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The contribution of trade in environmental goods and services

The transition to a low-carbon economy depends, among other things, on the development, adoption and diffusion of environmental goods, services and technologies. This chapter looks at the extent to which trade in environmental goods and services can contribute to the low-carbon transition. Although international trade in environmental goods is uneven across regions, the sector is very dynamic. While the WTO agreements ensure that trade in environmental goods and services flows as smoothly, predictably and freely as possible, the WTO could make an even greater contribution to the development and deployment of environmental technologies by addressing relevant trade barriers and improving data quality on trade and trade policy of environmental goods and services.

Contents

Key facts and findings

- Environmental goods and services cover a broad range of products used to measure, prevent, limit, minimize or correct environmental damages, including those related to climate change.
- Although high-income countries are the main exporters and importers of environmental goods, exports of environmental goods from middle-income countries increased tenfold between 2000 and 2020.
- Although tariffs on environmental goods are, on average, lower than those for other goods, they remain relatively high in low-income countries.
- The elimination of tariffs, together with the reduction in non-tariff measures, on a subset of energy-related environmental goods and environmentally preferable products could increase total exports by 5 and 14 per cent above the baseline, respectively, by 2030. It could further reduce carbon emissions by 0.6 per cent through improvements in energy efficiency.

1. Introduction

Climate change mitigation can be enhanced by developing, adopting and deploying environmental technologies (ET). International trade in environmental goods and services (EGS) can enable access to ET embodied in environmental products, and can help diffuse these technologies. Opening up trade in EGS further could potentially benefit the environment.

This chapter presents available information on the latest trend in trade in EGS and related trade barriers, pointing to a number of data-related issues and challenges. It then reviews the various mechanisms through which trade in EGS can reduce environmental harm, including mitigating carbon emissions. Simulation results quantifying the effect of opening up trade in environmental goods (EG) on trade, gross domestic product (GDP) and carbon emissions are also presented. The chapter concludes by outlining how international cooperation and the WTO can further boost trade in EG and access to ET.

2. There is scope for intensifying trade in environmental goods and services

Although the environmental industry is still emerging in many developing countries, it is a very dynamic and fast-growing sector providing important job opportunities. While there is no publicly available statistics on the size of the environmental industry, the environmental technology market is estimated at US$ 552.1 billion in 2021 and could reach US$ 690.3 billion by 2026 (MarketsandMarkets, 2022). The environmental industry remains highly segmented between well-established and new cutting-edge environmental technologies. Despite the fact that many new environmental technologies are developed in high income economies, the production of many environmental goods and services is spread across developed and developing countries, forming regional or global value chains (GVCs).

(a) Environmental goods and services serve to improve environmental outcomes

EGS have been defined as goods and services used to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems (OECD and Eurostat, 1999). They include cleaner technologies, products and services that reduce environmental risks and minimize pollution and resource use.

While the concept of EGS is rather intuitive, defining the scope of EGS has proven to be a complex exercise, in particular in the context of trade negotiations (see Section F.4). The environmental objective and the main end-use purpose of EGS are two of the main criteria that have been considered to delimit the scope of EGS. Over the years, various classifications and lists of EGS have been developed for different purposes, including statistical analysis and trade negotiations.

For instance, the so-called "OECD list of EG" (OECD list), stemming from joint work by the OECD and Eurostat, illustrates the scope of the environment industry for analytical and statistical purposes (OECD, 1999).[1] The list is broad, as it was not compiled with a view to being used for negotiations, and distinguishes between three broad categories of products.

(i) **Pollution management technologies and products** comprise goods and services that are clearly supplied for an environmental purpose and have a significant impact in reducing polluting emissions.[2] They include technologies and products supplied for air pollution control; wastewater management; solid wastewater management; remediation and clean-up; noise and vibration abatement; and environmental monitoring, analysis and assessment.

(ii) **Cleaner technologies and products** comprise goods and services that reduce or eliminate negative environmental impacts, but which are often supplied for other purposes than environmental ones.[3] They are directly related to the efficiency criteria, as well as to the reduction of environmental impacts during their end use.

(iii) **Resources management technologies and products** include the design, construction, installation or provision of technologies and products related to reducing the impact of intensive natural resource extraction on various ecosystems.[4] In particular, these EGS address indoor air pollution control; water supply; recycled materials; renewable energy plant; heat/energy savings and management; sustainable agriculture, fisheries and forestry; natural risk management and eco-tourism.

While EGS can cover ET, whose main (and often sole) purpose is to address or remedy an environmental problem, they can also cover products stemming from eco-innovation. Eco-innovation encompasses all forms of technological and non-technological innovation whose main purpose might be unrelated to the environment, but which possesses certain environmental benefits arising during the production (e.g., organic production), consumption and use (e.g., efficient cars) or disposal stage (e.g., jute), compared to substitutes or like products.

Products that, over their entire life cycle, including production, processing, consumption and disposal, cause significantly less environmental harm than alternatives are commonly known as environmentally preferable products (EPP). In that context, the United Nations Conference on Trade and Development (UNCTAD) identified several products that are more environment-friendly than their petroleum-based competitors, or whose production and sales contribute significantly to the preservation of the environment (UNCTAD, 1995).

Environmental services (ES) often complement EG, and in many cases, the provision and trade of ES drive the growth of trade in EG (Steenblik, Drouet and Stubbs, 2005). Environmental services have been estimated to represent more than 65 per cent of the market value of the environmental industry (EBI, 2017). Yet, ES are often overshadowed by EG despite the documented synergies existing between EG and ES. Measuring trade in ES and barriers to trade in ES is particularly challenging. Indeed, both the quality and the availability of data vary significantly, depending on the mode through which ES are traded (Sauvage, 2014). WTO members define ES according to the so-called Services Sectoral Classification List (W/120), based on the Provisional Central Product Classification[5] (CPC), which distinguish between sewage services; refuse disposal services; sanitation services; and other ES, including cleaning services of exhaust gases; noise abatement services, and nature and landscape protection services.[6]

In addition to ES, numerous ancillary services, such as business services, research and development (R&D), consulting, contracting and engineering, construction, distribution, transport, and repair and maintenance are essential to the sales, delivery, installation, functioning and maintenance of environmental plants, equipment and other goods (Nordås and Steenblik, 2021; Sauvage and Timiliotis, 2017).

The Asia-Pacific Economic Cooperation (APEC) economies recently endorsed a Reference List of Environmental and Environmentally Related Services that identifies both ES and relevant ancillary services based on the CPC 2.1 classification (APEC, 2021).[7]

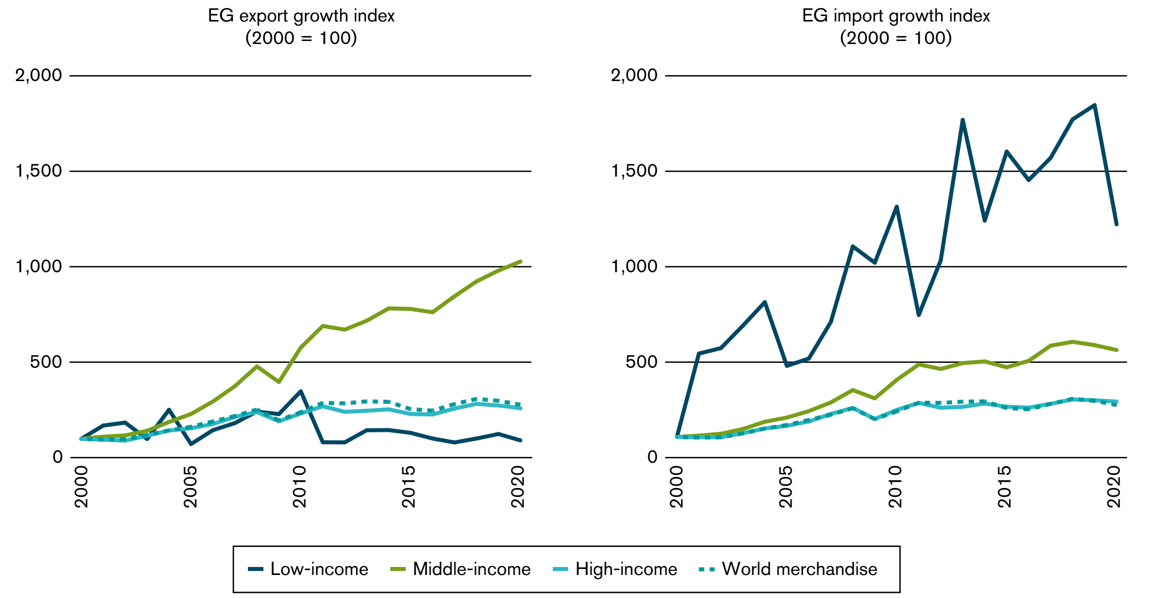
(b) Trade in environmental goods has been dynamic, but not equally so in all regions

