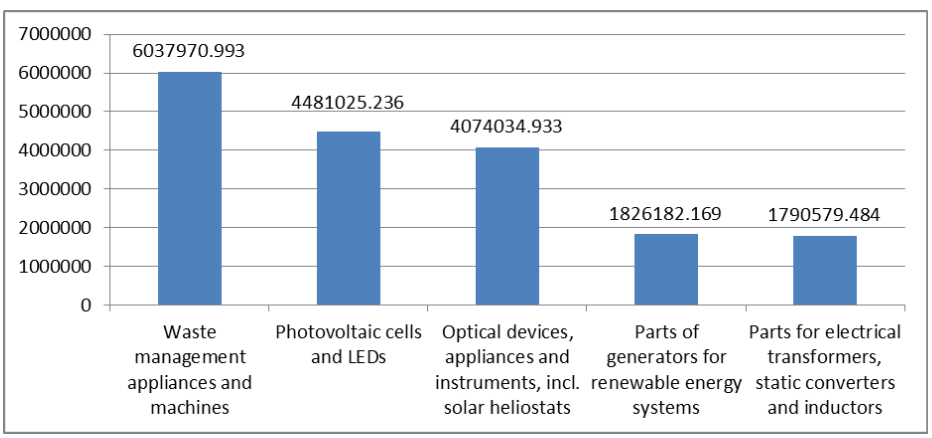
Source: Authors' calculation using data from UN COMTRADE Data accessed through WITS

As can be seen from the table 2.4, a total of 22 different countries have an emerging RCA in one or more environmental goods categories. Similarly, between 2005 and 2014, the Asia-Pacific region shows an emerging RCA in renewable energy and environmental monitoring equipment. Significantly, this is more than twice the number of Asia-Pacific countries who already have an RCA in one or more categories, which demonstrates that there is significant scope for future export increases. Policy makers may therefore wish to design policy instruments that capitalize on these emerging comparative advantages to capture future market share. These results moreover corroborate the macroeconomic lessons from above, providing insight into which countries have been the drivers of environmental goods acquiring an increasing share in the export basket of the region.

2.5. Top products

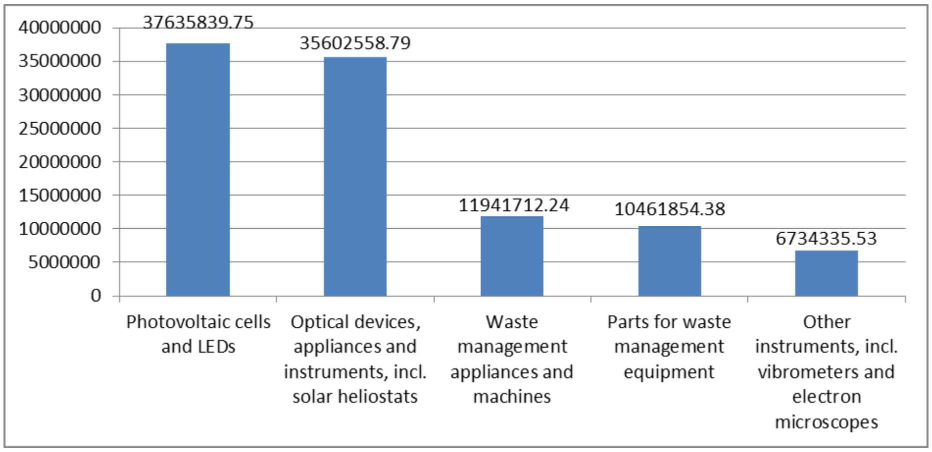
In 2002, the two most tradeed environmental goods at the six-digit level in the region were 847989 (waste management appliances and machines) and 854140 (photovoltaic cells and LEDs). With the phenomenal growth of solar energy sector, in 2015 the top place was taken by 854140 (photovoltaic cells and LEDs) and 901380 (optical devices, mainly solar heliostats used for solar-thermal power plants), both components attached to the solar energy sector. The remaining top five environmental goods categories for both years (based on HS-codes at the six-digit level) are summarized in figures 2-8 and 2-9. Waste management appliances and machines and associated parts are other prominent categories in terms of export value.

Figure 2-8: Top five environmental goods exports from Asia-Pacific in 2002 (by trade value, in 1000s USD)



Source: UN COMTRADE Data accessed through WITS

Figure 2-9: Top five environmental goods exports from Asia-Pacific in 2015 (by trade value, in 1000s USD)



Source: UN COMTRADE Data accessed through WITS

2.6. Current and emerging markets

When working to increase environmental goods exports, it is important for businesses and policy makers working to know where the largest markets are for exports. Interestingly, China is not only the biggest exporter of photovoltaic cells in the world but also the largest market for both renewable energy products and environmental monitoring equipment (coming in second for environmental protection equipment). Other Asian countries that appear in the top 10 importers in three of the four environmental categories (as has been noted above, 'environmentally preferable goods' only consists of bamboo flooring and is therefore a small, niche market) are Hong Kong, China; India; Japan; Russian Federation and Singapore. The top ten markets for each category is summarized in the table 2-5.

Table 2-5: Largest markets in 2015 for environmental goods categories (by shares in global imports)

Environmental monitoring	Environmental protection	Renewable energy
China (17.25%)	United States (13.68%)	China (27.07%)

United States (14.77%)	China (11.04%)	United States (12.10%)
Germany (9.22%)	Germany (6.92%)	Hong Kong, China (5.75%)
Japan (4.55%)	Mexico (4.04%)	Mexico (5.41%)
United Kingdom (3.83%)	Singapore (3.96%)	Japan (5.15%)
Mexico (3.59%)	Other Asia, nes (3.59%)	Germany (4.86%)
France (3.35%)	Russian Federation (3.44%)	United Kingdom (3.04%)
Singapore (2.94%)	Japan (3.39%)	India (2.21%)
Canada (2.86%)	Canada (3.00%)	France (1.97%)
Hong Kong, China (2.66%)	France (2.78%)	Other Asia, nes (1.89%)

Source: UN COMTRADE Data accessed through WITS

It is similarly relevant to know which markets are currently growing at the fastest rate. Given the high rate of market growth for EGs, these countries may present lucrative export destinations now or in the near future. The top 10 emerging markets for three environmental categories are listed in the table 2-6, based on the weighted rate of change in trade value between 2005 and 2014 (environmentally preferable goods are excluded due to lack of data).

What we see from this is that both developed as well as developing countries present growing markets for environmental goods. Among the formers, notables include the United States and the European Union which – not surprisingly – are in the top ten for all three categories, while Russian Federation is in the top for environmental protection and environmental monitoring equipment. Among the latter, Viet Nam stands out for being in the top ten fastest growing markets for both environmental protection and environmental monitoring equipment. The other Asian economies that top growth in one or more of the environmental categories are China, India, Hong Kong, china; Singapore, Japan, and republic of Republic of Korea. Environmental monitoring equipment appears to be the most lucrative market within the Asia-Pacific region, as China takes the lead and four other Asian countries are in the top ten. Environmental goods exporters in Asia-Pacific can therefore expect to see continued strong market growth both regionally and abroad.

Table 2-6: Top emerging markets in environmental goods categories (based on % growth from 2005 to 2014, weighted by market share)

Environmental monitoring equipment	Environmental protection	Renewable energy
China	United States	Uruguay
Germany	Russian Federation	United States
United States	Netherlands	Algeria
United Arab Emirates	Germany	Japan
Vietnam	Australia	Hong Kong, China
India	Vietnam	Panama
Hong Kong, China	China	China
Singapore	Brazil	Poland
Russian Federation	Saudi Arabia	Republic of Korea

Source: UN COMTRADE Data accessed through WITS

2.7. Share of specific sub-markets (APEC, EGA, OBOR, ASEAN and RCEP)

Regional cooperation is an important tool for increasing trade in environmental goods. In Asia-Pacific, this includes APEC, ASEAN, and RCEP, as well as the thirty-three nations in the region that form part of China's "One Belt, One Road" project (OBOR[4], also known as the belt and road initiative (BRI)). APEC has already demonstrated the potential impact of coordinated trade policy by reducing tariffs on 54 environmental goods. Once the EGA concludes negotiations, it is anticipated that their seventeen members will become another important market opportunity for exporters inside as well as outside the group as the EGA is expected to extend their final tariff preferences to other nations on MFN basis. Depending on the list of products that make it to the final list – built on the APEC list and currently numbering over 300 goods – this may help catalyze a more global reduction in environmental goods tariffs (and possibly environmental services as well).

