Asia-Pacific
Economic Cooperation

Advancing Free Trade
for Asia-Pacific **Prosperity**

Study on Non-Tariff Measures Affecting Trade in Goods Reducing Greenhouse Gas Emissions

APEC Policy Support Unit

May 2023

Prepared by:
Carlos Kuriyama and Sylwyn C. Calizo Jr.
Asia-Pacific Economic Cooperation Policy Support Unit
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 6891-9600 | Fax: (65) 6891-9690
Email: psugroup@apec.org Website: www.apec.org

and
Deloitte Access Economics Pty Ltd

Produced for:
Committee on Trade and Investment
Asia-Pacific Economic Cooperation

APEC#223-SE-01.3

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF BOXES

KEY FINDINGS

Member economies have taken steps to facilitate trade in goods reducing greenhouse gas (GHG) emissions, but more work needs to be done

- Most firms have said that trading these goods has become easier in the last five years due to reforms and tariff reductions, despite disruptions to supply chains.
- The experiences of firms with non-tariff measures (NTMs) affecting trade in these goods have received less attention in previous research on this topic.

Firms' experience of burdensome NTMs depend on the economy, sector and size of their operation

- Export and import formalities and quantity restrictions are the most widely recognised barriers to trade in goods reducing GHG emissions, but firm-level experience has varied depending on the market and product. The majority of NTMs are experienced by firms on the export-side of trades.
- Firms trading goods in the renewable energy sector face more burdensome NTMs than firms trading other goods reducing GHG emissions.
- Bilateral trade relationships significantly influence firm-level experiences with NTMs.
    - Firms generally found that NTMs are more burdensome in their largest bilateral trading relationships.
    - This association was strongest in high income economies.
- There is a significant difference in the types of burdensome NTMs faced by small- to medium-sized enterprises (SMEs) compared to larger firms.
- Firms recognised the burden of NTMs primarily through the time delays that they cause, related to associated documentation and procedures.

Domestic policy and regulation are essential to both creating new markets and developing existing markets for goods reducing GHG emissions

- Many environmental goods reducing GHG emissions are relatively new technologies, where international trade flows have not yet matured (e.g., clean hydrogen). Environmental policies and regulations that are mutually supportive of trade are a central tool in creating demand and new markets for these products.
- Firms note that the costs imposed by the NTMs, while burdensome, are less influential to their trade volumes than domestic policies which spur demand and markets for goods reducing GHG emissions.
- APEC member economies are recognised by firms as leaders in implementing policies to facilitate trade of goods reducing GHG emissions.
- Most firms make use of free trade agreements (FTAs) when trading goods reducing GHG emissions, although large firms are relatively more likely to do so than small firms. In negotiating new agreements, parties can look to leverage best practice to support trade in goods reducing GHG emissions.

Firm perspectives also need to be taken into account when designing effective multilateral trade policy

- Direct responses from firms, gathered systematically through surveys and interviews, can add further detail to publicly available databases that provide statistics on the impacts of NTMs on trade. Both types of information complement each other and provide valuable information to policymakers.

- A 'value chain' framework for understanding of trade in goods reducing GHG emissions is necessary to interpret the impacts of NTMs in a highly globalised trading system — the direct impact of NTMs on the trade of a particular good can have significant flow on effects to other products in these supply chains.

POLICY RECOMMENDATIONS

A wide range of technologies are required to support reducing GHG emissions. Efforts to reduce trade-restrictive NTMs should support this diversity and not just cover renewable energy production, but also goods for air pollution control, waste management, resource/energy efficiency, cleaner technologies, among others. In addition, governments need to put more emphasis on the implementation of NTMs that could enable trade. APEC economies could consider implementing actions from many different angles:

- In the short run, cooperation could prioritize reducing trade-restrictive NTMs affecting mature technologies that have the greatest potential to reduce emissions. Solar energy, wind energy and green hydrogen production are among the technologies with greater potential to reduce GHG emissions.
- It is important to continue to monitor the emergence of NTMs in emerging technologies as their trade grows (e.g., electric vehicles), while implementing policies to drive demand for those products.
- Changes to current NTMs restricting trade of goods reducing GHG emissions need to take into account their global value chains. Lowering barriers to trade, not just for the final goods but also to other components in the production process, could improve access to markets to upstream suppliers, intermediaries and downstream buyers, thus benefitting multiple APEC economies.
- While not unique to goods reducing GHG emissions, streamlining processes, reducing paperwork and ineffective customs formalities associated with burdensome NTMs would facilitate greater trade, particularly for SMEs. As indicated in this report, these procedures/formalities have been identified as one of the most critical issues affecting several products and billions of dollars in terms of trade. Firm perspectives have to be considered when designing effective trade policies.
- To take into account the APEC Cross-Cutting Principles on NTMs agreed in 2018, which establishes guidelines for the process to develop NTMs in a transparent and WTO-consistent manner. These principles state that NTMs cannot be more trade-restrictive than necessary to achieve an objective and should preferably focus on outcomes, rather than mandating prescriptive approaches. Furthermore, this initiative emphasizes that NTMs should be based on international standards, when appropriate, and should not pose unjustified barriers to innovation, among others. Environmental regulations, which could enable trade in goods reducing GHG emissions, should take into account these principles.
- Diverging technical regulations could represent an impediment to trade. APEC could promote initiatives to align technical regulations and implement conformity assessment procedures to facilitate trade in goods reducing GHG emissions. APEC could take a leading role in promoting good regulatory practices in the application of standards for new emerging technologies.
- Many firms use FTAs to have preferential access to markets and alleviate the impact of trade-restrictive NTMs. The most extensively used FTAs can provide a basis for lessons that can be adopted more widely across APEC. Besides FTAs,

there are new bilateral initiatives that also offer opportunities to increase trade in goods reducing GHG emissions. For example, the new Green Economy Agreement between Australia and Singapore include a mechanism to identify and address non-tariff barriers and a strong collaboration in standards and conformance (e.g., through the mutual recognition of certification and conformity assessment procedures in relation to the green economy).

- The list of environmental products designed to reduce GHG emissions can be optimized and improved. Any product not conducive to reducing GHG emissions should not be part of this list.

1. INTRODUCTION

1.1 CLIMATE CHANGE AND APEC

Global warming and climate change have been increasingly part of both domestic and international discussions ever since environmental challenges were mainstreamed into public consciousness around the 1970s. However, actions failed to keep pace with the discussions, having serious implications on environmental degradation. In fact, global carbon dioxide (CO_2) emissions stood at just six billion metric tons (MT) in 1950 but quickly expanded to 15 billion MT in 1970 and 37 billion MT estimated in 2019[1].

The accumulation of CO_2 emissions and other greenhouse gases (GHGs) led to global warming that, in turn, raises mean sea levels, strengthens storms, and creates harsher extreme temperature events (e.g., heatwaves), among others. Everyone is affected. In fact, APEC alone has already been hit by a total of 4,363 disasters, of which meteorological and hydrological events jointly accounted for 78 percent.[2] Total damages from 1989 to 2021 were estimated at USD 3.7 trillion (constant 2021 prices). These damages translate to losses that could have otherwise been used to improve households' standard of living, fund government programs (e.g., health, infrastructure, and environmental restoration), or pursue other objectives such as the empowerment of vulnerable populations.