Measuring trade in EG can be a difficult task, in particular when the purpose is to generate internationally comparable statistics. Trade-flow data on goods are collected and organized according to Harmonized System (HS) codes,[8] but few of the HS's six-digit subheadings (HS6) specifically cover goods that are mainly used for environmental purposes. A large share of EG is classified under generic subheadings, and is not separately identified, making it difficult to measure the size and pattern of world trade in the relevant goods. Photovoltaic (PV) cells and modules, for example, have been lumped together under the same HS subheading as light-emitting diodes (LEDs), the trade of which is also large and growing rapidly. As a result, it has been impossible to get internationally consistent information on actual trade in these solar energy technologies. Also, because of the difficulty in separating EG from other goods, and because some of these products can both benefit and harm the environment depending on their use (i.e., dual use), most trade data actually result in an overestimation of trade in EG. Nevertheless, the situation should improve, as the 2022 revisions to the HS include several amendments that separate EG from previous subheadings that covered other goods as well, often not of environmental interest (Steenblik, 2020).

Trade in EG, as defined in the OECD list and covering 124 HS-6 tariff lines, accounted for 5 per cent of global trade in 2020. High-income countries accounted for the largest share of EG exports (69.82 per cent), followed by middle-income countries (30.16 per cent) and low-income countries (0.02 per cent). For the period 2000-20, available statistics suggest that both exports and imports of EG increased relatively quickly for middle-income countries, while for low-income countries, exports mostly remained at the same level and imports increased at variable speeds (see Figure F.1). As for high-income countries, both their exports and imports increased, but only modestly.

As regards trade in ES, the availability and quality of data is even more limited, which prevents a comprehensive assessment of the evolution of international trade in ES. Preliminary WTO estimates

Figure F.1: Trade in environmental goods has grown in most regions, but at different speeds



Source: Authors' calculation, based on trade figures from the UN Comtrade database.

Note: The coverage of EG is based on the OECD list, which covers 124 tariff lines at the six-digit HS level. Income groups follow the World Bank classification.

suggest that some US$ 20 billion of traditional ES, including waste disposal, recycling, sanitation and cleaning of pollution, were traded in 2017, accounting for just 0.2 per cent of world services trade (WTO, 2019).

However, growing environmental concerns are boosting demand for ES worldwide. World trade in ES has grown by 4 per cent on average annually since 2005. Establishment of a commercial presence abroad (e.g., locally-established affiliate, subsidiary, or representative office of a foreign-owned and -controlled company) is the most important mode of supply in ES, as many traditional ES are highly dependent on infrastructure and require a continuous and long-term local presence. Case studies examining certain ES, for example ecotourism, have also shown that trade in ES can provide economic opportunities and incentivize the conservation of natural resources in developing countries (see Box F.1).

(c) Barriers to trade in environmental goods and services are still significant

On average, tariffs for EG are lower compared to tariffs for other goods (see Figure F.2). While average applied tariffs on EG are around 1.4 per cent in high-income countries, they go up to 7.3 per cent in low-income countries.

EG trade is also affected by various non-tariff measures (NTMs). The use of technical barriers to trade (TBT) measures is of particular relevance to EG, as EG are often subject to technical regulations and conformity assessment procedures. The intensity of TBT measures tends to be higher in high-income economies. High-income economies apply, on average, 11 TBT measures on EG imports, middle-income economies apply five TBT measures and low-income economies apply two TBT measures (see left panel of Figure F.3). The number of TBT measures applied to EG tends to be, on average, similar to these applied on other goods.[9]

Accounting for the share of imported EG affected by NTMs, 81 per cent of EG tariff lines at the six-digit HS level imported in high-income countries are, on average, affected by at least one TBT measure, as opposed to an average of 45 per cent in middle-income countries and 36 per cent in low-income countries, respectively (see right panel of Figure F.3).

It is important to note, however, that metrics based on the count of NTMs applied, such as the intensity and frequency indices of NTMs, are imperfect measures of the trade restrictiveness of NTMs, as they only provide an indication of the prevalence of NTMs, without accounting for the effect of different measures on trade, which may be more or less

Box F.1: Ecotourism as an economic incentive to preserve nature in Costa Rica

Ecotourism is a form of tourism that emphasizes the maintenance and preservation of nature and puts fauna, flora and cultural heritage at the centre of attractions for tourists. While ecotourism is a promising industry, its success hinges on conserving and protecting fragile natural areas while providing benefits to tourists and contributing to community development.

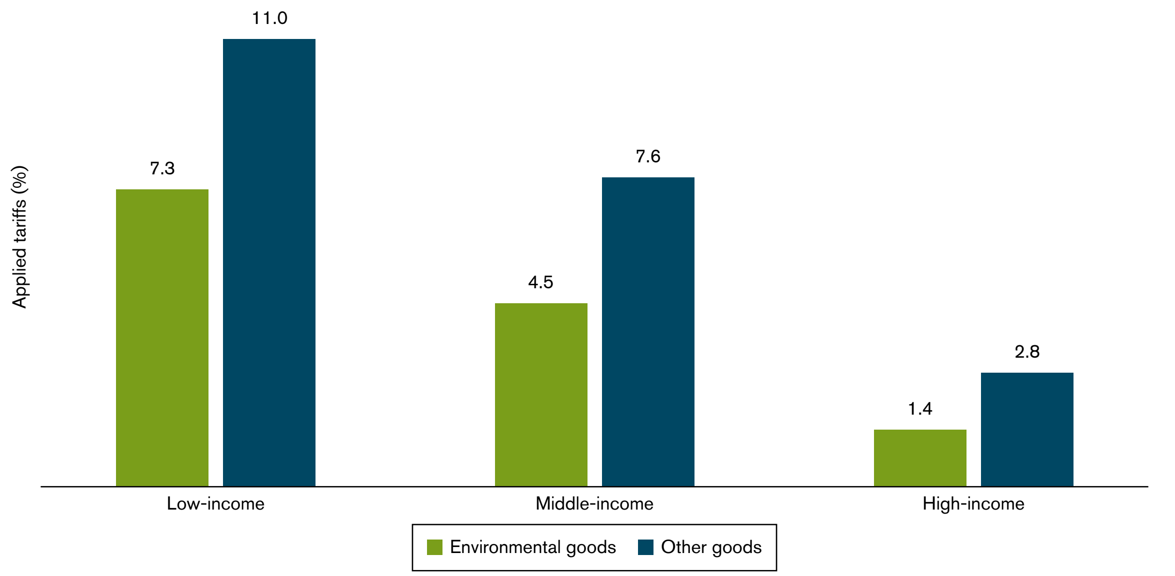
Widely known for its rich biodiversity, Costa Rica has developed a diversified economy that includes ecotourism. General tourism makes up 17-18 per cent of the country's value of exports and contributes up to 8 per cent of its GDP (Costa Rican Tourism Board, 2022a). Foreign tourist visits grew 43 per cent to over 3 million between 2011 and 2019, a substantial number given that the country's population is 5 million. Although the COVID-19 pandemic has taken a heavy toll on the tourism industry, the number of foreign visitors rebounded to 1.3 million in 2021 (Costa Rican Tourism Board, 2022b).

Because it can generate important revenues, ecotourism can serve as an economic incentive to preserve natural resources. Since Costa Rica designated its first natural reserve in 1963, 26 per cent of the national territory has been allocated to natural reserves. More than 70 per cent of tourists entering the country partake in ecotourist activities, such as hiking or wildlife observation in national parks or biological reserves (Costa Rican Tourism Board, 2022c).