Environmental goods exports from Asia-Pacific to these regional markets are significant. Exports to APEC member countries, for example, reached 74.82% of total Asia-Pacific environmental goods exports in 2015 while with the EGA group it stood at 72.19%.

[4] OBOR or BRI is a development strategy proposed by Chinese President Xi Jinping aimed at increasing connectivity, cooperation and trade between China and the rest of Eurasia through the revival of the historical Silk Road (the 'belt') and ancient maritime lanes (the 'road'). This trade and investment-based foreign policy initiative involves massive infrastructure expansion across 60 countries, and China is planning to invest some $4 trillion over an indefinite time period in projects ranging from gas pipelines, power plants, highways, and railway links to entire new ports and transportation hubs (the Economist (2016))

Taken together, APEC and EGA members account for roughly 87% of Asia-Pacific EG exports when accounting for overlapping bloc membership. EGA tariff reductions are therefore likely to increase Asia-Pacific export opportunities in environmental goods, even before the new tariff lines are extended on an MFN basis.

OBOR, has immense potential for galvanizing trade in environmental goods.. Asia-Pacific environmental goods exports to OBOR countries within the region currently accounts for 48.65% of total exports, and so OBOR-led infrastructure expansion – together with lowered tariff lines – will facilitate easier intra-regional trade in environmental goods.

Table 2-7: Comparison of Asia-Pacific EG exports to EGA, APEC, OBOR, ASEAN and RCEP blocks (as % of total regional exports) using mirror data

	EGA	APEC	OBOR (AP*)	ASEAN	RCEP	EGA+APEC‡
2002	81.84%	87.26%	51.15%	12.56%	47.23%	97.78%
2014	74.10%	74.10%	53.01%	11.19%	51.08%	87.57%
2015	72.19%	74.82%	48.65%	9.19%	52.35%	87.06%

*33 OBOR countries found in Asia-Pacific[5]

‡ Accounting for overlap between blocks (using disaggregated data)

Source: Authors' calculation based on UN COMTRADE Data accessed through WITS

3. Trends in trade policies in environmental goods

3.1 Tariffs

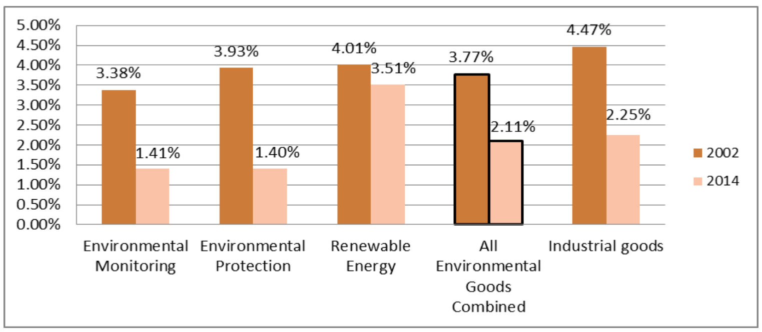
Average tariffs on most environmental goods in the APEC list were already below five percent before implementation, averaging 3.77% in 2002 and 2.11% in 2014.[6] This

[5] Afghanistan; Armenia; Azerbaijan; Bangladesh; Brunei Darussalam; China; Georgia; Hong Kong, China; Indonesia; India;Islamic Republic of Iran; Kazakhstan; Kyrgyz Republic; Cambodia; Republic of Korea; Lao PDR; Sri Lanka; Macao,, China; Myanmar; Mongolia; Malaysia; Nepal; Pakistan; Philippines; Democratic People's Republic of Korea;, Russian Federation; Singapore; Thailand; Tajikistan; Turkmenistan; Turkey; Uzbekistan; Viet Nam.

[6] Excluding "Environmentally Preferable Goods" (product group 441872) which is the only non-industrial product and accounts for virtually none of Asia-Pacific's EG trade. Group 441872 consists of multilayered bamboo panels,

stands marginally lower than the average weighted tariff of industrialized goods across Asia-Pacific as a whole (see figure 3-1) and also developing countries and least developed countries in the region (figure 3-2 and 3-3). Renewables were the exception to this trend, which despite their prominence had 1.26 percentage points higher tariffs than industrial goods in 2014. Tariffs remain significantly higher in least developed countries of the region compared to the regional average, at 4.73% versus 2.10% in 2014.

Figure 3-1: Weighted average applied tariffs for environmental goods categories in Asia-Pacific, compared to industrial goods, 2002 and 2014



Source: TRAINS data accessed through WITS

Most of these reductions have, in effect, been spearheaded by developing economies – which have experienced an average fall from 4.48% to 2.35% - while least developed countries have only seen a slight decrease in average weighted tariffs from 5.47% to 4.73%. This is summarized in the figures below, which exclude “environmentally preferable goods” due to lack of data as well as its still-negligible role in regional exports.

Figure 3-2: Weighted average applied tariffs for environmental goods categories among developing countries in Asia-Pacific, 2002 and 2014

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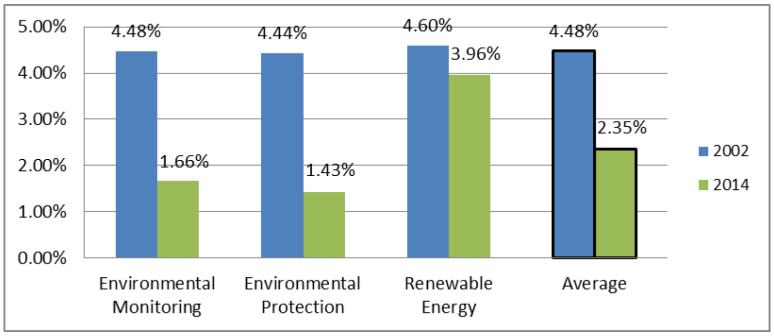
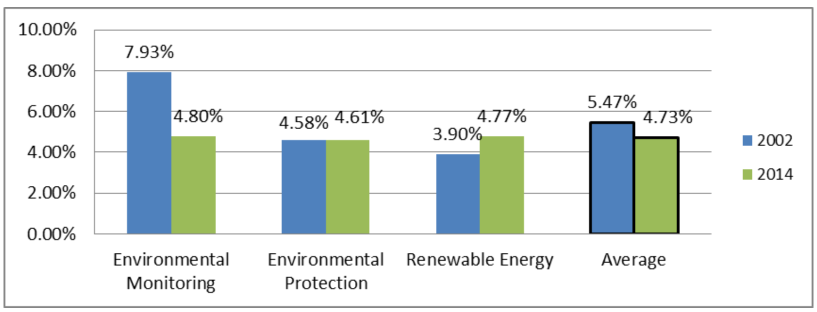
and is thus an agricultural good, and had a weighted average tariff across Asia-Pacific of 8.39% in 2014 (14.81% amongst Asia-Pacific LDCs).



Note: 'Average' is unweighted average of the three categories.

Source: TRAINS data accessed through WITS

Figure 3-3: Weighted average applied tariffs for environmental goods categories among Asia-Pacific least developed countries, 2002 and 2014

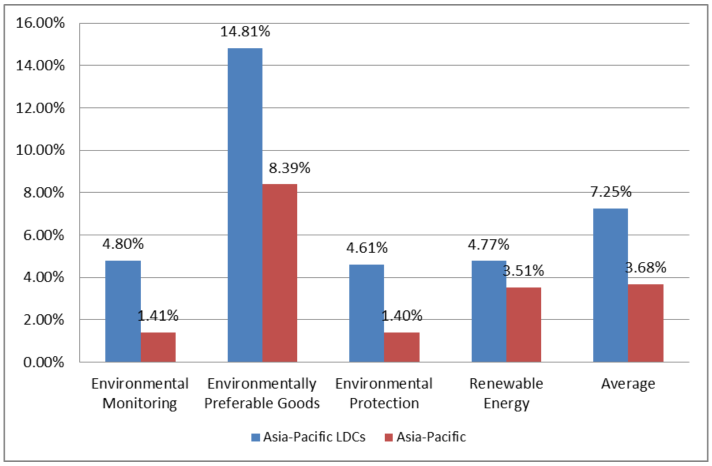


Note: 'Average' is unweighted average of the three categories.