Despite the gravity of the situation, it was only in 2015 that 196 Parties agreed to legally bind themselves to jointly address worsening climate change. The Paris Agreement calls for achieving a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century in order to limit global temperature rise to 'well below 2°C'. In other words, signatories to the agreement — across government, business and civil society — have committed to reducing GHGs emitted through human activity and cancelling out the remainder by removing GHG emissions from the atmosphere with carbon sinks.

Achieving the goals of the Paris Agreement, however, requires investment, planning, and — above all else — timely action. Under the Glasgow Climate Pact, the international community agreed to phase down unabated coal power and to phase out inefficient fossil fuel subsidies, among others (Fransen et al., 2022). This alludes to a stronger call towards the clean energy transition — ultimately leading to carbon neutrality by 2050. Incidentally, only six APEC economies (Canada; Chile; Japan; Korea; New Zealand; and Russia) legalized its net zero emissions target, as of January 2023.[3] Other economies institutionalized it through policy documents while the rest either made pledges or remain in discussion.

---

[1] APEC Policy Support Unit (PSU) calculations based on Our World in Data (https://ourworldindata.org/grapher/annual-co2-emissions-per-country?facet=none&country=~OWID_WRL). CO_2 emissions are from fossil fuels and industry (excluding land use changes).

[2] APEC PSU calculations based on the Emergency Events Database or EM-DAT (https://www.emdat.be/). EM-DAT defines disasters as having fulfilled any of the following: (1) 10 or more people deaths; (2) 100 or more people affected/injured/homeless; (3) declaration by an economy of a state of emergency and/or an appeal for international assistance.

[3] APEC PSU compilation based on the Net Zero Tracker – Net Zero Scorecard (https://zerotracker.net/)

1.2 RATIONALE

International trade is integral to achieving these goals at the lowest possible cost. Trade encourages the widespread adoption of products and technologies that contribute to emission reductions by making these products and technologies more accessible across a broader range of markets.

One way of advancing the clean energy transition is by facilitating and accelerating the widespread use of products and technologies that contribute to the reduction of GHG emissions. This underscores the importance of liberalizing international trade, which includes not just the elimination of tariffs but also non-tariff measures (NTMs). Indeed, this could encourage the utilization of existing products and the development of new technologies that reduce GHG emissions.

Given the role of trade in achieving the objectives of the Paris Agreement, APEC has devoted significant resources to measuring, facilitating and promoting trade in environmental goods reducing GHG emissions. In 2012, the 21 APEC member economies endorsed a list of 54 environmental goods and agreed to reduce tariffs on these goods to five percent or less by the end of 2020 (APEC, 2012). These goods include a number of air pollution control and renewable energy goods relevant to achieving carbon neutrality.

A review of this list released in October 2021 found that 19 of the 21 APEC member economies had already met this target (Kuriyama, 2021).[4] Ten years on from the original list and following growth and innovation in markets for environmental goods, APEC has examined the trade of new and emerging environmental goods to consider approaches to updating the 2012 list (The Australian APEC Study Centre at RMIT University et al., 2021). There is also progress in identifying a reference list of environmental services that was agreed upon by APEC economies in 2021 (APEC, 2021a). Indeed, APEC has been involved in seeking solutions to the worsening climate change situation. Part of this effort, for example, is a policy dialogue held virtually on September 2021 that discussed possible approaches to address the trade-related policies affecting products and technologies contributing to GHG emissions reduction (APEC, 2021b).

Reforms to date have focused on tariff measures. It can be challenging to isolate the net economic effects of NTMs because (a) their costs are often not directly observed (i.e., increasing time spent on compliance rather than a direct monetary fee), and (b) they could be implemented to advance desirable public policy objectives in areas like health, safety and the environment (The Australian APEC Study Centre at RMIT University et al., 2021). Consequently, a deeper understanding of NTMs would benefit decisions about their reform. Although NTMs are reported through the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information Systems (TRAINS) and the World Trade Organization (WTO) Integrated Trade Intelligence Portal (I-TIP) databases, the validity and quality of this information could be enhanced by seeking primary input from firms.

Evidence that trade policy globally does not encourage the trade of goods reducing GHG emissions reinforces the case for inquiry into NTMs. In fact, current global trade policy settings subsidise and encourage the trade of goods increasing GHG emissions. Recent estimates show

[4] However, it is important to mention that the data shown in the October 2021 review does not incorporate recent tariff reductions in Indonesia to meet the target set in the APEC List of Environmental Goods. In addition, in the case of Chile, it has a universal six percent import most favoured nation (MFN) tariff duty, but due to Chile's comprehensive network of free trade agreements (FTAs), its applied average tariff is low, at around one percent.

an implicit subsidy of between USD 550 billion to USD 800 billion per year towards CO_2 emissions in traded goods (Shapiro, 2020). The study identified NTMs specifically as a functionally higher barrier to trade on low-emissions goods than on high-emissions goods.

This report advances the discussions of the aforementioned policy dialogue organized in September 2021 by identifying NTMs affecting trade in goods reducing GHG emissions. This is conducted in two complementary ways: (1) through desk-research, analysing trade databases with information on NTMs, and (2) by collecting firm-level perspectives on the nature and scale of the effects of NTMs in trade in goods reducing GHG emissions, via online surveys and interviews targeting firms that trade in these goods. The responses to the survey and interviews inform policy recommendations that aim to minimize inhibitive NTMs and improve the design of measures to facilitate trade in goods reducing GHG emissions. This report also offers concrete areas for regulatory cooperation related to trade and climate change to assist in outlining priority areas for further work within APEC and beyond. Through this exploratory work, APEC economies will be able to gain a clearer picture of the options for policy cooperation and other ways forward.

Box 1.1 Transaction costs and NTMs

The global value chains (GVCs) for many goods reducing GHG emissions are interconnected and highly specialised, it is important that firms can transact easily across borders. Consequently, the *transaction costs* of NTMs can pose direct and indirect impediments to trading these goods. Transaction costs are not limited to pecuniary costs of fees, but can also include the administrative, bargaining and search costs involved in an exchange.

A sizeable empirical literature has attempted to translate these NTM-related transaction costs into a comparable, monetary value. Most quantitative studies convert the vast range of NTMs into an ad valorem tariff equivalent (AVE). One of the most cited econometric estimates finds that 'core NTMs' impose a 12 percent AVE (Kee et al., 2008). Another study found that a halving of the AVE of NTMs (from 10 percent to 5 percent) would increase international trade by 2 percent to 3 percent (Hoekman and Nicita, 2011; UNCTAD, 2013) has reported that NTMs are twice as trade restrictive as tariffs.

Consequently, the impact of NTMs on goods that reduce GHG emissions is especially relevant. It also means that the 'direct approach' adopted in this study underestimates the benefits of reducing trade-restrictive NTMs. Reductions in the transaction costs of NTMs are likely to yield indirect benefits across the value chain. If the transaction costs of NTMs are lower for exporters of raw materials, the cost of inputs for manufacturing economies will decrease, and the benefits will flow through to downstream consumers. In this sense, the direct approach adopted in this study, where firms only report on the NTMs that directly affect them, understates their full economic effects. In reality, reducing the NTMs that firms find burdensome will likely yield flow-on benefits across their highly globalised and specialised value chains.