Ecotourism can also promote the restoration of ecosystems that have been degraded, damaged or destroyed. For example, in the 1980s, the Costa Rican government began to focus on the development of international ecotourism and thereby took action to reverse deforestation, as in the 19th century and the first half of the 20th century, there had been a significant decline in forest cover due to ranching and agriculture. Government incentives to increase both forest cover and protected areas have allowed Costa Rica's ecotourism sector to thrive (Tafoya et al., 2020).

By means of the revenues generated by natural reserves, visitors help to protect the species inhabiting these ecosystems and to contribute to the conservation of the country's national parks and the development of local communities. For local residents, ecotourism often represents a better livelihood than existing alternatives such as construction, transportation and small-scale agriculture (Hunt et al., 2015). Costa Rica's experience has shown that ecotourism can be a major force for promoting natural resource conservation and respect for local communities.

Figure F.2: Tariffs on environmental goods are low compared to those for other goods, but remain significant in low-income countries



Source: Authors' calculation, based on 2019 tariff data from the WTO Integrated Database (IDB) and 2019 trade figures from the UN Comtrade database.

Note: The coverage of EG is based on the OECD list, which covers 124 tariff lines at the six-digit HS level. Income groups follow the World Bank classification.

restrictive, or may even be trade-promoting (WTO, 2012).

The number of specific trade concerns (STCs) raised and discussed by WTO members in WTO committees also provides a useful indication of the number of measures taken by members that are sources of concern for exporters (WTO, 2012). Between 2005 and 2020, some 126 STCs relating to EG were raised in the WTO Technical Barriers to Trade (TBT) committee, an average of eight STCs per year. Measures underlying TBT-related STCs on EG potentially affect a large value of trade. Over the period 2005 to 2020, STCs covered an annual average of US$ 42 billion in imports of EG.

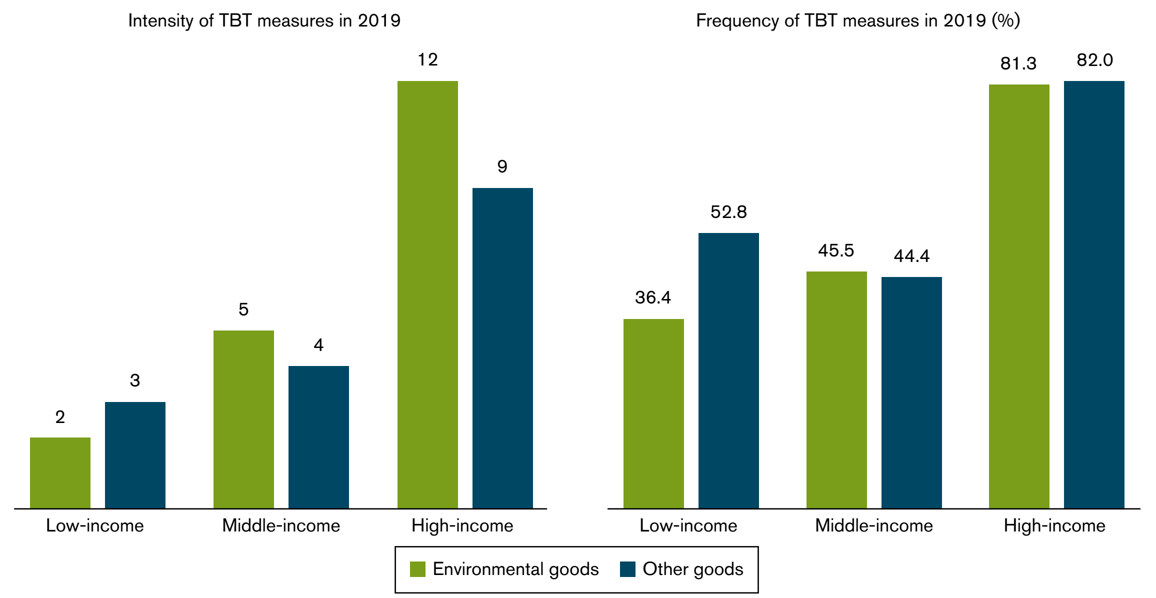
In recent years, an increasing number of trade remedies have also been applied to some EG, such as solar panels and wind turbines. These antidumping duties and countervailing measures can be substantial, often over 100 per cent of the value of the EG.[10]

Given the limited information on applied measures restricting trade in ES, the commitments of WTO members in the General Agreement on Trade in Services (GATS) give an idea of the willingness of members to open their market for ES. ES are one of the least-committed sectors under the GATS.[11] Only 59 WTO members (counting the European Union as one member) have undertaken specific commitments in at least one of the seven provisional CPC sub-sectors. Several members have limited their commitments to consulting and/or advisory services in relation to ES, either across the entire range of committed sectors or with respect to some sub-sectors only.

On average, only 38 per cent of members committed not to impose any new measures that would restrict entry into the market or the operation of the ES (GATS mode 1).[12] There is a high proportion, averaging 71 per cent, of full commitments for consumption of ES abroad (GATS mode 2). The proportion of full commitments for the establishment of a commercial presence abroad to supply an ES (GATS mode 3) is, on average, 57 per cent, with a relatively higher share of full commitment (71 per cent) for sanitation and similar services. Finally, 13 per cent of members have taken full commitments for the temporary movement of natural persons to supply ES (GATS mode 4).

The relatively modest level of binding commitments in ES under the GATS stands in contrast with levels of bindings on ES that have been achieved by various WTO members in bilateral and regional trade

Figure F.3: The intensity of NTMs for environmental goods is higher for high-income countries than for middle and low-income countries



Source: Authors' calculation, based on 2019 TBT data from the UNCTAD TRAINS database.

Note: The coverage of EG is based on the OECD list, which covers 124 tariff lines at the six-digit HS level (HS-6). The left panel displays the average number of TBT measures imposed by countries within an income group targeting a given EG or another good. The right panel displays the average share of HS-6 lines that a country import subject to at least one TBT measure, among all the EG and other goods HS-6 lines they import. The analysis covers 57 countries, encompassing 11 high-income countries (with the European Union counted as one), 36 middle-income countries and 10 low-income countries. Income groups follow the World Bank classification.

agreements. Parties to services trade agreements tend, on average, to go well beyond the commitments they had undertaken in the GATS (WTO, 2019). This is in part a reflection of the fact that most GATS commitments date from 1995.

Trade-opening commitments on ES are, in part, limited because the provisions of many traditional ES, like sewage and refuse disposal, are natural monopolies where only a single firm, typically a public operator, supplies the ES with limited competition with other companies. Natural monopolies tend to be prevalent in traditional ES markets because some of these ES, like the cleaning of roads and beaches, have the characteristics of public goods.[13] Unless special measures are taken, no single firm has an economic incentive to provide the adequate level of service and capture the economic returns. Some traditional ES, like sewage services, also require high levels of investment to build special distribution or collection networks, which often create significant barriers to entry. Governments are often reluctant to allow private or foreign ownership of essential services for fear that they would exploit consumers (WTO, 2010). Other ancillary services, which facilitate the provision of ES, but which are also used for other purposes are also subject to numerous restrictions (USITC, 2013).

3. Trade in environmental goods and services can contribute to climate change mitigation

A broad range of EGS is particularly relevant to climate change mitigation. For instance, energy-related EG (EREG), including clean and renewable energy, energy-efficiency and resource-efficiency goods, can contribute to reducing greenhouse (GHG) emissions.[14] Clean and renewable energy goods cover all products required for the generation of electricity, for example wind turbines, by methods that are environmentally preferable to conventional methods. Energy-efficiency goods help to manage and restrain growth in energy consumption.[15] Resource-efficiency goods help to improve the efficiency with which resources are used, and are, by nature, close to energy-efficiency goods and to clean and renewable energy goods, as they operate through the same channels and aim to reduce energy consumption.

Another category of environmental products highly relevant in the fight against climate change is goods and services essential to help to adapt to climate change (see Chapter B). Examples of such goods and services relevant to the agricultural sector include stress-tolerant cultivars (i.e., cultivated varieties of plants specifically developed and bred for distinct traits), pesticides for weed control, early warning weather systems, equipment for renewable off-grid power generation, irrigation technology and related engineering and technical services, as well as agricultural extension services (GCA, 2021).[16]

(a) Trade in EGS can contribute to climate change mitigation through three main channels

Because EGS affect the environment in distinctive ways, removing barriers to trade in such products and facilitating the diffusion of ET can contribute to climate change mitigation and adaptation and other environmental objectives, including pollution control, wastewater treatment, recycling, and organic agriculture.