Source: TRAINS data accessed through WITS

Thus, tariffs remain higher amongst least developed countries as compared to the Asia-Pacific region as a whole.

Figure 3-4: Weighted average applied tariffs on environmental goods categories in 2014, contrasting Asia-Pacific region and least developed countries in Asia-Pacific

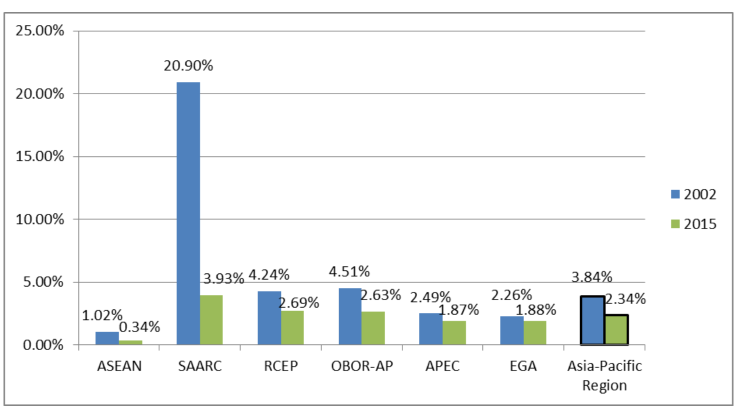


Note: 'Average' is unweighted average of the three categories.

Source: TRAINS data accessed through WITS

Comparing various regional economic blocks, the weighted average tariffs for environmental goods in 2015 for SARC, RCEP, and OBOR countries in Asia and the Pacific were slightly higher than the average for the region as a whole while for the EGA parties, APEC, and ASEAN they were slightly lower. Inter-block differences are relatively low, as none of the country groupings had average tariffs higher than 4% in 2015. This is significantly lower than in 2002, where the average tariff was 20.90% in SAARC followed by 4.51% in the Asia-Pacific OBOR countries.

Figure 3-5: Comparison of weighted average tariffs on environmental goods between 2002 and 2015 for various regional blocks (ASEAN, SAARC, RCEP, OBOR (AP), APEC and EGA) and Asia-Pacific region as a whole



Source: TRAINS data accessed through WITS

The lowering of tariff on environmental goods is certainly a move in the right direction. However, a point that needs to be highlighted is the need for a "holistic approach" to tariff reduction/elimination. The low tariffs on environmental goods included in the APEC list rarely apply to complementary goods that are required for the implementation of any specific environmental project. Box 3.1 illustrates this using the example of Solar Lamp Kits and wind power projects. This means that while listed environmental goods frequently face average tariffs of close to zero, complementary goods required in an industry typically face higher tariffs. For least developed countries in particular, tariffs for non-listed goods were often close to 10%, going as high as 14.85% and 20.32% for some of the complementary goods used in the solar industry (HS 850710 and 940510, respectively). Policymakers may therefore need to consider the effective tariff rates on the entire linkages of direct EGs and their complementary goods ("indirect EG"?) by carefully considering all components that are involved in environmental projects. Otherwise, the positive impact of a tariff reduction in few of the components related to an environmental project or industry may be substantially weakened by higher tariffs in related components.

Box 3.1: Need of a holistic approach to tariff liberalization

As demonstrated in the previous section, tariffs on environmental goods on the APEC list are generally low. However, this list is unlikely to cover all or even the majority of the main components required for environmental projects, which therefore still face significantly higher average tariffs. For the purpose of illustration, therefore, this section briefly describes two environmental projects case studies (based on European Commission 2016 report) with an analysis of the average tariffs the key components would face – on average – within Asia-Pacific. While goods on the APEC list typically have negligible tariffs, complementary goods face tariffs of 3% or higher, sometimes surpassing 10% among LDCs.

As mentioned above, the phenomenal rise of China's productive capacity in photovoltaic cells has been a key driver of falling costs. However, solar PV installations require other accessories such as converters and batteries. Converters are devices which alter the nature of an electrical signal (such as from DC to AC or from high to low voltage) and are key components in any energy or battery installation.[7] Static converters, which belong to product group 850440 (a category that also includes different types of power supplies), are a key product in many renewable energy projects such as solar farms and solar lamp kits.

Low-cost solar lamp kits are an example of a solar industry which still faces significant tariffs in spite of the inclusion of solar panels on the APEC list. Solar lamp kits are part of off-grid household-based solar power solutions which promote electrification in rural areas that are difficult to connect to the national grid. The relevant products for manufacturing them include small solar photovoltaic panels, solar batteries, LED lamps and charging cables which fall under the following four product groups:

Table 3-1: List of main goods required for solar lamp kit project

Product name	**HS classification**
Solar PV panel	HS 854140
LED lamps	HS 940510
Battery	HS 850710
Static converter	HS 850440

Source: WITS/COMTRADE

Photovoltaic cells (854140) are on the APEC list and while their tariffs in most countries are at or near 0%, the same cannot be said for the other products. Static converters are a particularly important component for most solar energy installations, but in Asia-

[7] Static converters are electrical networks mainly composed of semiconductor devices, and are used in a large variety of domains from telecommunications to particle accelerators. Source: https://cds.cern.ch/record/987498/files/p13.pdf

Pacific the average import tariff for static converters (HS 850440) was 2.32% for developing countries in 2015, which compares to 0.02% for photovoltaics. Among least developed countries, this rises to 5.43% and 2% for the two categories, respectively. Excluding solar panels, the three other types of products required to make solar lamps face average tariffs of 3.71% for developing countries and 13.5% for least developed countries in 2015. Including photovoltaic cells, average tariffs for solar lamp kits still reach up to 10.65% as shown intable 3-2..

Table 3-2: List of average weighted tariffs applied to solar lamp kit project goods in Asia-Pacific (in %)

	2002	2014	2015
Asia-Pacific	3.11%	2.58%	2.313%
Asia-Pacific Developing	4.57%	3.56%	2.80%
Asia-Pacific LDCs	17.02%	5.64%	10.65%

Source: TRAINS data accessed through WITS

Let us analyse the case of wind power projects. About 2.6% of global electricity generation comes from wind power, making it the second-largest renewable energy source after hydropower.[8] In 2015, wind power was the largest source of new renewable energy installations with a record 63 GW added for a total of about 433 GW in global capacity.[9] For a standard wind power project, three of the component categories (*) are already in the APEC list of environmental goods while six others are not, as summarized in the table below.[10]

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8 http://www.iea.org/topics/renewables/subtopics/wind/

9 Ren21 (2016), Renewables 2016 Global Statis Report, page 23.

10 This industry study is based on the Lake Turkana Wind Farm (Kenya) case study in the EU's 2016 EGA sustainability report. The project – begun in 2014 – aims to become the largest windfarm in Africa and supply 20% of Kenya's energy needs upon completion in 2017.

Table 3-3: List of main goods required for wind power project

Product name	HS sub-category
Tower	HS 730820
Generator	HS 850231*
Gear box	HS 848340
Ball bearings	HS 848210
AC generators (alternators) of an output exceeding 750 kVA	HS 850164*
Rotor and blade	HS 841290*
Electrical lightening and signalling equipment; parts of engines and motors	HS 851290
33/400 kV step-up transformer	HS 850431
Double circuit high-voltage busbar and associated circuit breaker system	HS 853620

Source: WITS/COMTRADE

APEC EG products 850231, 841290 and 850164 in 2015 had tariffs of 1.44% on average for AP developing countries. However, other required products face tariffs of up to 7.66% and the average for all nine product groups is 3.45% for developing countries (5.68% for LDCs).