2. MAPPING OF NON-TARIFF MEASURES AFFECTING APEC

This report mapped the NTMs affecting APEC using two methods: (1) through the analysis of international trade databases; and (2) by gaining insights from firm survey and interviews. NTMs are defined, according to UNCTAD (2019), as policy measures, other than ordinary customs tariffs that potentially have an effect on international trade in goods such as changing quantities traded, or prices or both. In this sense, the UNCTAD Multi-Agency Support Team (MAST) has created a classification system that organizes NTMs into chapters (Table 2.1).

Table 2.1 UNCTAD NTM classification system

	Category	Chapter	Description
Imports	Technical measures	A	Sanitary and phytosanitary (SPS) measures
		B	Technical barriers to trade (TBT)
		C	Pre-shipment inspection and other formalities
	Non-technical measures	D	Contingent trade-protective measures
		E	Non-automatic licensing quotas, prohibitions, and quantity-control measures and other restrictions not including SPS measures or measures relating to TBT
		F	Price-control measures including additional taxes and charges
		G	Finance measures
		H	Measures affecting competition
		I	Trade-related investment measures
		J	Distribution restrictions
		K	Restrictions on post-sales services
		L	Subsidies and other forms of support, excluding exports subsidies under P7
		M	Government procurement restrictions
		N	Intellectual property
		O	Rules of origin
Exports		P	Export-related measures: - P1 Export measures related to sanitary and phytosanitary measures and technical barriers to trade - P2 Export formalities - P3 Export licences, export quotas, export prohibition and other restrictions other than SPS or TBT - P4 Export price-control measures - P5 State trading enterprises, for exporting; other selective export channels - P6 Export-support measures - P7 Measures on re-export - P8 Exports on measures not elsewhere specified

Source: Adapted from UNCTAD (2019).

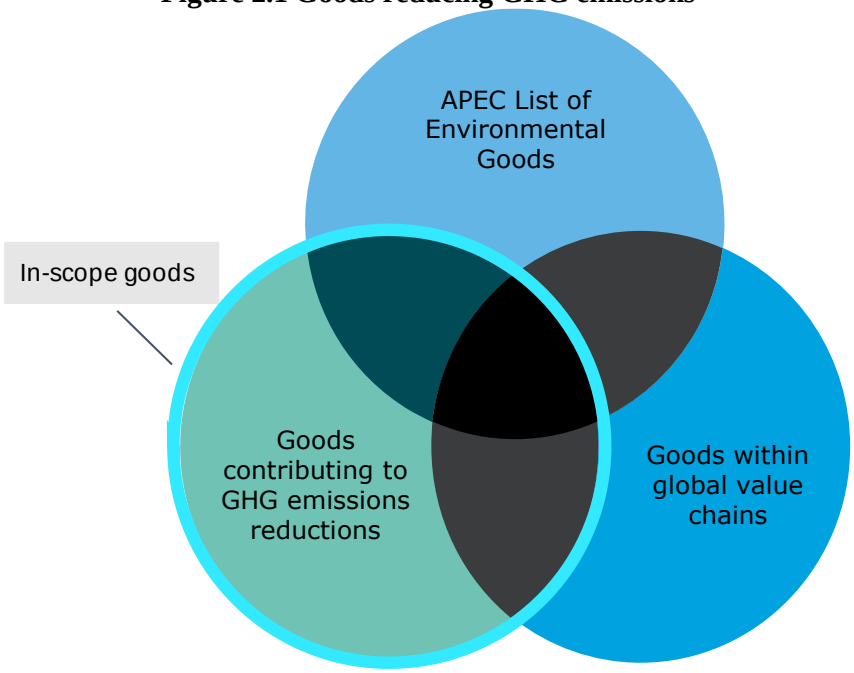
The goods reducing GHG emissions included in the analysis are those where the main purpose of the good is to:

1. Directly reduce GHG emissions through the displacement of an activity that would have otherwise produced GHG emissions. Examples could include products and technologies that:
   - enable energy to be generated from renewable or zero emission sources (e.g., solar panels, wind turbines and component parts) displacing the combustion of fossil fuels.
   - are more energy efficient (e.g., LED lightbulbs, heat pumps), thus decreasing demand for fossil fuel combustion.
   - enable renewable energy to be stored (e.g., batteries, zero emission hydrogen).
   - control air pollution or filter harmful GHGs (e.g., catalytic converters, incinerators, carbon capture and sequestration).

2. Directly remove GHGs from the atmosphere. This could either by done through:
   - technological solutions — products that assist in the capture and storage of GHGs from the atmosphere (e.g., biomass carbon removal and storage and direct air carbon capture and storage).
   - nature-based solutions — products that enable afforestation, reforestation, restoration of coastal and marine habitats or those that support the creation of natural GHG sinks.

It is important to emphasise that this analysis is not limited to products in the current APEC List of Environmental Goods because the products of interest were in scope if they met the definition above. In effect, this could include a subset of APEC Environmental Goods, as well as intermediate parts that do not directly contribute to GHG emissions reduction but are essential components in GVCs for these products (Figure 2.1).[5]

Figure 2.1 Goods reducing GHG emissions



Source: Deloitte Access Economics.

Services contribute to the value chains of these products, and indeed many firms produce services alongside the goods that they trade. NTMs that affect the services that support the trade of goods reducing GHG emissions will therefore indirectly affect trade of in-scope products. Nevertheless, the impact of NTMs on these services are considered out of scope for this project, which is focused specifically on goods.

2.1 ANALYSIS BASED ON INTERNATIONAL TRADE DATABASES

Three international trade databases are utilized in this study, namely: (1) the UNCTAD TRAINS; (2) the WTO I-TIP; and (3) the Global Trade Alert (GTA). Each of these databases

[5] Due to limited resources, this study only includes some intermediate products, for example, HS 730820 - iron and steel, structures and parts thereof, towers and lattice masts, which are important components for GHG-reducing goods or infrastructure associated to those goods. However, data limitations can make a comprehensive analysis on these goods challenging because those goods could be used on many different activities, and customs authorities do not typically identify whether they will be used for a GHG-reducing, a GHG-increasing, or a GHG-neutral purpose. Notwithstanding, a separate and comprehensive study exploring the impact of NTMs on these dual use intermediate goods could provide more insights to policymakers on additional effective ways to facilitate the production of GHG-reducing goods.

provides different insights and the NTMs analysis benefit from complementing insights from each other. For example, UNCTAD TRAINS can identify the percentage of goods affected by at least one NTM, but it cannot provide detailed information on the stringency of the NTMs. Meanwhile, the WTO I-TIP can provide this detailed information but has a restricted coverage on the incidence or frequency of NTMs affecting traded goods.

In addition, the discussion in this section is based on NTMs affecting a total of 69 goods (HS 6-digit level)[6] that reduce GHG emissions (henceforth, GHG-reducing goods). These are further grouped into four categories, namely: (1) air pollution control; (2) cleaner alternatives; (3) renewable energy; and (4) waste management. Appendix A.1 provides the list of goods under each of these categories.