As with the general effects of trade on carbon emissions (see Chapter E), the effects of trade in EGS can be decomposed into scale, composition and technique effects.

First, increased trade in EGS, all else being equal (i.e., maintaining a constant mix of goods produced and production techniques), would mean more economic activity and more transport, and this would increase emissions (**scale effect**). Opening trade in EGS would lower their domestic price, raise real income and increase demand for environmental products, trade and economic activity.

Second, maintaining a constant scale of the economy and constant carbon emissions intensities, the lowering of tariffs and NTMs on imports of EGS would lead to changes in countries' allocation of resources towards activities with either higher or lower emission intensities depending on their respective comparative advantages (**composition effect**).

Third, holding scale and composition constant, improved access to EGS would encourage a switch to low-carbon production techniques, and this would reduce emissions (**technique effect**). This positive trade effect on climate change mitigation captures various channels. For instance, international trade can accelerate the cross-country diffusion of ET, making local production processes more efficient and environmentally sound (Garsous and Worack, 2021). Trade provides an opportunity for developing countries to adopt cleaner technologies and, in some instances, to leapfrog the stage of intensive fossil fuel energy use. Opening up trade in EGS can also stimulate innovation spillovers through the diffusion of knowledge embodied in intermediate EGS. Reducing trade barriers has been found to be associated with a boost in environmental innovation globally (Dechezleprêtre and Glachant, 2014).

Trade in EGS could also contribute to sustainable development by supporting and creating additional employment in the renewable energy sector and in sectors implementing climate-friendly technologies, including those promoting energy efficiency and conservation. In particular, trade in EG can increase demand for ES and ancillary services, including those related to the sales, delivery, installation and maintenance of EG and ET. Given that jobs in the EGS industry tend to be higher-skilled, better paid and more gender-inclusive, trade in EGS can contribute to supporting a more just and inclusive low-carbon economy (see Chapter C).

(b) Opening up trade in energy-related environmental goods would reduce emissions and raise GDP in all regions

Despite an extensive literature on trade in EGS, the effect of trade in EGS to address specific environmental issues has been less investigated and is still not well understood. This is in part because there is a lack of internationally comparable data on trade in EG, with even fewer data available on trade in ES, and in part because the mechanisms through which trade in EGS affects carbon emissions and other environmental outcomes are complex to capture and to quantify.

Only a few empirical studies have focused on the effect of opening up trade in EG on different types of pollutions (de Alwis, 2015; Zugravu-Soilita, 2018, 2019) and on EG exports (He et al., 2015; Tamini and Sorgho, 2018), and have found mixed results. For instance, trade intensity in EG relative to GDP has been found to reduce carbon dioxide (CO_2) emissions but to increase water pollution with no impact on sulphur dioxide (SO_2) (Zugravu-Soilita, 2018).[17] However, trade in EG has also been shown to have no impact on total carbon dioxide and sulphur dioxide emissions, although trade in EG improved the emission efficiency of both pollutants (Zugravu-Soilita, 2019).

Several studies also use modelling techniques to assess the potential effects of opening up trade in EG (Dijkstra and Anuj, 2016; Hu et al., 2020; Nimubona, 2012; Wan, Nakada and Takarada, 2018). However, the large number of channels through which trade in EG can affect economic and environmental outcomes makes the overall effect difficult to model.

The WTO Global Trade Model (GTM) was used to fill part of the gap in the literature and analyse how opening further trade in a subset of specific EG could affect their trade, GDP and carbon dioxide emissions (Bacchetta et al., 2022).[18] The model captures two mechanisms through which trade in EG can affect carbon emissions: improvements in energy efficiency (mainly a technique effect) and the replacement of non-renewable with renewable energy (a combination of a technique and a composition effect). The simulations focus on EREG, namely energy-efficiency, resource-efficiency and clean and renewable energy goods, that are most relevant to reducing carbon emissions.[19] The set of EG is subsequently extended to EPP because of their potential export interest for a broad range of countries, including developing economies and LDCs.[20]

Four scenarios combining reductions in tariffs and NTMs for EREG and EPP are considered:

(1) elimination of tariffs on EREG;

(2) elimination of tariffs and a 25 per cent reduction in the *ad valorem* equivalent of NTMs on EREG;[21]

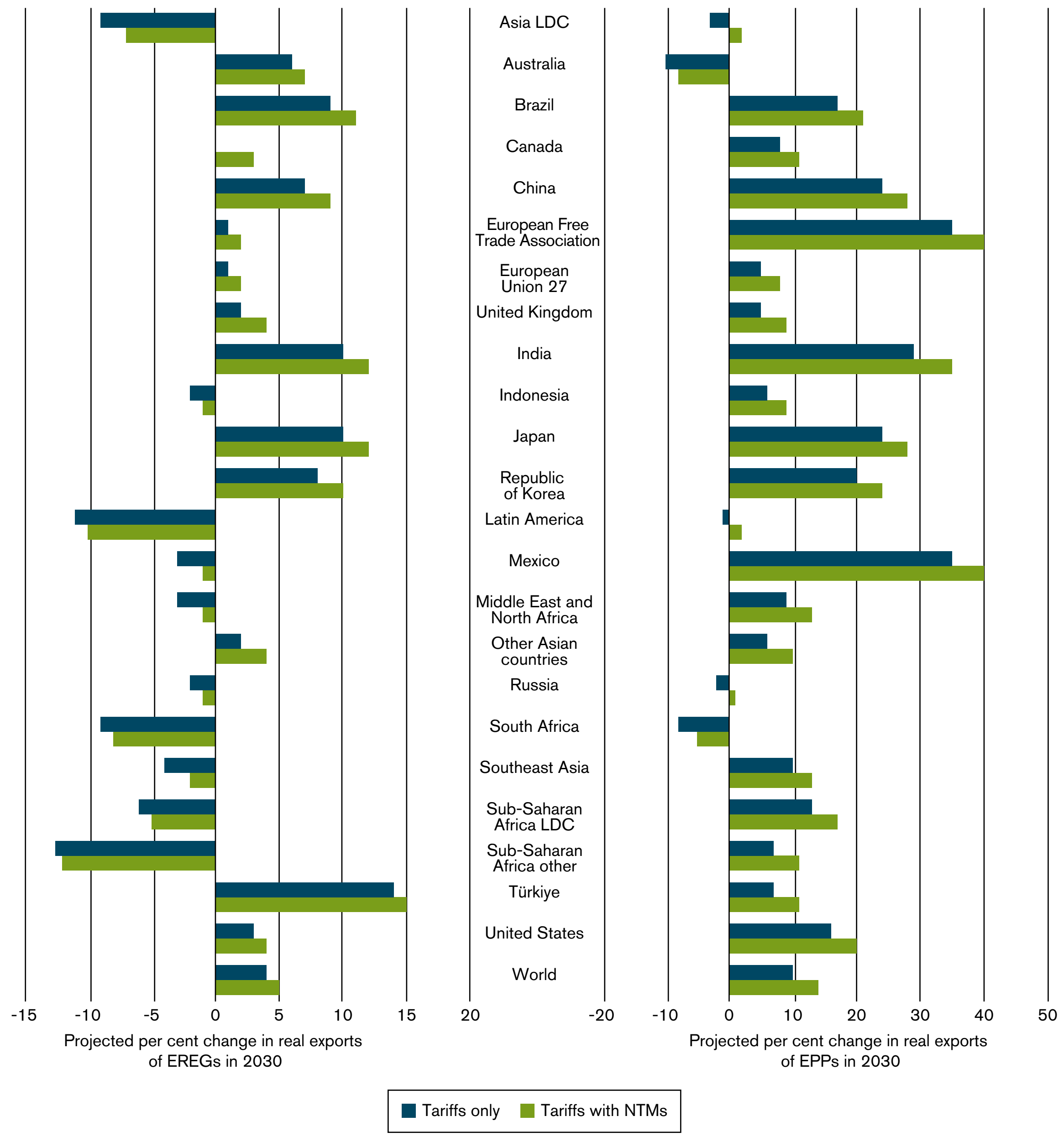
(3) elimination of tariffs on EREG and EPP and a 25 per cent reduction in the *ad valorem* equivalent of NTMs on EREG; and

(4) elimination of tariffs and a 25 per cent reduction in the *ad valorem* equivalent of NTMs on EREG and EPP.