Table 3-4: List of average weighted tariffs applied to wind power project goods in Asia-Pacific (in %)

	2002	2014	2015
Asia-Pacific	5.57%	2.86%	3.02%
Asia-Pacific	6.78%	3.26%	3.45%

Developing			
Asia-Pacific LDCs	10.50%	3.56%	5.68%

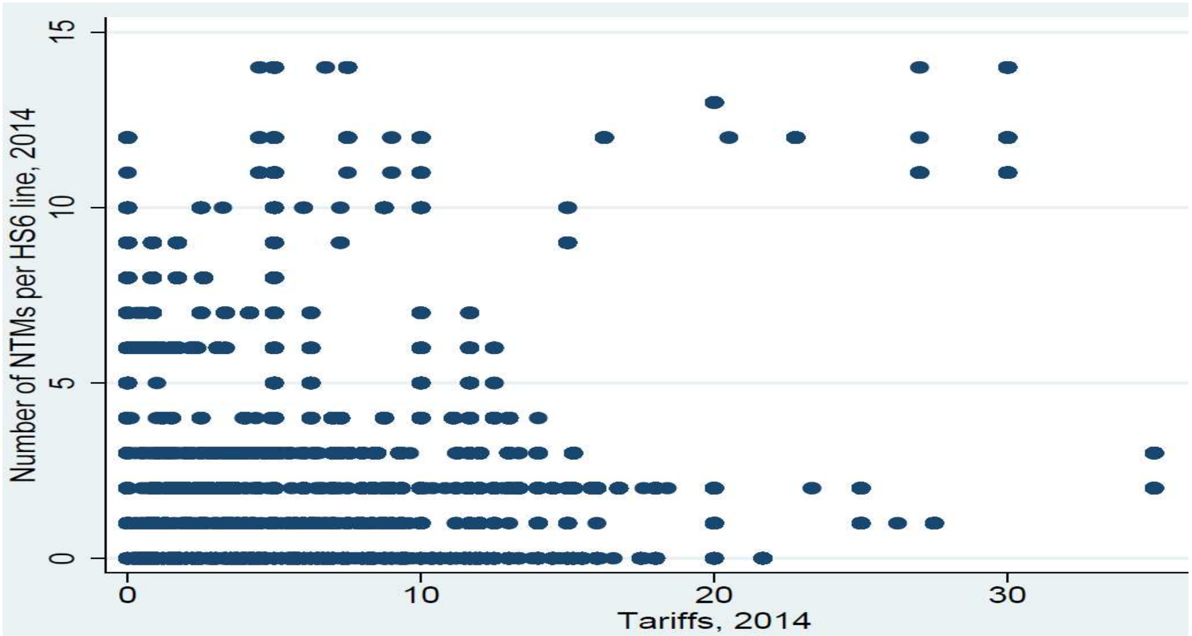
Source: TRAINS data accessed through WITS

3.2 Non-tariff measures

According to UNCTAD (2016), environmental goods still face significant Non-Tariff Measures (NTMs). Since tariffs are already relatively low, further tariff reductions are not likely to increase trade in environmental goods by more than a few percentage points (European Commission, 2016, pp.163-294). Moving forward, policy makers intending to boost environmental goods trade should therefore focus more on lowering NTMs than tariff lines. The figure 3-6 provides a scatter plot between NTMs and tariffs in a set of 65 countries for which the NTM data is currently available under the TNT initiative, which is the most comprehensive dataset on NTMs currently available. The figure below shows that for most products, tariffs are much lower than 10%. However, even in cases with almost zero tariffs these products face a similar number of NTMs per product as compared to those products that have tariffs of over 5%. This suggests that the impact of NTMs requires further research.

Figure 0-1: Comparing tariffs and average number of NTMs in the world sample[11], 2014

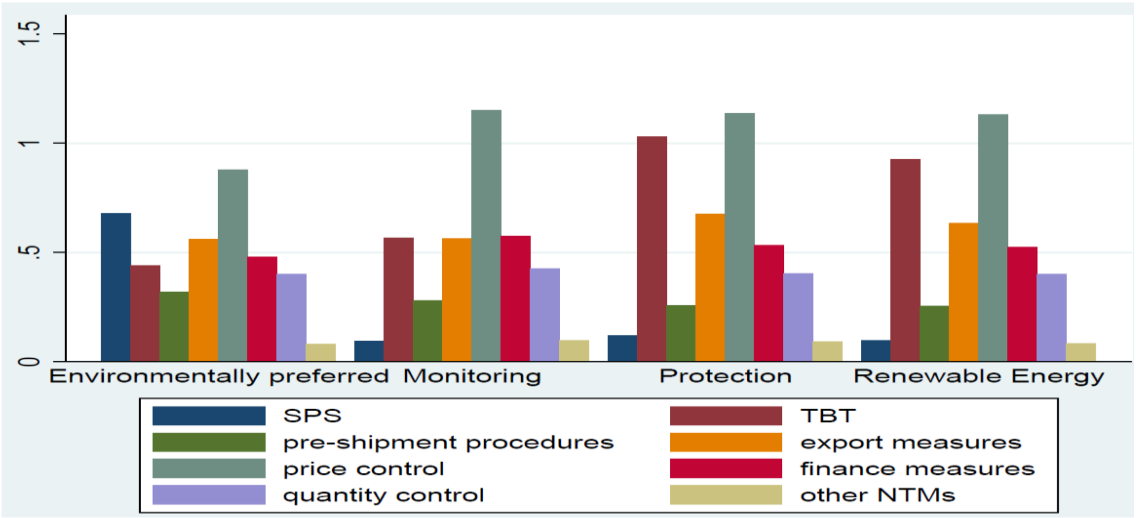
[11] See section 5 for the details of the sample.



Source: Authors' calculation using UNCTAD TRAINS NTM data set

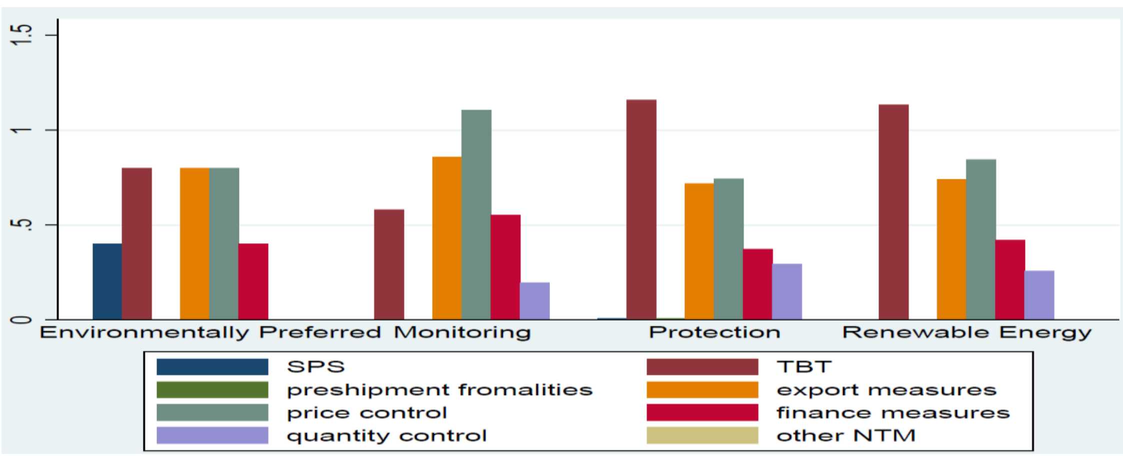
The figures 3-7 and 3-8 analyze the NTMs currently in place based on the TNT database. Figure 3.7 gives the number of different NTM categories per product based on the UNCTAD (2012b) classification of NTMs. Price Control measures, TBT , Export related measures and Finance measures emerges as the four main categories of NTMs impacting the prominent EG sector categories. For environmentally preferable goods that comprises of bamboo related products, SPS measures also emerge as a prominent NTM. Figure 3-8 reflects that the top NTMs categories remaing the same within the sub-sample of Asia-Pacific countries included in the sample.