2.1.1 UNCTAD Trade Analysis Information System (TRAINS)

The UNCTAD TRAINS database allows to calculate (1) the percentage of traded goods affected by at least one NTM (frequency index); and (2) the percentage of trade value subject to at least one NTM (coverage ratio). However, neither of these two indicators accounts for stringency. In addition, the database only includes "de jure" information (i.e., those NTMs based on the examination of regulations and procedures), but it does not take into account the "de facto" situation regarding the actual implementation of those NTMs.

The analysis in this section used reported trade data from the United Nations Comtrade database and on the aforementioned NTMs data from UNCTAD TRAINS. Since the list of traded goods can vary across years, trade values were based on the average of trade from 2013 to 2021.[7] Meanwhile, the reported NTMs data was built using the latest available year for each economy, owing to unavailability of annual data for most economies (Table 2.2).

Table 2.2 Available NTMs data, by latest year available

Year	Economies	Count
2012	Afghanistan; Burkina Faso; Cote d'Ivoire; Guinea; Nepal; Senegal	6
2013	Gambia; Nigeria	2
2014	Benin; Cape Verde; Ghana; Liberia; Mali; Niger; Palestinian Territory, Occupied; Togo	8
2015	United Arab Emirates; Bahrain; Bahamas; Barbados; Switzerland; Cameroon; Dominica; Ethiopia (excludes Eritrea); Grenada; Guyana; Jamaica; Kuwait; Mauritania; Oman; Suriname; Trinidad and Tobago	16
2016	Antigua and Barbuda; **Australia**; **China**; Algeria; **Hong Kong, China**; Israel; Jordan; **Japan**; **Korea**; Lebanon; Sri Lanka; Morocco; **New Zealand**; Pakistan; **Papua New Guinea**; Qatar; **Russia**; Saudi Arabia; Tunisia; Turkey	20
2017	Bangladesh; Botswana; **Canada**; India; Kazakhstan; Kyrgyzstan; Mauritius; Uganda; Zimbabwe	9
2018	Argentina; Bolivia; Brazil; **Brunei Darussalam**; **Chile**; Colombia; Costa Rica; Cuba; Ecuador; European Union (Austria; Belgium; Bulgaria; Croatia; Cyprus; Czechia; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden; and the United Kingdom); Guatemala; Honduras; **Indonesia**; Cambodia; Lao PDR; **Mexico**; Myanmar; **Malaysia**; Nicaragua; Panama; **Peru**; **the Philippines**; Paraguay; **Singapore**; El Salvador; **Thailand**; Tajikistan; Uruguay; **United States**; Venezuela; **Viet Nam**;	58
	Total	119

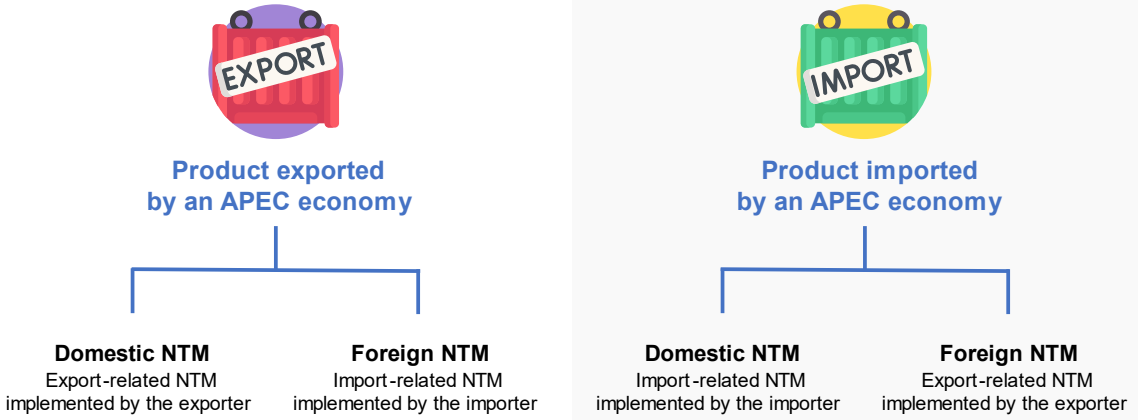
Note: Reported NTMs data for Chinese Taipei is unavailable. APEC economies in bold.
Source: APEC Policy Support Unit (PSU) compilation based on UNCTAD TRAINS (downloaded 9 June 2022).

[6] The Harmonized Commodity Description and Coding Systems (HS) is an international nomenclature for the classification of products that was developed by the World Customs Organization in 1988. The HS system contains 21 Sections that further categorizes products into Chapters (2-digit level), Headings (4-digit level), and Sub-headings (6-digit level). The HS is particularly useful for analyzing international trade because it provides a common nomenclature for all economies albeit limited to just the 6-digit level. For more information about the HS, see: https://unstats.un.org/unsd/tradekb/Knowledgebase/50018/Harmonized-Commodity-Description-and-Coding-Systems-HS.

[7] Trade for Chinese Taipei was based on reported data for "Other Asia, nes". Trade for Papua New Guinea was based on reported data by other economies (i.e., mirrored data) since Papua New Guinea as a reporter was not available.

Since the analysis' perspective is on how APEC's trade is affected by NTMs, the consolidated database naturally includes both domestic NTMs (applied by the reporting economy itself) and foreign NTMs (applied by partner economies), as shown in Figure 2.2. In this regard, a trade transaction needs to consider those NTMs present in both exporting and importing side. For example, reporting economy imports need to consider those NTMs implemented by the importing side, as well as those export-related NTMs implemented by their partners.

Figure 2.2 Perspective on domestic and foreign NTMs



Source: Authors' rendition.

Some data caveats have to be considered when looking at the figures. *First*, the frequency of NTMs is reported in percentage terms, as NTMs are identified by economy pairs for each of the 69 GHG-reducing goods considered in the study. For example, an economy could trade one of the GHG-reducing goods to 10 economies, but not all those bilateral transactions will be affected by NTMs. If only 2 of the 10 economy pairs trading this product were affected by NTMs, the frequency indicator would take a value of 20 percent. The reason behind this is that NTMs are applied differently by each economy, which implies that each product-economy pair has a unique combination of NTMs. This is also the reason why percentage shares are more intuitive at illustrating the incidence of NTMs compared to using the actual number of NTMs.