The elimination of tariffs and the reduction in NTMs on EREG and EPP (as per scenario 4) would raise global exports (expressed in real terms) of EREG and EPP in 2030 by 5 per cent and 14 per cent above the baseline, respectively. While the percentage increase in exports would be larger for EPP than for EREG, the value of trade in EREG would be much greater. Total exports are projected to rise for all regions, as the fall in trade costs of EREG and EPP and the implied increase in energy efficiency would both raise GDP, leading to an increase in import demand. This positive effect would dominate the negative effect of trade diversion for EREG in some regions.

While exports of EPP from most regions are expected to increase, mainly due to larger decreases in trade costs compared to current values, exports of EREG are projected to rise only in slightly more than half of the regions, due to trade diversion effects (see Figure F.4). Market access would be improved for important exporters of EREG, whereas for EPP the gain would be rather shared among all regions,

Figure F.4: Opening up trade in environmentally preferable products would raise exports in most regions



Source: Bacchetta et al. (2022).

Note: The figure displays the percentage changes in exports of EREG and exports of EPP projected with the WTO Global Trade Model for 2030. The left panel shows the projected percentage change of real exports of EREG with only a reduction in tariffs under scenario (1) and a reduction in both tariffs and NTMs under scenario (2). The right panel shows the projected percentage change of real exports of EPP with only a reduction in tariffs under scenario (3) and a reduction in both tariffs and NTMs under scenario (4). The percentage change of exports for the World corresponds to a trade weighted average over all regions.

with low-income regions projected to expand trade of EPP for which they have a comparative advantage.

Besides trade flows, the removal of tariffs and reduction of NTMs on EREG and EPP (per scenario 4) would raise global GDP (expressed in real terms) by 0.8 per cent relative to the baseline in 2030.[22] GDP would rise in all regions, including those where exports of EREG and EPP are projected to fall (relative to baseline) due to two effects. First, lowering barriers to trade would reduce distortions. Second, productivity would increase owing to lower costs of compliance with NTMs and lower prices for goods that facilitate the more efficient use of energy and materials.[23] Most of the projected increase in GDP is driven by trade-opening of EREG, since the projected change in trade in EPP is smaller than the projected change in trade of EREG.

The elimination of tariffs and the reduction of NTMs on EREG and EPP (scenario 4) would reduce global CO_2 emissions by 0.58 per cent in 2030, relative to the baseline. About half of this reduction in emissions would be the result of tariff liberalization, while the other half could be attributed to the reduction of NTMs. The total effect can be broken down into three components along the lines discussed in Section F.3(a).

First, opening trade in EREG and EPP would stimulate trade and GDP, and thereby raise the demand for energy, thus raising emissions by 0.034 per cent in 2030 (a form of scale effect).[24] Second, the scale effect would be more than offset by increased energy efficiency in both production and consumption due to higher imports of energy efficiency and clean and renewable energy goods (a form of technique effect). Combined with the scale effect, the energy-efficiency effect is projected to result in a reduction of annual CO_2 emissions by 0.58 per cent in 2030. The third effect achieved through the shift towards renewable energy (a form of composition effect) would be negligible[25] because, in order for an economy to switch to sectors that produce using clean technologies, large investments in fixed costs are needed, so it is expected that opening up trade in EG alone would not be enough to result in large composition effects.[26]

As explained previously, the simulations only capture two mechanisms through which trade in EG can affect carbon emissions. At least three additional channels through which trade in EG could reduce carbon emissions are not modelled. First, increased trade in EG can promote the diffusion of environmental innovation, which would likely reinforce the energy-efficiency effect through another form of technique effect. Second, detailed effects related to ES, for example better environmental monitoring or waste management, are not considered. Modelling such channels would require extensive study of the role of imported capital goods in the adoption and diffusion of sustainable environmental management. Third, opening up trade in EPP can lead to a shift in consumption and production towards EPP and help reduce carbon emissions as well as address other environmental issues.[27]

For some EG, such as solar panels, substantial declines in price have, in the recent past, been accompanied by large trade flows. At the same time, installed capacity in solar panels increased about 15-fold from 2010 to 2019, during which the levelized cost of energy plummeted in most countries (IEA, 2022a).

A recent study suggests that trade liberalization in solar PV power generation technologies might bring considerable reductions in carbon emissions by helping to stimulate production, reduces price and application costs, and increases solar PV power capacity. Eliminating half of the trade barriers on solar cells and modules could reduce global emissions by 4 to 12 gigatonnes of CO_2 ($GtCO_2$) between 2017 and 2060, corresponding to a cumulative reduction of global emissions of 0.3 to 0.9 per cent.[28]

The contribution of trade in EGS to the transition to a low-carbon economy could be significantly larger if the opening of EGS markets were accompanied by relevant complementary policies. As discussed in Chapter C, ambitious, credible and timely climate policy strategies are essential to signal the market, investors and consumers to make more low-carbon investment and consumption decisions, including with respect to the development, adoption and deployment of EGS.[29] Climate change policy can also affect how responsive agents are to price changes in EGS and high-carbon products (i.e., price elasticity of demand).[30]

A wide adoption of EGS is likely to only take place when the price drop of EGS caused by the reduction in trade barriers in EGS is sufficient to render them as affordable as, or cheaper than, high-carbon goods. When the level of trade barriers on EGS is already relatively low, the liberalization of trade in EGS might not necessarily lead to a price drop large enough to make EGS price competitive. In addition, other factors besides the price of EGS can influence the decision to replace high-carbon technologies with low-carbon ones. For instance, the choice of a given energy technology can also depend, among other things, on its life cycle and reliability, as well as the marginal cost of the electricity generated, installation cost, grid infrastructure, storage capacity, and structure of the electricity market. Well-targeted and adequately financed energy and infrastructure policies are important to make EGS and ET investable by reducing uncertainty and improve investment risk management.

A well-functioning quality infrastructure system – comprising legal and regulatory frameworks responsible for standardization, accreditation, metrology and conformity assessment – is also key to guarantee the supply of high quality EGS and keep deficient, sub-standard quality products from entering the supply chain (WTO and IRENA, 2021). Setting up and upgrading the quality infrastructure can also contribute to reduce trade costs, increase the likelihood that domestic companies participate in the value chains of EGS and ultimately build an EGS sector that delivers economic, social and environmental benefits.

4. The development and deployment of environmental goods and services require greater international cooperation

The transition to a low-carbon economy will not be possible unless ET are developed, deployed and diffused quickly. International cooperation on EGS, and in particular on trade in EGS, can play a major role in supporting the development and in scaling up the adoption of EGS.

Addressing, through cooperation, the trade barriers that hinder the adoption and diffusion of ET can improve market access to more efficient, diverse and cheaper EGS and stimulate innovation. This is particularly relevant for economies that do not necessarily possess the know-how and manufacturing capacity to produce ETs. However, this does not mean that these and other economies cannot contribute to the production of EGS, given that ET are often produced in GVCs, in which many economies participate in the supply of parts and services.

Facilitating access to EGS through trade can also provide economies with greater opportunities to adapt ET to their local needs, spurring potentially greater environmental innovation. When there is little or no international trade cooperation on ET, the level of development, deployment and use of EGS is likely to be less than optimal from a global perspective, resulting in a slower transition to a low-carbon economy.

While trade and trade policy on EGS are particularly relevant, other issues that hinder the development, adoption and diffusion of EGS have to be addressed to ensure that trade in EGS contributes to the fullest to the transition to a low-carbon economy. Some of these barriers include inadequate infrastructure, skills, and environmental and energy policies. Addressing trade barriers faced by EGS through trade agreements could also contribute to making climate policies more credible by signalling to the market and investors in ET that governments are seriously committed to improving the ET industry. Such signalling could also increase transparency and predictability.

(a) Facilitating trade and investment in environmental goods and services is essential

Although international cooperation on EGS is attracting attention, it is not a recent phenomenon. Multilateral negotiations to reduce or eliminate tariffs and non-tariff barriers (NTBs) on EGS were launched in 2001 as part of the Doha Development Agenda.[31] The lack of progress in the Doha Development Agenda negotiations ultimately led 46 WTO members to launch the negotiations of a plurilateral Environmental Goods Agreement in 2014.[32] The Environmental Goods Agreement negotiations then stopped in 2017 and have not resumed since.