Figure 0-2: Average number of NTMs per product, world sample



Source: Authors' calculation using UNCTAD TRAINS NTM data set

Figure 0-3: Average number of NTMs per product, Asia-Pacific sample average



Source: Authors' calculation using UNCTAD TRAINS NTM data set

As discussed in the box 3.2, some of these NTMs are linked to the different state support measures to particular EG industries. Given the increasing role of Asia-Pacific economies, it is not surprising to find that most of the state measures imposed in the EG sector affect at least one of these economies. Like NTMs in any sectors, some of the NTMs could be due to legitimate policy objectives while others could be motivated by protectionist tendencies. The analysis here only shows the number of NTMs and not their impacts. Section 6 of this paper delves deeper into estimating the trade reducing impact of the stock of the current NTMs.

Box 3.2: State measures affecting environmental goods sectors: Case study of solar and wind energy sectors

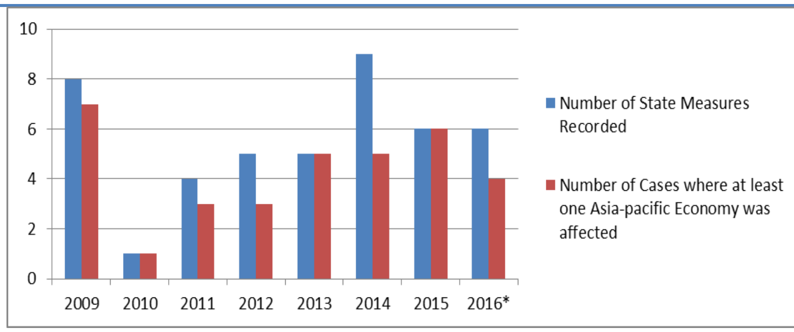
As discussed earlier, governments have started taking active interest in the environmental goods sector often using different policy tools. Some of these state measures are considered hampering to foreign commercial interests and can be seen as discriminatory. It is difficult to track these measures on a systematic basis.

In the after-math of the outbreak of the 2008 financial crisis, many governments resorted to subsidized financing in the form of bailing out industries that were severely injured. Such measures are not part of WTO disciplines (agreements) and thus are not included in the WTO reports. However, the Global Trade Alert (GTA) initiative, gathering data from a wider range of sources and consequently capturing a larger variety of trade distorting measures, aims to close the data gap on less transparent trade distorting measures.

Solar and Wind energy sectors have recently seen a variety of state measures being implemented. This section analyses the state measures affecting the wind and solar sectors[12] using the GTA dataset. Since 2009, GTA data has so far recorded 44 instances of global state measures affecting solar or wind energy sectors. As shown in figure 3.9 , most of these measures affected economies in the Asia-Pacific region. Figure 3.10 shows the composition of these state measures. Localization measures, trade defence measures (AD, CVD, safeguard) and state-aid (including subsidies and bail outs) emerges as the top three categories of state measures affecting these two sectors. Like in any other sectors, some of these state measures are retaliatory and are thus in response to other state measures.

Figure 0-4: Number of state measures affecting solar and wind sectors

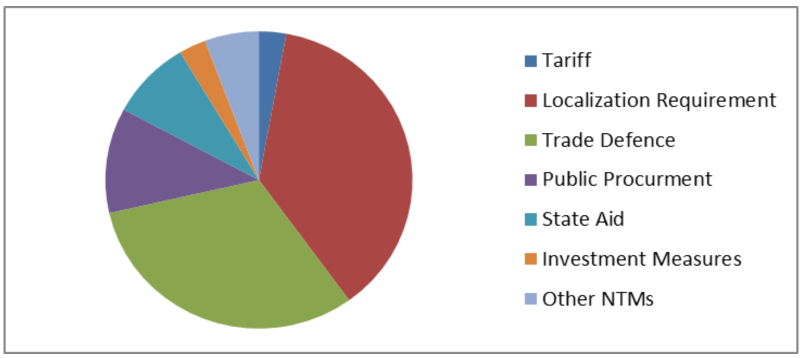
[12] Since the GTA records data at 4 digit level it is difficult to monitor the state measures for all 54 environmental goods.



Source: Author's calculation based on data from Global Trade Alert, 2016, accessed August 2016

Note: 2016 figures are updated as of June, 2016.

Figure 0-5: Proportion of different types of state measures affecting solar and wind sectors



Source: Authors' calculation based on data from Global Trade Alert, 2016 (accessed August 2016).

The experience in several industrial sectors (especially steel) show that trade distortive measures of the past can result in future escalation of protectionism and even trade wars (APTIR 2016). Hence, the impact of excessive state measures in the EG sectors can be detrimental to future trade growth in the sector. It needs to be seen whether some of the EG industries that enjoy (or have enjoyed) excessive state support measures remain competitive once exposed to world market realities.

4. The role of services in environmental projects

Services play an important role in any environmental related projects. These can be direct in terms of so-called "environmental services" or indirect in terms of services facilitating the design, installation and maintenance of environmental projects. This section discusses some of the linkages between services and environmental projects, including the trade in environmental goods. While the APEC list only includes environmental goods (EGs), the EGA negotiations aim to create an expansive list as a "living document" which will allow the addition of new products and related environmental services in the future.[13] If implemented, this may significantly increase trade in environmental goods and services, given that services are estimated to account for 65% of the market value of environmental business and the two, environmental goods and services, are highly complementary.

"Environmental services" can be used to refer to any service which has direct benefits to the environment. The WTO Services Sectoral Classification List (1991) initially identified the environmental service sectors as comprising "Sewage services" (CPC prov. 9401), "Refuse disposal services" (9402), "Sanitation and similar services" (CPC Prov. 9403), and "Other environmental services" such as noise abatement and landscape protection (9404-9409).[14] However, this classification is widely considered too narrow and inadequate (De Melo, 2015)[15] and for example does not have provisions for including renewable energy (Bernabe, 2014).[16] Given that the environment industry has been "evolving rapidly," the OECD (1998) for example calls for incorporating "a broader range of pollution management, cleaner technology and resource management activities."[17]

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[13] "Report from the 15th round of negotiations for an Environmental Goods Agreement" (2016). http://trade.ec.europa.eu/doclib/docs/2016/august/tradoc_154835.pdf

[14] Melo and Vijil (2014))

[15] De Melo, Jaime. Trade Liberalization at the Environmental Goods Agreement Negotiations: What is on the Table? How Much to Expect? In: GGKP Green Growth Knowledge Platform -Third Annual Conference Fiscal Policies and the Green Economy Transition: Generating Knowledge – Creating Impact, Venice (Italy), 29-30 January 2015.

[16] http://www.ictsd.org/sites/default/files/event/J.%20Bernabe%20-%20Addressing%20services%20related%20to%20the%20delivery%20of%20environmental%20goods.pdf

[17] OECD (1998), The Environmental Goods and Services Industry: Manual for Data Collection and Analysis,

A plethora of services can be classified as being environmentally beneficial insofar as they assist with the implementation of environmentally friendly projects and increased resource efficiency. Thus any service assisting with (for example) the construction of a photovoltaic solar panel farm from design, impact assessment, and construction to logistics, training, and maintenance could be classified as an environmental service.

Because many new climate mitigating technologies and policies are under development, it is difficult for any single definition or list of ES to be exhaustive. As Steenblik and Geloso (2011, pp.36-37) point out, this means that "extensive R&D is needed to develop most of the GHG [green house gas] mitigation activities" and will often require broad training for local capacity building. Similarly, institutions like the Green Climate Fund (GCF) and sophisticated carbon-finance mechanisms will require various financial services to secure and deploy funding, as well as measurement and verification of emissions and/or carbon sequestration (ibid.).

Environmental services are critically important because they have a great deal of jointness, or complementarity, with environmental goods (Melo and Vijil, 2014, p.3). In the words of Steenblik and Geloso (2011, p.36), "the deployment of GHG-mitigation technologies is often heavily dependent on the availability of specialised quality services, including those imported from other countries." Services may also increase the lifetime and/or efficiency of existing capital, analogous to how specialized software is required to optimize the performance of hardware.[18]

Complementarity goes both ways, meaning that increased demand for EGs will lead to a higher demand for ESs and vice versa: just as an array of services are needed to install a large solar park, conversely, an environmental consultant may propose a more efficient valve mechanism for a waste-war treatment plan. Significantly, then, some services may in fact be market drivers for environmental goods. This is particularly the case where goods are very closely associated with a particular environmental service, such as trash compacters (HS 8479.89 ex) which are almost entirely used by solid

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OECD Publications, Paris.