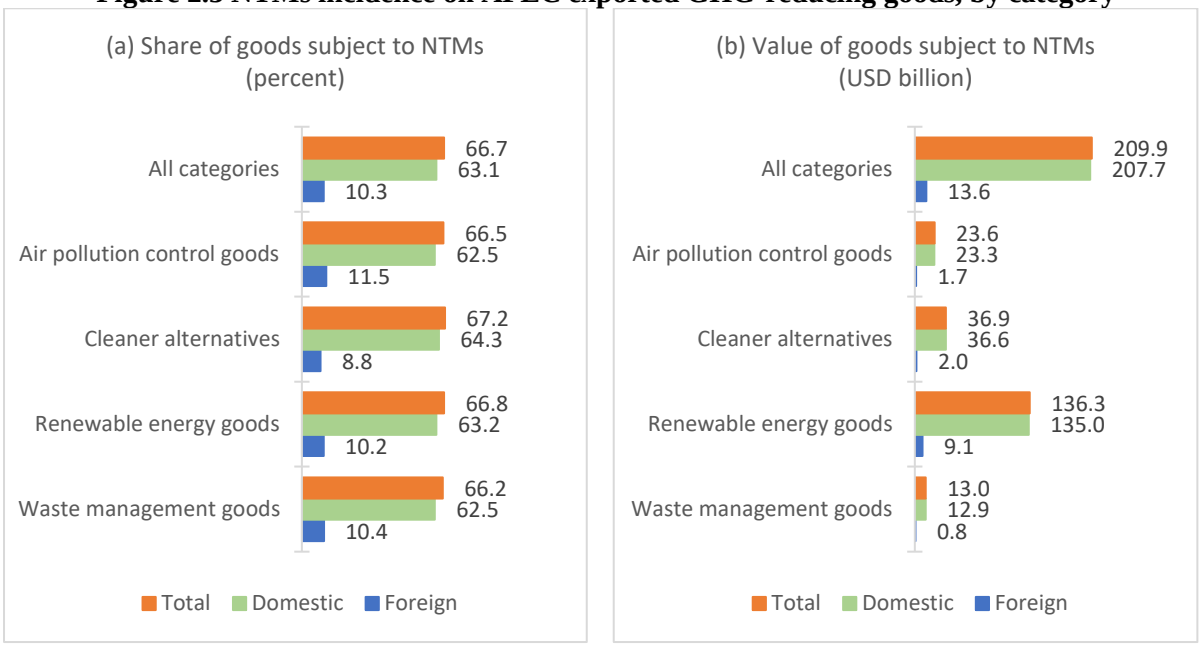
Second, products in this analysis were aggregated at the HS 6-digit level, even when NTMs are typically applied at more disaggregated levels (e.g., 8-digit level). This aggregation harmonizes products across different economies, which enables a comparative analysis. However, this aggregation has an important implication on trade values. For example, an NTM could be applied to product 2203.00.11 but not to product 2203.00.05. Ideally, only the trade value for product 2203.00.11 should be counted. However, aggregating both products to 6-digits (i.e., 2203.00) makes this separation difficult (some economies also do not have trade data beyond the HS 6-digit level). Instead, the analysis counts the entire trade value of product 2203.00 as affected by at least one NTM, thereby including the trade value of product 2203.00.05 in the process. In other words, this analysis could overestimate the actual trade value of products subject to NTMs.

APEC Exports

For brevity, only the APEC aggregate will be discussed in this section, although tables showing the incidence of NTMs for each APEC economy are available in Appendices A.2. to A.5. Figure 2.3(a) shows that 66.7 percent of GHG-reducing goods exported by APEC economies are subject to at least one type of NTM. Meanwhile, 63.1 percent of the products are subject to domestic NTMs (i.e., export-related measures) and 10.3 percent of the products are affected by foreign NTMs (i.e., import-related measures). Across APEC, these affected exports are valued at around USD 209.9 billion, of which almost all are exports affected by domestic NTMs [Figure 2.3(b)].

Probing deeper into each category, goods classified as cleaner alternatives were the most affected by NTMs (67.2 percent), followed by renewable energy products (66.8 percent). Noticeably, the affected exports of renewable energy goods were comparatively larger than those of the rest of the categories, comprising about USD 136.3 billion, followed by cleaner alternatives (USD 36.9 billion), air pollution control goods (USD 23.6 billion), and waste management goods (USD 13.0 billion).

Figure 2.3 NTMs incidence on APEC exported GHG-reducing goods, by category



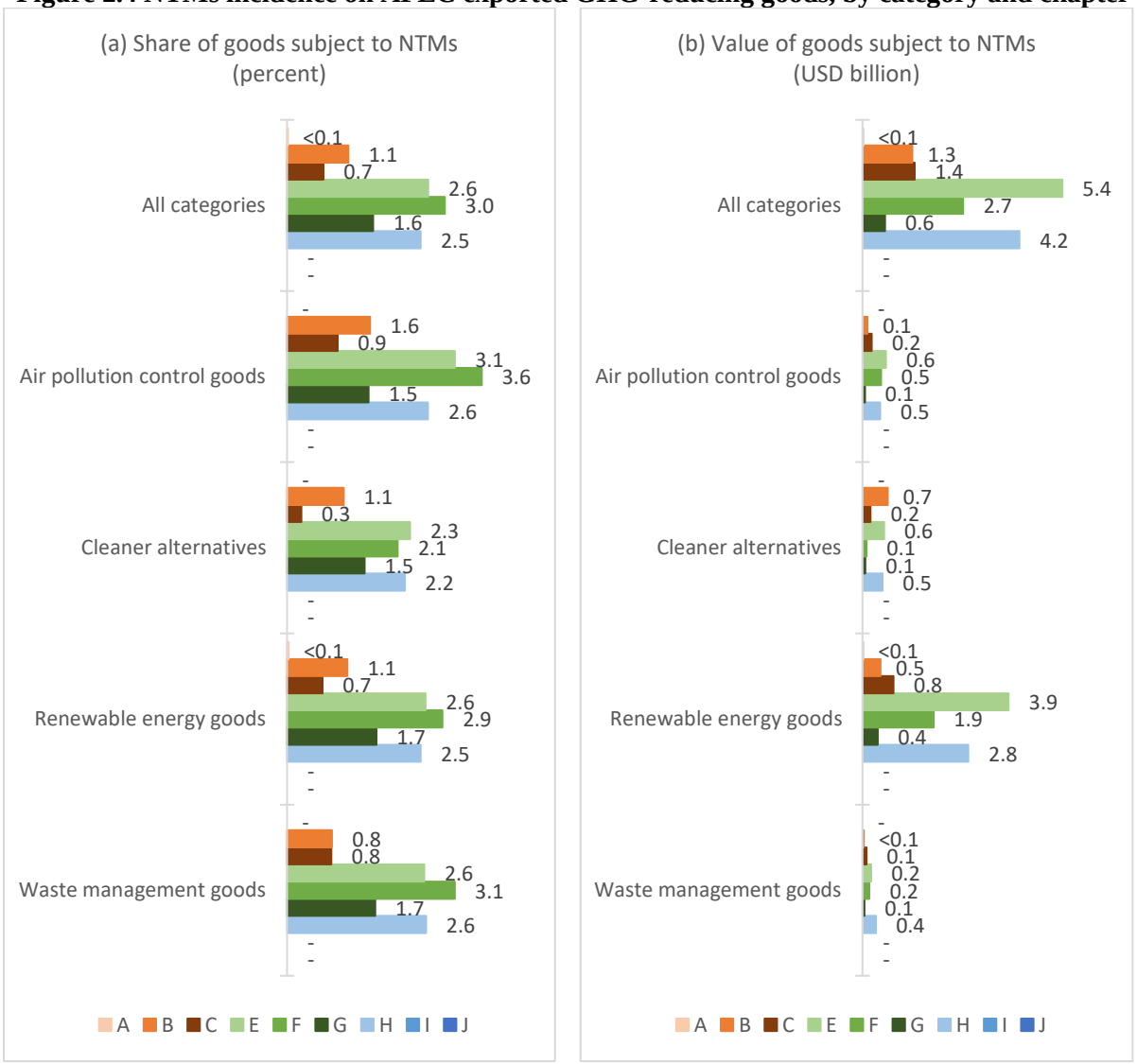
Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. NTMs data for Chinese Taipei is not available. The sum of trade affected by domestic NTMs and foreign NTMs will exceed the total, as some products are affected by NTMs imposed by both the exporting and importing side.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Among the types of NTMs affecting APEC exports from the importing side, price-control measures were the most extensive ones, affecting about 3.0 percent of exported GHG-reducing goods [Figure 2.4(a)]. This is followed by non-automatic licenses, quotas, and prohibitions (2.6 percent) and competition measures (2.5 percent). Non-automatic licenses, quotas, and prohibitions, however, affected the largest value of products, reaching a total of USD 5.4 billion [Figure 2.4(b)]. In comparison, price-control measures and competition measures affected USD 2.7 billion and USD 4.2 billion worth of exports, respectively.