Multilateral and plurilateral trade negotiations on EGS have faced a number of challenges. While trade negotiations do not seek to identify the full range of EGS, negotiations on the criteria defining the scope of EGS have faced significant hurdles. While some products, such as wind turbines or solar panels, may seem to be intrinsically environmental, there are many other products that may not come across as being environmental *per se*, but which are nevertheless essential when carrying out environmental activities or implementing ET. A product may be used for both environmental and non-environmental purposes. While manufacturing goods received the most attention in trade negotiations, there has been discussion about whether some agricultural goods, such as organic fruits and vegetables, may be considered as EG. The rapidly evolving nature of ET also raises the question of how to address obsolete EGS technologies in the future, and how to ensure that the latest environmental innovations are considered.

The difficulty in reaching consensus at the multilateral and plurilateral level has led regional trade cooperation to become the main avenue to promote trade in EGS. The 2012 Vladivostok APEC Leaders' Declaration marked the first time a group of economies agreed to a set of EG (i.e., 54 EG), with a view to reducing their respective applied tariff rates to 5 per cent or less by the end of 2020. The APEC list includes solar panels, wind turbines and bamboo flooring, as well as environmental monitoring, analysis and assessment equipment.[33]

In parallel to these initiatives, an increasing number of regional trade agreements (RTAs) explicitly address trade in EGS (see Figure F.5). Although the inclusion of provisions on EGS in RTAs is not a recent trend, the number of these provisions in any given agreement has increased significantly over the years.

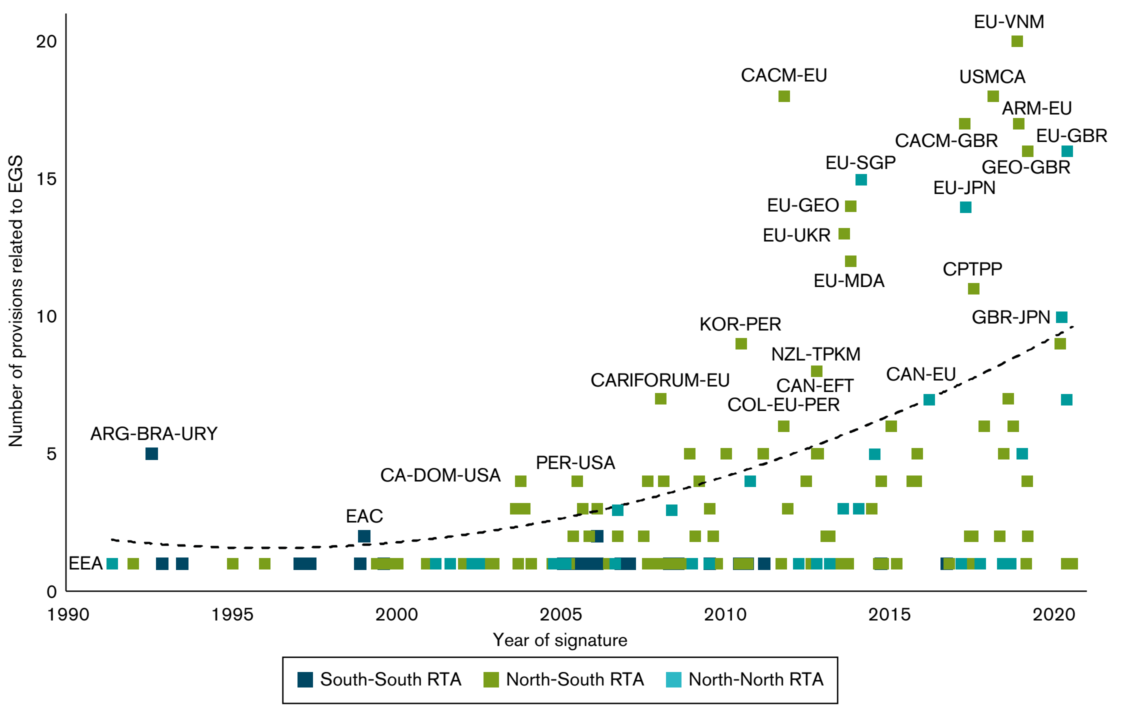
Environmental provisions are known to be heterogenous across RTAs, and provisions on EGS are no exception (Monteiro, 2016; 2022b). They differ in terms of structure and location in RTAs, as well as in language and scope. While some provisions refer to EG, ES or technologies in general, other provisions address specific categories of EGS, such as goods and services related to sustainable renewable energy and energy efficiency, or goods and services subject to eco-labelling and fair trade schemes. A few more recent provisions explicitly refer to climate-friendly goods, services and technologies. Provisions on EGS complement other environmental provisions, including those promoting voluntary environmental performance mechanisms, such as private-public-partnerships and voluntary environmental auditing and reporting, found in a limited number of RTAs. Similarly, provisions on EGS complement provisions on trade in natural resource-based products obtained through a sustainable use of biological resources and provisions on sustainable management of fish and forests, and on trade in fish and timber products, found in an increasing number of RTAs.

Provisions committing parties to endeavour to facilitate and promote trade and, in some agreements, foreign direct investment in EGS are the most common type of provisions on EGS. Most other provisions on trade in EGS are only specific to a single or a few RTAs.

While many RTAs include different market access and national treatment commitments for ES (mostly related to waste management and treatment), only a couple of agreements establish explicit tariff reductions or eliminations for specific EG.[34] The 1992 Partial Cooperation and Trade Agreement between Argentina, Brazil and Uruguay was one of the first trade agreements to eliminate tariffs and NTMs on an agreed list of EG (58 tariff lines at the 10-digit national product classification level). More recently, the RTAs negotiated by New Zealand with Chinese Taipei and the United Kingdom include a list of EG (132 and 298 tariff lines, respectively, at the six-digit HS level), whose tariffs are to be eliminated. An alternative market access approach, only found in the RTA between Indonesia and Switzerland, establishes a preferential tariff rate quota access for palm oil produced sustainably in Indonesia.

Besides tariffs, some recent RTAs explicitly call on the parties to address potential NTMs on EG. Many

Figure F.5: Provisions on environmental goods and services are increasingly included in RTAs



Source: Monteiro (2022b).

Note: Analysis based on RTAs notified to the WTO. "North" is defined as high-income countries, whereas "South" is defined as middle- and low-income countries according to the World Bank's country classification.

of these provisions add clarifications or expand some of the disciplines set out in the WTO TBT Agreement. A few provisions promote good regulatory practices when designing standards and technical regulations relating to EG in general. Other provisions establish regulatory commitments on specific categories of EG, such as listing relevant international standard-setting bodies for the design of domestic standards on products related to renewable energy;[35] harmonizing energy performance standards and test products;[36] acceptance of the other party's technical regulations, standards or conformity assessment procedures related to the production, processing or labelling of organic products;[37] and mutual acceptance of conformity assessment procedures for products related to renewable energy.[38]

While most detailed provisions on EGS in RTAs focus on EG, only a few detailed provisions explicitly address trade barriers on ES, such as facilitating the movement of businesspersons involved in the sale, delivery or installation of EG or the supply of ES.[39] Provisions on support measures related to EGS are also limited. For instance, a recent provision commits each party to refrain from adopting local content requirements or any other offset affecting the other party's products, service suppliers or establishments related to energy generation from renewable and sustainable non-fossil sources.[40]

The remaining types of provisions on EGS in RTAs are mostly about cooperation. While some cooperation provisions refer to cooperation on EGS in general, other cooperation provisions focus on specific categories of EGS or specific issues. Some provisions encourage cooperation between enterprises in relation to goods, services and technologies beneficial to the environment. A few other provisions call on the parties to cooperate in international fora to support trade and investment in EGS.

Although progress in trade negotiations on EGS in the WTO has been limited, the multilateral trading system ensures that trade in EGS flows as smoothly, predictably and freely as possible through its disciplines, which limit members' discretion to adopt policies unjustifiably, thereby causing negative cross-border spillovers. Tariffs on manufacturing goods, including many EG, were, on average, significantly reduced with the conclusion of the Uruguay Round (1986-94). The General Agreement on Tariffs and Trade (GATT) and the GATS ensure that trade policies, including those related to EGS, are non-discriminatory and transparent. The TBT Agreement also aims to ensure that technical regulations, standards and conformity assessment procedures on goods, including those related to EG, do not create unnecessary obstacles to trade and are based on relevant internationally agreed standards. The TBT Agreement further promotes the harmonization, equivalence and mutual recognition of technical regulations and conformity assessment procedures. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) also supports the development and dissemination of ET by establishing a set of minimum standards for the protection and enforcement of intellectual property rights.