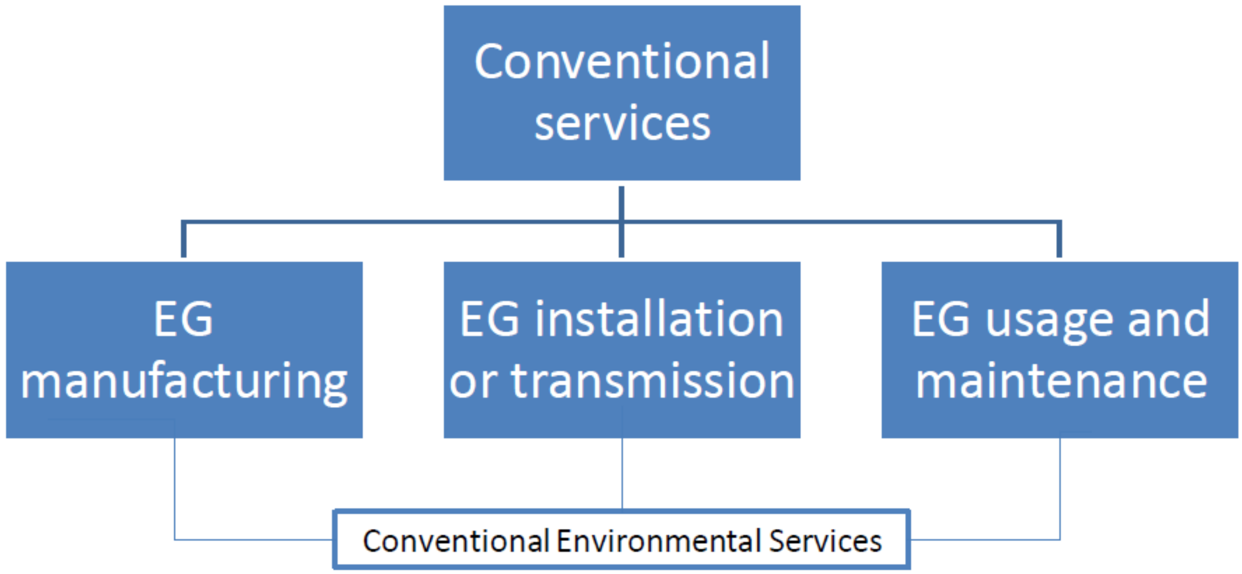
[18] Sauvage (2014), "The Relevance of Environmental Services for the Delivery of Environmental Goods" http://www.ictsd.org/sites/default/files/event/J.%20Sauvage%20-%20OECD%20Presentation.pdf

waste management services (Steenblik et al., 2005, pp.17-18). The level of complementarity may vary, but the key lesson is that a decrease in barriers to trade in environmental services is likely to create synergies; thus, "the potential benefits to simultaneously liberalising trade in environmental services and in environmental goods are likely to be much greater than liberalising trade in only one or the other" (Steenblik et al., 2005).

Trade liberalization in environmental services is also critical since knowledge and capacity in renewable energy and other climate mitigating technologies varies across nations, and is often unavailable in developing countries (Steenblik and Geloso, 2011, p.37). Without access to appropriate service provision, countries will face difficulty installing modern climate technologies or develop local capacity.

It is difficult to summarize the full spectrum of environmental services given the lack of a standardized definition. Moreover, as with environmental goods, many services have dual use and may therefore be environmentally preferable (i.e. non-environmental services which achieve an environmentally friendly objective, such as supporting an environmental goods manufacturer) even if they are not a traditional environmental service. Similarly, distribution services (whether public or private) can also be considered environmental services, such as waste collection and recycling (direct ES) or electricity distribution from renewable energy sources (indirect ES). Again, non-environmental services which facilitate the provision of such utilities can also be considered as environmental services insofar as they assist with the achievement of environmentally beneficial outcomes. For simplicity, a conceptual model is presented in figure 4-1, which summarizes these various forms of environmental services.

Figure 4-1: Various forms of environmental services



Source: Authors compilation

As with EGs, one of the main challenges to liberalizing ES is the difficulty of carving out what counts as services that are specific to the environment, particularly since such a wide variety of technologies and services are relevant to climate change abatement. Moreover, given the rapid pace of technological change, any given list is likely to become quickly outdated, which is why the EGA is aiming to become a living agreement to allow the addition of new products in the future.[19]

However, ESs also face other potential barriers to trade dependent on its mode of supply. According to Steenblik and Geloso (2011, pp 38-39), mode 3 and 4 are the main provision forms for environmental services and so trade barriers are most likely to arise in the form of investment restrictions or impediments to the temporary movement of service providers. Other possible barriers include: barriers to entry in large-scale projects; impediments to qualification and licensing of foreign professionals; procurement regulation for public projects; building regulations and technical standards;

[19] http://trade.ec.europa.eu/doclib/press/index.cfm?id=1116

red tape and lack of transparency; and transactions costs related to climate certification or carbon credit trading.

Box 4.1: Application of services in environmental projects: Three case studies

Services can be found everywhere in the value chain of any environmental projects, from R&D and production to installation and consumption. The three case studies below illustrate a variety of ways in which services are leveraged within environmental projects.

Solar panel manufacturing value chain in China

In addition to research and development, producers of environmental goods also require a slew of services for effective daily operations. In a case study of the Chinese solar panel manufacturing sector, ITC (2015)[20] found that over 40 different services are required for the value chain. While some are 'typical' environmental services like sewage water treatment (CPC 94110), the variety of services entering the chain span across imports, sales and exports, operations and management, and in factory and factory-related services such as quality control, packaging, security, cleaning, and canteen operations. Three-quarters of the services in this value chain were partially or fully outsourced, and accounted for 20-25% of total costs. Across-the-board services are therefore not only vital for day-to-day operations, but make up a large proportion of the operational costs of solar panel manufacturers. A project-based approach to tariff liberalization on environmental services could therefore greatly lower the costs of photovoltaic cell manufacturing and (thus) make renewable energy cheaper.

Landfill-gas collection and flaring system at Nam Son, Vietnam [21]

Anaerobic fermentation at municipal landfills produce a variety of gases, the majority

[20] "Services in Global Value Chains: Solar Panel Manufacturing In China" this belongs to list of references?

[21] http://www.newstatesman.com/energy-and-clean-tech/2010/03/son-project-bionersis-gas and https://cdm.unfccc.int/Projects/DB/RINA1274714283.4/view

being methane (CH_4) which is about 56 times more potent as a GHG than carbon dioxide (CO_2). To reduce GHG emissions, technology can be installed to capture methane gas and either flare or convert it to electricity. The Nam Son landfill gas and recovery project near Hanoi (Vietnam) is being designed and implemented by a French company while a German company will oversee the carbon credit trading. Beginning in 2010, it has a life time of 20 years and is anticipated to reduce approximately 2.6 million tons of carbon emissions in its first seven years of operation. The project will cost an estimated €6.6 million and is expected to generate value from both electricity sale and carbon credit trading, while moreover contributing to technology transfer, improve local water systems, and improving the local ecosystem by covering the landfill (among others). Environmental services are vital to this type of project, and include feasibility studies, complete design of the landfill gas extraction scheme, construction of the facility and its operation over its 20-year contract period, implementing and maintaining monitoring and control systems, and sale of carbon credits on the CER market (Certified Emission Reduction units).