Among individual product categories, price-control measures were the most extensive in air pollution control goods (3.6 percent), waste management goods (3.1 percent), and renewable

energy goods (2.9 percent). Regarding cleaner alternatives, non-automatic licenses, quotas, and prohibitions were more extensive instead (2.3 percent). In terms of affected value, both air pollution control goods and renewable energy goods were affected the most by non-automatic licenses, quotas, and prohibitions, with USD 0.6 billion and USD 3.9 billion worth of exports, respectively. Surprisingly, TBT measures affected cleaner alternatives the most (USD 0.7 billion) despite affecting only 1.1 percent of traded cleaner alternatives. Meanwhile, waste management goods were largely affected by competition measures (USD 0.4 billion).

Figure 2.4 NTMs incidence on APEC exported GHG-reducing goods, by category and chapter



(A) SPS measures; (B) TBT measures; (C) Pre-shipment inspection and other formalities; (E) non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT reasons; (F) price-control measures including additional taxes and charges; (G) finance measures; (H) measures affecting competition; (I) trade-related investment measures; and (J) distribution restrictions.

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. NTMs data for Chinese Taipei is not available. The sum of trade affected by domestic NTMs and foreign NTMs will exceed the total, as some products are affected by NTMs imposed by both the exporting and importing side. Values marked as "-" are zero.

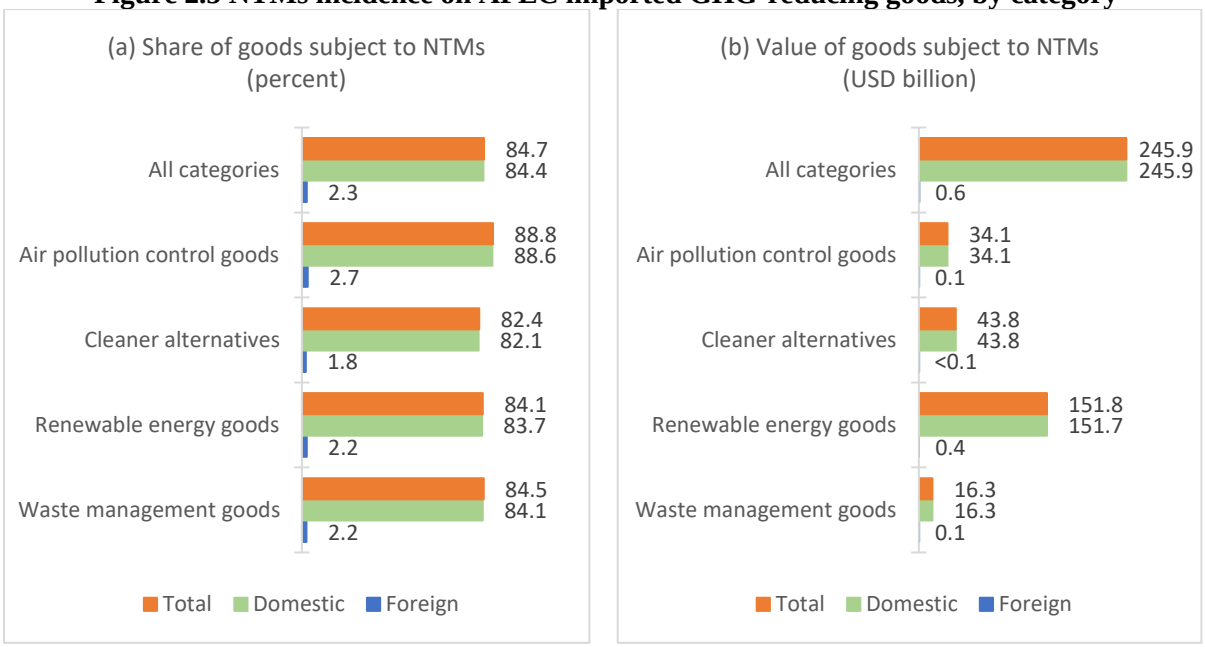
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

APEC Imports

NTMs were found to be relatively more extensive on APEC imports compared to APEC exports. In fact, around 84.7 percent of imports were subject to at least one type of NTM [Figure 2.5(a)]. The majority of these affected products (84.4 percent) were also dominated by domestic NTMs (i.e., those implemented by the importing side). Affected imports reached about USD 245.9 billion, of which practically all were subjected to import-related NTMs [Figure 2.5(b)]. On the contrary, imports affected by foreign NTMs (i.e., export-related measures) were valued at just USD 0.6 billion.

Looking at each product category, air pollution control goods had the most extensive incidence of NTMs (88.8 percent) — comparatively higher than waste management goods (84.5 percent), renewable energy goods (84.1 percent), and cleaner alternatives (82.4 percent). Import-related NTMs also dominated all of these product categories. In terms of value, imports of renewable energy goods were the most affected (USD 151.8 billion), followed by cleaner alternatives (USD 43.8 billion), air pollution control goods (USD 34.1 billion), and waste management goods (USD 16.3 billion). Yet again, the value of imports affected by export-related NTMs was relatively negligible.

Figure 2.5 NTMs incidence on APEC imported GHG-reducing goods, by category



Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. NTMs data for Chinese Taipei is not available. The sum of trade affected by domestic NTMs and foreign NTMs will exceed the total, as some products are affected by NTMs imposed by both the exporting and importing side.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Among the types of NTMs affecting APEC imports from the importing side, Figure 2.6(a) shows that TBT measures were the most extensive on GHG-reducing goods (68.7 percent). This is followed by price-control measures (56.0 percent) and non-automatic licenses, quotas, and prohibitions (38.5 percent). Trade-related investment measures and distribution restrictions were implemented into a remarkably small percentage of goods (less than 0.4 percent). In terms of value, TBT measures affected the largest amount of imports, reaching a total of USD 219.3 billion [Figure 2.6(b)], followed by non-automatic licensees, quotas, and prohibitions (USD 130.1 billion) and price-control measures (USD 128.6 billion).