The WTO could make an even greater contribution to promoting trade in EGS by advancing a couple of initiatives currently being pursued by several WTO members at the plurilateral level.[41] The Trade and Environmental Sustainability Structured Discussions (TESSD) explore opportunities and possible approaches for promoting and facilitating trade in EGS. The TESSD intends to broaden the scope beyond tariff liberalization and cover NTMs, the dissemination of technology and ES – including those that can facilitate the uptake and use of EG – and technical assistance. Potential outcomes of the TESSD could include identifying and compiling best practices, as well as exploring opportunities for voluntary actions and partnerships to promote and facilitate access to EGS, including new and emerging low-emission technologies, and other climate-friendly technologies.[42]

Efforts to support trade in EGS could also be reinforced by promoting sustainable trade in plastics, including low-carbon alternatives, a topic currently under discussion in the Informal Dialogue on Plastics Pollution and Environmentally Sustainable Plastics Trade at the WTO. Similarly, rationalizing and phasing out the use of fossil fuel subsidies, under the Fossil Fuel Subsidy Reform initiative,[43] could promote low-carbon energy sources, including renewable energy equipment.

(b) Inclusive participation in developing and deploying environmental goods and services is important

A just transition to a low-carbon economy requires giving particular attention to the challenges and opportunities faced by developing countries and vulnerable groups when they engage or seek to participate in trade in EGS.[44] Given that the ET sector is only just emerging in most developing countries and LDCs, reducing tariff barriers and NTMs to EGS is only one way of reducing the costs and increasing the availability of and access to ET. Additional efforts could ensure that effective transfer of ET takes place in practice. In the context of climate change, the Intergovernmental Panel on Climate Change (IPCC) defines technology transfer "as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organizations (NGOs) and research/education institutions" (IPCC, 2000).

Technology transfers through cross-border partnerships can facilitate manufacturing scale-ups and innovation in multiple contexts. Firms can manufacture an environmental product that was successfully developed by an originator firm under some form of licence or production contract that encompasses the transfer of know-how along with formal intellectual property and access to the regulatory dossier. Alternatively, the transfer of technology can help competitors to modify and improve existing ET. A transfer of technology can also be used, irrespective of the type of ET, to develop and produce new ET.

Technology transfers can come from both private and public sources. In the case of climate change, such aid often involves international cooperation (Popp, 2011). For example, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank jointly implement the Global Environment Facility (GEF),[45] which provides grants for projects in developing countries to address global environmental issues, including those related to climate change.

Another example is the Clean Development Mechanism (CDM),[46] defined in Article 12 of the Kyoto Protocol, which offers developed countries the opportunity to earn credits (called saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO_2), in return for financing projects in developing countries that reduce emissions, thus enabling the transfer of climate-friendly technologies (Dechezleprêtre, Glachant and Ménière, 2008). The CDM's underlying infrastructure and remaining funds will largely be repurposed to implement Article 6.4 of the Paris Agreement that establishes a new mechanism for parties to cooperate in achieving their NDCs.

Another international initiative is the Climate Technology Initiative (CTI), operating under the International Energy Agency (IEA), which works to accelerate the development and diffusion of climate-friendly and environmentally sound technologies and practices and to strengthen the capacity of developing countries to employ them. In addition, the World Intellectual Property Organization (WIPO) has established WIPO GREEN, an online database and network that connects owners of new technologies with individuals or companies who might be looking to commercialize, license or otherwise distribute ET.

A very limited but increasing number of RTAs include specific cooperation provisions aimed at facilitating the transfer of ET. Some provisions refer, in general, to the promotion of ET development, innovation, transfer and application.[47] Other provisions specifically cover the promotion of measures at the domestic, regional and international levels, related to R&D, demonstration, deployment, transfer and diffusion of new, innovative, safe and sustainable low-carbon and climate adaptation technologies.[48]

As discussed in Chapter C, the TRIPS Agreement also helps to facilitate the transfer of technology, including of ETs, through developed-country members' commitments under TRIPS Article 66.2 to provide incentives for enterprises and institutions in their territories to encourage technology transfer to LDCs. The Aid for Trade Initiative could also contribute to the transfer of ET by supporting developing countries, in particular LDCs, in building low-carbon and climate-resilient trade capacity and infrastructure (see chapters B and C).

(c) More detailed data on trade and trade policy on EGS are needed

The need for more detailed data on trade and investment in EGS is becoming pressing as governments strive to unlock trade in ET. Different statistical classifications or nomenclatures, including the HS, have been used to identify EG and ES separately. The lack of disaggregated and comparable data on trade in EGS and related trade policies continues to hold back research and can hinder trade negotiations in EGS. Several international organizations have attempted to define and classify EGS.

As discussed above, the OECD/Eurostat Informal Working Group has developed a list based on the six-digit HS intended to illustrate the scope of the "environmental industry" (Steenblik, 2005). UNCTAD (1995) identified several EPP that are more environment-friendly than petroleum-based competitors, produced in an environment-friendly way or that contribute to the preservation of the environment. More recently, the World Customs Organization (WCO) released the 2022 version of the HS, which includes new commodity codes specific to several technologies that use solar energy and energy-efficient light-emitting diodes. These changes should facilitate the monitoring of trade in specific EG. The United Nations' CPC, released in 1991, identifies several types of ES (WTO, 2010). Several international organizations, including APEC and the OECD Secretariat, have also worked to update the list of ES (APEC, 2021; Sauvage and Timiliotis, 2017).

The WTO provides access to official tariff and trade data at the tariff-line level, which often means eight, or sometimes even 10, digits, including in some cases for specific EG for some countries. WTO agreements also promote transparency in trade measures via formal, publicly available notifications of all laws and regulations affecting trade, including those related to EGS. Notifications explicitly related to EGS are reported in the WTO Environmental Database (EDB).

The WTO could further improve the quality and availability of its data on EGS by strengthening its collaboration with statistical agencies and other government offices, as well as with other international organizations, including the WCO. Ongoing plurilateral initiatives, including TESSD, could also play an important role in improving transparency of relevant measures, offering an opportunity for sharing experiences and best practices.

5. Conclusion

The transition to a low-carbon economy will require the development, deployment and diffusion of ET at an unprecedented pace, and trade in EGS can contribute to this process. However, EGS trade flows and trade policies differ across regions: exports of EGS from middle-income countries have been growing dynamically over the past two decades, whereas those of low-income countries have remained almost constant. Conversely, low-income countries' imports of EGS have been increasing faster than those of other countries, suggesting a strong demand for EGS in those countries.

Simulations using the WTO GTM suggest that the elimination of tariffs, together with the reduction in NTMs on a specific subset of EG, could make a contribution to reducing carbon emissions while contributing to an increase in exports and GDP in all regions. These simulations, however, only account for two of the various mechanisms through which trade in EG can affect emissions, suggesting that the actual effects of opening up trade in EGS could potentially be considerably more significant with a broader set of EGS, if all effects were taken into account and if relevant complementary policies accompanied the liberalization of trade in EGS.

International cooperation on trade in EGS can play a major role in supporting the development and in scaling up the adoption of EGS. The multilateral trading system ensures that trade in EGS flows as smoothly, predictably and freely as possible. The WTO agreements can also support the transfer of ET to developing countries, in particular to LDCs. The difficulty in reaching consensus in multilateral and plurilateral trade negotiations has, however, led regional trade cooperation to become the main avenue to promote trade in EGS.

The WTO could make a greater contribution to promoting trade in EGS. Several plurilateral initiatives currently being pursued by subsets of WTO members could play an important role in promoting and facilitating trade in EGS. The WTO could also further improve the quality and availability of data on EGS by strengthening its collaboration with national statistical agencies and other international organizations.