Drip irrigation systems in India

Drip irrigation, also known as trickle irrigation, is a popular choice to conserve water which can be installed as Micro Irrigation Systems (MIS) for smallholder farmers or in large-scale, high-tech commercial farms. Drip irrigation involves the targeted delivery of water (with or without fertilizer) directly to individual plants via a network or tubes or pipes, which not only saves water and fertilizer but also increases plant yield and reduces weed growth. One of the largest MIS manufacturers in the world, is an integrated agribusiness headquartered in India called Jain Irrigation Systems Ltd, which supplies both the goods and services needed to increase farm productivity. How the company supplies both services and goods to its clients is a perfect example of complementarity of services to environmental goods. The company supplies farm inputs (irrigation systems, seeds, saplings, PVC piping) as well as financing and training in the installation and maintenance of these MIS. Typical projects has resulted in annual yield increases of between 60% and 130% and water savings of 30% to 65% as compared with traditional surface irrigation methods.[22]

Source: Newstatesman (2010) and UNFCCC (2010)

5. Analyzing determinants of environmental goods using a gravity model

The gravity model is the work-horse of international trade analysis. This section uses a gravity model to explore the factors that affect the trade in EGs. One of the unique contributions of this section is that it explicitly integrates tariffs as well as non-tariff measures at the HS6 product level for the 54 environmental goods along with the services trade restrictiveness at the country level into the gravity model estimations. This helps us to determine to what extent, if at all, these factors affect the trade flows and the level of significance of their impact, respectively.

5.1. Theory and model

The empirical specification closely follows the specifications used by previous researchers attempting to estimate the impact of NTMs on trade flows such as Disdier et al. (2008) and Disdier et al. (2015).

$$\begin{aligned} \boldsymbol{Import\ Value_{ijs}} &= \boldsymbol{\beta_0} + \boldsymbol{\beta_1 tariff_{is}} + \boldsymbol{\beta_2 NTM_{is}} + \boldsymbol{\beta_3 STRI_i} + \boldsymbol{\beta_4 STRI_j} + \boldsymbol{\beta_5 RTA_{ij}} \\ &+ \boldsymbol{\beta_6 Common\ Language_{ij}} + \boldsymbol{\beta_7 Contiguous_{is}} + \boldsymbol{\beta_8 Common\ Coloniser_{is}} \\ &+ \boldsymbol{\beta_9 Colony_{is}} + \boldsymbol{\beta_{10} Log\ (GDP)_i} + \boldsymbol{\beta_{11} Log(GDP)_j} + \ + \boldsymbol{\beta_{12} Log(Distance)_{ij}} \\ &+ \varepsilon_{ijs} \end{aligned}$$

where: i and j indexes represent importers and exporters respectively, the tariff is variable captures the applied tariff at HS6 level for product s applied by importer i on exports from country j, and NTM is the measure of NTM imposed by country on product

22 https://www.ifc.org/wps/wcm/connect/f6fdcd8047e252ca9d05fd299ede9589/Jain+Temporary.pdf?MOD=AJPERES

s (at HS6 level). The NTM impact is quantified in two ways in the estimation, in terms of a dummy variable that takes the value 1 if the NTM exist and secondly in terms of number of NTMs that exists per HS6 product line. The STRI is the World Bank services trade restrictiveness index for importer and exporter; Distance is the geographic distance between the exporter and the importer; RTA is a dummy equal to one if the exporter and the importer are in the same RTA; Contiguous is a dummy equal to one if the export-import pair share a common land border; colony is a dummy equal to one if one of the countries in the pair was once a colony of the other; common colonizer is a dummy equal to one if the countries in the pair were once colonized by the same power; common language is a dummy equal to one if the countries in the pair share a common language (ethnographic basis); GDP is gross domestic product in the importer (i) and the exporter (j), respectively; and ε_{ijs} is an error term that varies along the three dimensions of importer, exporter and product.

Based on the existing discussions in previous sections we hypothesize that environmental goods trade will be adversely affected by non-tariff measures. The tariff levels of several categories of EGs have dropped significantly since 2002, so while tariffs are expected to have a negative impact on trade, it needs to be verified based on data to what extent they remain significant for EG trade. The services sector play a key enabling role for environmental goods sectors, as revealed by the discussions in section 5 above. The service trade restrictiveness is therefore expected to have a negative impact on the trade flow of environmental goods. The standard gravity model predicts that GDP will have a positive impact on trade and that distance will have a negative impact on trade. These results are expected to hold for the case of environmental goods.

However, using a gravity model for disaggregated data comes with challenges as noted by UNCTAD and WTO (2012). Hence, there is a risk that even GDP variables might not have the positive correlation with trade flows. To deal with the issue of zero trade flows the gravity model is estimated using the Poisson Pseudo Maximum Likelihood estimator (PPML) approach proposed by Silva and Tenreyro (2006). The estimator is consistent under weak assumptions and do not impose stringent distributional assumptions on data, and at the same time it is robust under the presence of large number of zeroes, which makes it an ideal estimator (Silva and Tenreyro, 2011).

5.2. Dataset

As in the earlier sections of this paper, environmental goods trade is based on the APEC list of 54 goods. The sources of gravity model data is fairly standard (listed in Annex table 1) except for two variables that will need some explanation. First, data on NTMs is based on the new database collected by the Transparency in Trade (TNT) Initiative. This is currently the most comprehensive dataset on NTMs publicly available. The main advantage of this dataset is that it contains information on NTMs from national legal texts in addition to the WTO notifications database, which has a limited scope. This dataset uses the UNCTAD (2012) classification of NTMs and currently data is available for over 65 countries.[23] Second, in quantifying the service trade restrictiveness the World Bank's Services Trade Restrictiveness Index (STRI) is used.[24]. Brochert et al. (2012) provides details on the construction of this index. The dataset has already been used widely in empirical analyses related to trade policy (see van der Marel and Shepherd (2013); Hoekman and Shepherd (2015)). The data set covers 103 developed and developing countries and key modes of service supply (modes 1, 3 and 4).

5.3. Results

The annex table A.3 provides the detailed results of the gravity model estimations and table 5-1 provides the summary of the key trade policy variables within the gravity model estimations.

In tables 5-1 and A.1, Column 1 provides the estimation results with a dummy variable indicating presence of NTMs. Column 2 adds the number of NTMs per product HS6 line as a measure of NTMs. Column 5 adds the specific numbers related to technical NTMs and non-technical NTMs. Column 6 adds the interaction terms between the number of

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[23] Authors would like to thanks UNCTAD Trade Analysis Branch for making this dataset available.

[24] Authors would like to thank Ben Shephard for making available the Gravity model dataset used in Hoekman and Shepherd (2015).

NTMs per product line with the income level[25] (high, low and middle) of the exporting country. The standard errors were clustered at different levels of aggregation in tables A2 and the errors are clustered at the importer-exporter pair.

The main result that holds true in all specifications is the significance of the NTM variables. We find that in specification with heterogeneous measures of NTMs the technical NTMs that includes TBT, SPS and pre-shipment inspections (categories A, B, C in UNCTAD (2012) classification of NTMs) emerge as the more significant sub-category of NTMs that affect the EG trade when compared to non-technical NTMs. Interestingly, tariffs emerge as statistically non-significant across specifications, alluding to their declining importance as a trade impediment.

In specification (v) the heterogeneous impact of NTM on exporters from low income, middle income and high income countries are tested. Disdier et al. (2008) and Disdier et al. (2015) find that NTMs tend to have a larger negative impact on exporters from developing countries. Specification (v) helps to test whether this result holds in the case of trade flow of environmental goods. The results show that while low income, middle income and high income countries seem to be all affected by NTMs, it is the low income country exports that faces the highest magnitude of negative impacts among country groups.

Services trade restrictiveness of the exporter and importer also seems to play a significant role in the level of environmental goods trade between countries. There are only few studies that explicitly integrate STRI within gravity models. Our results are in line with the results of Hoekman and Shepherd (2015), who found that higher STRI has a dampening effect on the trade in manufacturing goods overall. The estimations further highlight the role of services in the environmental projects and environmental goods trade both directly and indirectly as discussed in the earlier sections of the paper.

The GDP of the exporter and importer represent the ability of the exporter to supply specific goods and the ability of importer to absorb the same, respectively. The GDP of

[25] Based on the World Bank classification of countries based on income groups.

exporter and importer have a positive impact on EG trade in all specifications. While the distance between exporters and importers – as expected – has a significant negative impact.

Among the other variables the impact of RTAs is not very clear. Not every RTA has special provisions for environmental goods. For example, a text search analyses of 155 preferential trade agreements involving Asia Pacific countries reveal that 92 of those agreements mentions 'environment' as an important policy consideration, while 59 of them[26] contains articles or chapter specifically mentioning environment related aspects. However, only a handful of them have any specific clauses related to environmental goods. Our results show that RTAs do not have any significant positive impact on EGs. However, RTAs with deeper integration clauses on environmental policy might have positive impact on EG trade, but given there are only very few of them, we cannot uncover their impact within the EG trade.