Unsurprisingly, TBT measures were the most extensive type of NTM across all individual product categories, followed by price-control measures and non-automatic licenses, quotas, and prohibitions. Interestingly, non-automatic licenses, quotas, and prohibitions were proportionately more extensive in air pollution control goods (46.6 percent) compared to the other product categories (at most 38.8 percent). It is also worth noting that cleaner alternatives were affected by trade-related investment measures, albeit only on a small percentage of these goods (2.3 percent). In terms of import values, TBT measures affected the largest amount of imports, ranging from USD 136.9 billion (renewable energy goods) to USD 13.3 billion (waste management goods). After TBT measures, price-control measures and non-automatic licenses, quotas, and prohibitions were the next two NTM categories affecting imports of all product categories.

Figure 2.6 NTMs incidence on APEC imported GHG-reducing goods, by category and chapter

(A) SPS measures; (B) TBT measures; (C) Pre-shipment inspection and other formalities; (E) non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT reasons; (F) price-control measures including additional taxes and charges; (G) finance measures; (H) measures affecting competition; (I) trade-related investment measures; and (J) distribution restrictions.

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. NTMs data for Chinese Taipei is not available. The sum of trade affected by domestic NTMs and foreign NTMs will exceed the total, as some products are affected by NTMs imposed by both the exporting and importing side. Values marked as "-" are zero.

Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

2.1.2 WTO Integrated Trade Intelligence Portal

The WTO I-TIP database contains information on nine categories of NTMs,[8] which can be divided into categories and chapters following the UNCTAD NTM classification system, and two categories of specific trade concerns (STCs) (Table 2.3). Entries in the WTO I-TIP are based on formal notifications to the WTO or concerns raised in WTO committees, which means that the database may underestimate the actual number of NTMs currently in force at any given time.[9] For example, the WTO has acknowledged that notifications for subsidies are delayed for more than half of WTO membership (WTO, 2022). In addition, HS codes in some of the database's measures (16.5 percent) are interpreted codes made by the WTO. This interpretation is necessary because some policies do not clearly identify specific HS codes wherein the NTM would apply.

Table 2.3 List of NTMs available in the WTO I-TIP database

#	Category	Chapter	Measure
1	Technical measures	A	SPS measures (regular and emergency)
2		B	TBT measures (regular)
3	Non-technical measures	D	Anti-dumping
4		D	Countervailing duties
5		D	Safeguards
6		D	Special safeguards
7		E	Quantitative restrictions
8		E	Tariff-rate quotas
9	Export-related measures	P	Export subsidies
10	Specific Trade Concerns	STC	SPS
11		STC	TBT

Source: APEC PSU compilation based on the WTO I-TIP database (https://i-tip.wto.org/goods/default.aspx).

Table 2.4 shows that a total of 906 NTMs affecting APEC trade of GHG-reducing goods remain in force as of June 2022. Around 74.5 percent of these NTMs are technical measures on SPS (3.1 percent) and TBT (70.1 percent) reasons. Box 2.1 provides some examples of these TBT measures. It is worth emphasizing that these WTO notifications of technical measures do not necessarily provide an indication of trade protectionism, as many of these notifications are not about the implementation of measures that could represent a barrier to trade. In fact, many of these SPS and TBT notifications could actually be the opposite of a barrier to trade, as they reflect transparency by informing on new protocols that provide additional information to agents, thereby facilitating trade.

In order to explore possible barriers to trade, it is important to examine the STCs reported by economies in WTO committees instead. For example, Table 2.4 shows that 16 STCs affecting APEC trade of GHG-reducing goods were notified to the WTO SPS and TBT Committees. Most of these STCs were notified to the TBT Committee and renewable energy goods had the greatest number of notified STCs, reaching a total of 13. Box 2.2 provides one example of how trade can possibly be affected by NTMs.

[8] Technically, the WTO I-TIP database also includes a tenth option for state trading enterprises (Ch. H and Ch. P). However, this measure was excluded from the analysis since not all members regularly submit their bi-annual notifications.

[9] As of June 2022, there are a total of 13,338 notified measures affecting APEC economies (all products). Among these, 2,915 measures do not have either an economy-provided HS code or a WTO-interpreted HS code and are, therefore, excluded from the analysis. In effect, the final database contains a total of 10,423 notified measures.

Table 2.4 Number of NTM notifications on APEC trade of GHG-reducing goods, by category and type of NTM

Category	A	B	D	E	P	STC	Total
All categories	28	635	85	137	5	16	906
Air pollution control goods	0	102	5	52	0	2	161
Cleaner alternatives	1	207	4	71	0	6	289
Renewable energy goods	22	493	52	115	5	13	700
Waste management goods	5	98	26	63	0	2	194

(A) SPS measures; (B) TBT measures; (D) contingent trade-protective measures; (E) non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT reasons; (P) export-related measures; and (STC) specific trade concerns.
Note: Measures in force as of June 2022. The sum of individual categories will exceed total as some NTMs affect more than one type of product.
Source: APEC PSU calculations based on data from the WTO I-TIP database (https://i-tip.wto.org/goods/default.aspx), downloaded 14 August 2022.

Box 2.1 Examples of TBT measures notified at the TBT Committee on GHG-reducing goods

1. **Greenhouse and energy standards for air conditioners, heat pumps, and other similar products**

   This NTM applies to air conditioners and heat pumps (HS 841510 and HS 841861) and other similar products such as gas water heaters (HS 841911 and HS 841919). Under the Greenhouse and Energy Minimum Standards (GEMS) Act 2012, the Australian government can set mandatory minimum efficiency performance standards and energy rating label requirements for electrical equipment and appliance products. These requirements are set out in legislative instruments called GEMS determinations.

2. **Standards for liquefied anhydrous ammonia**

   This NTM applies to liquefied anhydrous ammonia (HS 281410). This measure applied by China specifies the requirements, test methods, inspection rules, marking, package, transportation, storage, and safety requirements for liquefied anhydrous ammonia.

3. **Control of air pollution from new motor vehicles and new motor vehicle engines, including heavy-duty vehicles and engine standards, onboard diagnostic requirements, and rule motor**

   This NTM applies to motor vehicles (HS 8703; HS 8704). In 2001, the US Environmental Protection Agency (EPA) finalized a new, major program for highway heavy-duty engines. That program, the Clean Diesel Trucks and Buses program, resulted in the introduction of advanced emissions control systems such as catalyzed diesel particulate filters (DPF) and catalysts capable of reducing harmful nitrogen oxide (NOX) emissions. This required that these advanced emissions control systems be monitored for malfunctions via an onboard diagnostic system (OBD), similar to those systems that have been required on passenger cars since the mid-1990s. This required manufacturers to install OBD systems that monitor the functioning of emission control components and alert the vehicle operator to any detected need for emission related repair. This also required that manufacturers to make available to the service and repair industry the information necessary to perform repair and maintenance service on OBD systems and other emission related engine components and revise certain existing OBD requirements for diesel engines used in heavy-duty vehicles under 14,000 pounds.