Endnotes

1 The OECD list of EG contains 164 tariff lines at the six-digit Harmonized System (HS) level organized according to three main categories and 18 sub-categories. The list covers, however, 132 unique HS-6 tariff lines after eliminating multiple listings across various sub-categories of some tariff lines. The tariff classification is based on the 1992 version of the HS nomenclature.

2 According to the OECD list, pollution management technologies and products include goods and services that are easily identifiable statistically (OECD, 1999).

3 According to the OECD list, cleaner technologies and products include some goods and services whose statistical assessment remains disputed, difficult or expensive (OECD, 1999).

4 Although environmental protection is excluded from the coverage of resource management, inevitably some products associated with environmental protection may be included, although their prime purpose is not environmental protection.

5 The CPC, prepared under the auspices of the United Nations and other international bodies, provides a classification structure for goods and services based on a set of internationally agreed concepts, definitions, principles and classification rules. The first version of the CPC, the Provisional Central Product Classification, was published in 1991.

6 National and regional statistical classifications of the EGS sector (i.e., EGS sector account) have also been expanded over the years. See for instance Eurostat (2009, 2016).

7 The specific services relevant to the environment are identified within sub-classes of the CPC 2.1 classification at the five-digit level through the use of "ex out" (which indicates that the identified service is extracted from the five-digit subclass) (Nordås and Steenblik, 2021).

8 International trade in goods is classified using the World Customs Organization (WCO) Harmonized Commodity Description and Coding System (HS). The HS classifies all products using six-digit codes that are organized by chapter (two digits), heading (four digits), and subheading (six digits).

9 Notifications of environment-related countervailing measures can be found in the WTO Environmental Database (EDB), which can be consulted at https://edb.wto.org/.

10 The TRAINS database covers 57 countries, encompassing 11 high-income countries (with the European Union included as a country group), 36 middle-income countries and 10 low-income countries.

11 See the Note by the WTO Secretariat on "experiences in the promotion and facilitation of environmental goods and services" (WTO official document number INF/TE/SSD/W18, accessible via https://docs.wto.org/).

12 For more information about the GATS modes of supply, see https://www.wto.org/english/tratop_e/serv_e/gatsqa_e.htm.

13 Public goods are a special case of positive externalities for which the cost of extending the service to an additional person is zero and which it is impossible to exclude individuals from enjoying.

14 GHG comprise carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphurhexafluoride (SF_6). Although carbon dioxide is the primary GHG emitted through human activities, methane has become an emerging GHG given its more potent heat-trapping ability.

15 For example, using LED light instead of filament lamps would reduce energy consumption, as the former is more energy-efficient.

16 Some climate change adaptation solutions can exacerbate some environmental issues in the absence of complementary actions. For instance, artificial snow might help keep slopes snowy at higher temperatures, but its production can be energy- and water-intensive. The chemicals or biological additives used to enhance artificial snow's quality and slow down its melting can also impact the environment, including biodiversity (Rixen, Stoeckli and Ammann, 2003).

17 Trade intensity is defined as the ratio of exports plus imports over GDP.

18 See Aguiar et al., (2019) for a technical description of the WTO GTM, a recursive dynamic computable general equilibrium model. The energy and electricity version of the WTO Global Trade Model was used to generate a baseline projection until 2030 for the global economy with the path for global CO_2 emissions close to the emissions projected by the International Energy Agency (IEA) as reported in Böhringer et al. (2021). Bilateral tariff rates are from the Market Access Map (MAcMap) database, provided by the International Trade Centre (ITC). Ad valorem equivalents of NTMs are taken from Cadot, Gourdon and van Tongeren (2018), based on count data on NTMs from the UNCTAD TRAINS database. The elasticity of carbon emissions with respect to trade in EG were estimated econometrically (Bacchetta et al., 2022).

19 The list of EREG is derived from the OECD list of EG (OECD, 1999).

20 The list of EPP is based on the list reported in Tothova (2005).

21 NTMs are modelled as iceberg costs (i.e., some of the product is lost between the buyer and the seller). A 25 per cent reduction in NTMs is in line with empirical estimates of the effect of a regional trade agreement on NTMs (Benz and Yalcin, 2013), as well as with the literature on regulatory convergence (Vanzetti, Knebel and Peters, 2018).

22 The higher projected global GDP level by 2030 is the result of a higher projected GDP growth trajectory between 2021 and 2030.

23 For the products modelled, the NTMs concern mostly TBT, which require firms to allocate extra resources to comply with them.

24 Part of the effect is also driven by increased demand for transportation services, which generates additional CO_2 emissions.

25 This is the case with or without end-use control. Under the scenario without "end-use control", all energy producing sectors would benefit from the lower prices of clean and renewable energy goods, so that the increase in electricity

produced by fossil fuels would increase emissions. Conversely, under the scenario with “end-use control”, only sectors producing electricity with renewables would benefit from the lower prices of clean and renewable energy goods, which would reduce emissions.

26 The estimated effects, based on the WTO GTM, are an order of magnitude smaller than those found by Hu (2020), due to differences in the models used to determine the price of clean and renewable energy goods and the impact on emissions, and different assumptions concerning the decline in the price of domestic clean and renewable energy goods.

27 In particular, a lack of emissions data at the detailed sectoral level makes it difficult to evaluate the emissions effects of trade in EPP.

28 The estimated cumulative reduction of global emissions of between 0.3 per cent and 0.9 per cent between 2017 and 2060 assumes that emissions remain constant at the level of 2020 (31.5 $GrCO_2$) until 2060 (Wang et al., 2021).

29 For instance, following a reduction in trade barriers on EG, a government which used to extract tariff revenue with tariffs on EG, might be tempted to respond by strategically lowering the level of environmental protection to stimulate domestic production. Depending on the marginal pollution rate associated with the production of the high-carbon product, the reduction in trade barriers on EG could lead to an increase (or decrease) in pollution when the marginal pollution rate is significantly high (or low) (Nimubona, 2012).

30 The price elasticity of demand itself largely depends on the choice and implementation of environmental policy instruments (David and Sinclair-Desgagné, 2005).

31 The WTO Special Session of the Committee on Trade and Environment (CTESS) was established to conduct negotiations on trade and environment. The reduction or elimination of tariffs on EG was also discussed in the context of the WTO's Negotiating Group on Market Access, but without addressing the specific issues that were debated in the CTESS. In addition, the Special Session of the Council for Trade in Services is in charge of the negotiations on services, including ES.

32 The Environmental Goods Agreement discussion initially built on the 54 EG set out in the 2012 Leaders' Declaration of the Asia-Pacific Economic Cooperation (https://www.apec.org/meeting-papers/leaders-declarations/2012/2012_aelm).

33 More recently, APEC economies have been considering updating the list of EG and advancing trade in ES, including by identifying different types of ES (https://www.apec.org/meeting-papers/sectoral-ministerial-meetings/trade/2021_mrt).

34 The tariff reduction and elimination of goods covered in the WTO and in RTAs can apply to EG without explicitly singling out any specific EG.

35 For example, European Union-Singapore and European Union-Viet Nam RTAs.

36 For example, United States-Mexico-Canada (USMCA).

37 For example, Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

38 For example, European Union-Singapore RTA.

39 For example, Chinese Taipei-New Zealand RTA.

40 For example, European Union-Singapore and European Union-Viet Nam RTAs.

41 These WTO initiatives complement other initiatives, such as the one led by Costa Rica, Fiji, Iceland, New Zealand, Norway and Switzerland that seeks to negotiate tariff elimination on EG and binding commitments for ES in an Agreement on Climate Change, Trade and Sustainability.

42 See TESSD Ministerial Statement on Trade and Environmental Sustainability (WTO official document number WT/MIN(21)/6, viewable via https://docs.wto.org/).

43 See Ministerial Statement on Fossil Fuel Subsidies (WTO official document number WT/MIN(21)/9/Rev.1, viewable via https://docs.wto.org/).

44 A number of international initiatives support micro, small and medium-sized enterprises (MSMEs) in introducing innovations to their operations and scaling them for trade across borders. For instance, the World Banks's Climate Technology Program (CTP) supports the private sector in developing countries, and in particular small and medium-sized enterprises and entrepreneurs, to use new technologies and business models to address local climate challenges.

45 See https://www.thegef.org/.

46 See https://cdm.unfccc.int/index.html.

47 See for instance the European Union-East African Community (EAC) RTA.

48 See for instance the European Union-Armenia RTA.