Table 5-1: Gravity model estimation: summary of significance of trade policy variables

	(i)	(ii)	(iii)	(iv)	(v)
Tariffs					
NTM dummy		x	x	x	x
Number of NTMs per product	x		x		x
Number of technical NTMs per product	x	x		x	x
Number of non-technical NTMs per product	x	x		x	x
High income country exporter * Number of NTMS per product	x	x	x	x	
Low income country exporter * Number of NTMs per product	x	x	x	x	
Middle income country exporter * Number of NTMs per product					
Overall STRI				x	
Overall STRI of importer	x	x	x		x
Overall STRI of exporter	x	x	x		x
RTA					
Red : indicates the variable negatively impacts trade flow at a minimum 10% level of significance; yellow : indicates the impact of variable is not significant even at 10 % level of significance; "x" : indicates variable not included in the specification.					

[26] Based on the information provided in APTIAD, available from: http://www.unescap.org/content/aptiad/

The specification of the gravity model used here omits the multilateral resistance terms in the theoretically consistent gravity model described in Anderson and Van Wincoop (2003). This omission can potentially create bias in our results. One approach to address this problem to see if the results hold even after the introduction of importer and exporter specific fixed effects, often paired with product groups. However, such estimations will result in the omission of country specific variables in the estimations, which could be of interest. In our case, the STRI index is country specific and fixed effects estimations will result in omission of the same from estimations. Despite this limitation, fixed effects estimations provide further robustness checks on variables that vary within country trade flow observations. We conducted a high dimension fixed effects estimation of the model and find that the NTM dummy as well as number of NTMs per product maintains their significance and negatively impacts the trade flows. We also introduce the importer/exporter-HS2 product pair fixed effects and the key results hold for this specification as well. Another potential way to circumvent this problem is to estimate the Gravity model using the method proposed by Baier and Bergstrand (2009) using appropriate Taylor series approximations; this is left as future research. Finally, more work is required to further deal with any potential endogeneity of any of the variables involved in the estimation. However, finding appropriate instrumental variables for NTMs at the HS6 level can pose serious challenges.

6. Policy considerations and conclusion

The Asia-Pacific region has been increasing its share in the global trade in EG goods since 2002, contributing roughly to over 40% of the global export and import of EG goods. The share of intra-regional trade of EG has also been on the rise. Given the 2030 agenda and the focus of many countries to decouple economic growth from environmental degradation, the importance of the EG trade expected to rise in the future. The analyses in this paper take stock of current trends in the EG and ES trade, and provide important insight for policy makers vis-à-vis national trade policy and trade agreement negotiations. The following are the three key policy messages arising from the analysis in the paper.

i. **While proceeding with tariff liberalization countries need to adopt a holistic approach**

While tariffs on the EGs analyzed in the paper are on the fall in country groups of the region, the tariffs on several key complementary goods required for environmental projects or related industries are still high, especially in LDCs. To attain the end goal of promoting environmental friendly production and consumption, countries need to adopt a systemic approach to liberalization in order to achieve this goal. This should start with identifying the critical complementary goods to environmental goods and proceed with simultaneous liberalization of these goods along with EG.

ii. **NTMs are a bigger impediment to trade and integrate discussions on the same within EG liberalization**

The gravity model estimation in the paper clearly shows that NTMs are a significant impediment to EG trade, especially for exporters from low income economies. The EGA and related negotiations on EG have so far shied away from discussions on NTMS. Discussions on NTMs, including the possibility of establishing mutual recognition agreements (MRAs) and harmonization of standards, need to take the center stage of EG negotiations, in order to facilitate trade in EG.

iii. **Services play an important role in EG trade and EG sectors, hence liberalization of complementary services is key to promote EG trade**

> The case study discussions and the gravity model estimations revealed that services are crucial in promoting environmental projects and EG trade. Liberalization of services, which are closely linked to EG trade and environmental projects, can be an important step in enhancing trade in EG. Through stakeholder interactions, services that are important for environmental projects need to be recognized and liberalization of supply of such services merits urgent consideration.

The EGA negotiations have been delayed but are ongoing and have committed to continue the process in 2017. The results of this paper shed lights on avenues where these and other negotiations dealing with environmental goods need to ideally focus on in the future.

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Annex

Table A1: Data Sources

Tariff	WITS/TRAINS
NTM	Data collected through the Transparency in Trade (TNT) initiative available through UNCTAD TRAINS NTM dataset
STRI	World Bank available at : http://iresearch.worldbank.org/servicetrade/
RTA	CEPII
GDP	World Development Indicators
Distance	CEPII
Contiguous borders	CEPII
Colonial links	CEPII
Common coloniser	CEPII
Common language	CEPII
Trade Values	WITS/TRAINS
Renewable energy production	World Development Indicators

HS6 codes of environmental goods used in the analyses

List of Environmental Monitoring Goods	List of Renewable Goods	List of Environmental Protection Goods	List of Environmentally Preferable Goods
902610	841919	840410	441872
902620	850239	840420	
902680	850231	840490	
903289	901390	841939	
903290	850164	841989	
901580	901380	842121	
902690	850490	842129	
902710	850300	842139	
902720	841290	842199	
902730	841199	847420	
902750	841990	847982	
902780	841182	847989	
902790	840290	847990	
903149	840690	851410	
903180	854140	851420	
903190		851430	
903300		851490	
		854390	

841780 841790 841960

Source: Classification based on Vossenaar (2013). Authors' thank Mr. René Vossenaar for providing the product classification.

Table A2: Results of the Gravity Model Estimations (Poisson Pseudo Maximum Likelihood Estimations)

	(i)	(ii)	(iii)	(iv)	(V)
Tariff	0.014	0.007	-0.0297	-0.0002	.002
	(0.512)	(0.739)	(0.218)	(0.991)	(0.908)
NTM dummy	-0.749***				
	(0.001)				
Number of NTMs per product		-0.101***		-0.100***	
		(0.003)		(0.003)	
Overall STRI	-0.0082	-0.012***	-0.012***		-0.009***
	(0.154)	(0.007)	(0.004)		(0.004)
RTA	-0.058	-0.082	0.059	-0.087	-.092
	(0.895)	(0.862)	(0.867)	(0.850)	(0.843)
GDP importer	0.958***	0.998***	0.963***	0.989***	0.981***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP exporter	1.020***	1.012***	0.956***	1.015***	.998***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance	-0.924***	-0.872***	-0.676***	-0.855***	-0.850***
	(0.004)	(0.005)	(0.001)	(0.006)	(0.007)
Contiguous borders	-0.329	-0.283	-0.0337	-0.259	-0.264
	(0.421)	(0.484)	(0.903)	(0.512)	(0.506)
Colonial links	-0.119	-0.184	-0.0811	-0.194	-0.174
	(0.605)	(0.402)	(0.664)	(0.365)	(0.421)
Common coloniser	-1.557**	-1.623*	-1.339*	-1.586*	-1.527*
	(0.048)	(0.050)	(0.066)	(0.056)	(0.053)
Common language	-0.253	-0.209	-0.121	-0.219	-0.215
	(0.179)	(0.260)	(0.512)	(0.232)	(0.236)
Number of technical NTMs per product			-0.0264*		
			(0.096)		
Number of non-technical NTMs per product			-0.112		

			(0.400)		
Overall STRI of importer				-0.007	
				(0.139)	
Overall STRI of exporter				-0.019***	
				(0.004)	
High income * Number of NTMS per product					-.0896**
					(0.02)
Low income * Number of NTMs per product					-1.297***
					(0.000)
Middle income * Number of NTMs per product					-.155***
					(0.000)
Constant	-31.62***	-33.04***	-32.35***	-32.95***	-32.45***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	72895	72895	55185	72895	72895
Adjusted R squared	0.63	0.62	0.77	0.63	0.63
Notes: p-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01 Standard errors clustered at exporter-importer pair					