Source: APEC PSU compilation based on data from the WTO I-TIP database (https://i-tip.wto.org/goods/default.aspx), downloaded 14 August 2022. The report does not prejudge whether these NTMs in this box are trade-restrictive or not. In some cases, it is possible that NTMs could be associated to an increase of trade as they could increase transparency by providing information to producers and consumers, and create a market for goods reducing GHG emissions.

Box 2.2 Case example of a TBT measure affecting trade

In early 2011, Economy A notified the WTO that it will be implementing revised technical specifications for air conditioners and comfort fans, aligned with combating climate change. The new requirements would enter into force in 2012. Following this notification, Economy B raised concerns first in late 2011 and second in early 2012. One possible reason for Economy B's concern is because trade with Economy A could be adversely affected by the new technical specifications. In fact, Table 2.5 shows that Economy A's global imports of air conditioners and comfort fans fell by 16.4 percent between 2011 and 2012 while imports from Economy B dropped by 11.5 percent during the same period. This would echo similar examples provided by a 2014 APEC Policy Support Unit (PSU) report (Kuriyama et al., 2014).

Table 2.5 Economy A's imports of air conditioners and comfort fans (USD million)

Product	Origin	2010	2011	2012	Variation (2011-12)
Air conditioners and comfort fans (HS 8415)	From World	11,010.69	12,755.37	10,658.40	-16.4%
	From Economy B	1,369.12	1,750.49	1,549.98	-11.5%
Total Imports (all products)	From World	5,144,443.45	6,040,934.24	5,629,862.27	-6.8%
	From Economy B	413,893.91	449,268.93	407,021.35	-9.4%

Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 6 December 2022.

Non-technical measures, meanwhile, comprised 24.5 percent of total NTMs in force, of which non-automatic licenses, quotas, and prohibitions were the more prominent (15.1 percent of total NTMs). Contingent measures such as anti-dumping and countervailing duties were relatively extensive, accounting for 6.8 percent and 2.5 percent of total NTMs, respectively. No safeguards affecting GHG-reducing goods remained in force. Export-related measures, particularly export subsidies, were small (0.6 percent of total NTMs).

Renewable energy goods were the product category subjected to most NTMs (700 measures), being TBT measures around ¾ of these. In the case of waste management goods, 53.1 percent of their NTMs were technical and 13.4 percent of their NTMs were related to trade remedies, which is a relatively higher share compared to the other product categories, considering that trade remedies only represented 1.4 percent of the NTMs affecting cleaner alternatives and 7.4 percent of the NTMs affecting renewable energy goods. Meanwhile, non-automatic licenses, quotas, and prohibitions were most extensive on both waste management goods (32.5 percent) and air pollution control goods (32.3 percent). In comparison, this type of measures was relatively smaller on renewable energy goods (16.4 percent). Notably, export-related measures (Ch. P) were present only for renewable energy goods.

2.1.3 Global Trade Alert

Since November 2008, the GTA database has independently monitored different discriminatory interventions and policies affecting trade. A total of nine interventions are tracked by the GTA database (Table 2.6), which enables the identification of measures related to TBT measures; contingent measures; non-automatic licenses, quotas, and prohibitions; price-control measures; finance measures; trade-related investment measures; subsidies; government procurement restrictions; restrictions related to intellectual property; and export-related measures.

These measures are also evaluated and categorized into three levels: red; amber; and green (Evenett and Fritz, 2022). Red interventions are those that almost certainly discriminates against foreign commercial interests while amber interventions likely involve discrimination against foreign commercial interests. Green interventions, meanwhile, liberalizes on a non-discriminatory basis or improves the transparency of a relevant policy.

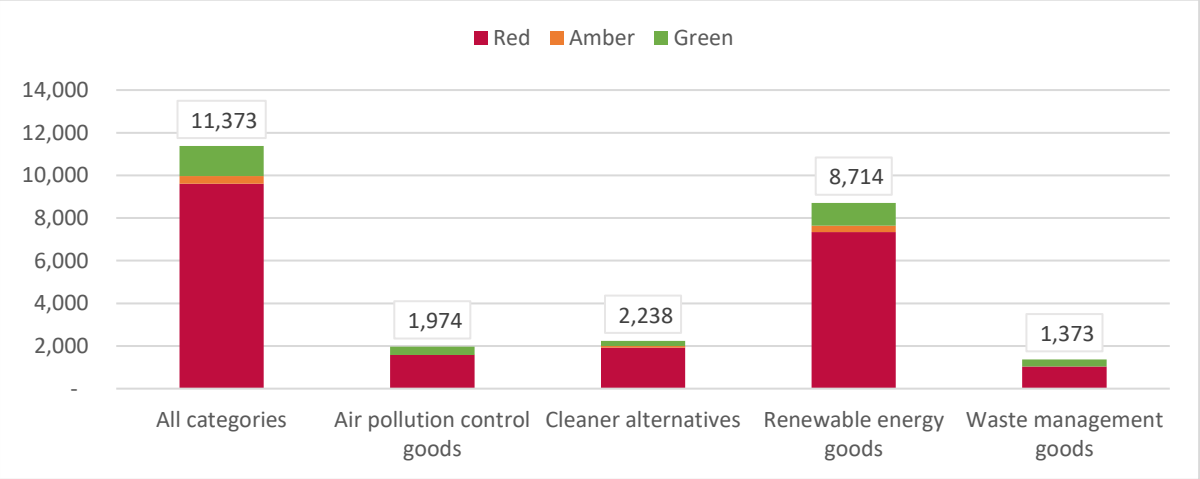
Table 2.6 List of interventions monitored by the GTA database

#	Intervention	Examples
1	Capital controls and exchange rate policy	Control on personal transactions; controls on commercial transactions and investment instruments; controls on credit operations; competitive devaluation; repatriation and surrender requirements; and trade payment measures
2	Export and import policy instruments	Bans; licensing requirements; quotas; subsidies; tariff-quotas; taxes; tax incentives; internal taxation of imports; foreign customer rule; trade balancing measures; trade finance; and trade payment measures
3	Foreign investment policy	Entry and ownership rules; financial incentives; and other treatment and operations
4	Labor force migration policy	Labor market access; post-migration treatment
5	Localization policy	Local labor; local operations; and local sourcing
6	Public procurement policy	Access; localization requirements; preference margin
7	Subsidies and aid	Bailouts; financial assistance in foreign markets; financial grants; in-kind grants; interest payment subsidy; production subsidy; loans; tax or social insurance reliefs
8	Trade defense instruments	Anti-circumvention; anti-dumping; anti-subsidy; and safeguards
9	Other instruments	Intellectual property protection; SPS measures; and TBT measures

Source: APEC PSU compilation based on the GTA database (https://www.globaltradealert.org/)

As of September 2022, a total of 11,373 NTMs remain in force across APEC traded GHG-reducing goods, of which only 1,401 NTMs (12.3 percent) are green (Figure 2.7). This implies that a significant proportion of evaluated NTMs were likely discriminatory (84.5 percent are red interventions while 3.2 percent are amber interventions). Among the individual categories, renewable energy goods experienced the greatest number of NTMs at 8,714 measures, of which 84.2 percent are red interventions. Other product categories experienced comparatively less NTMs, although red interventions were similarly dominant.

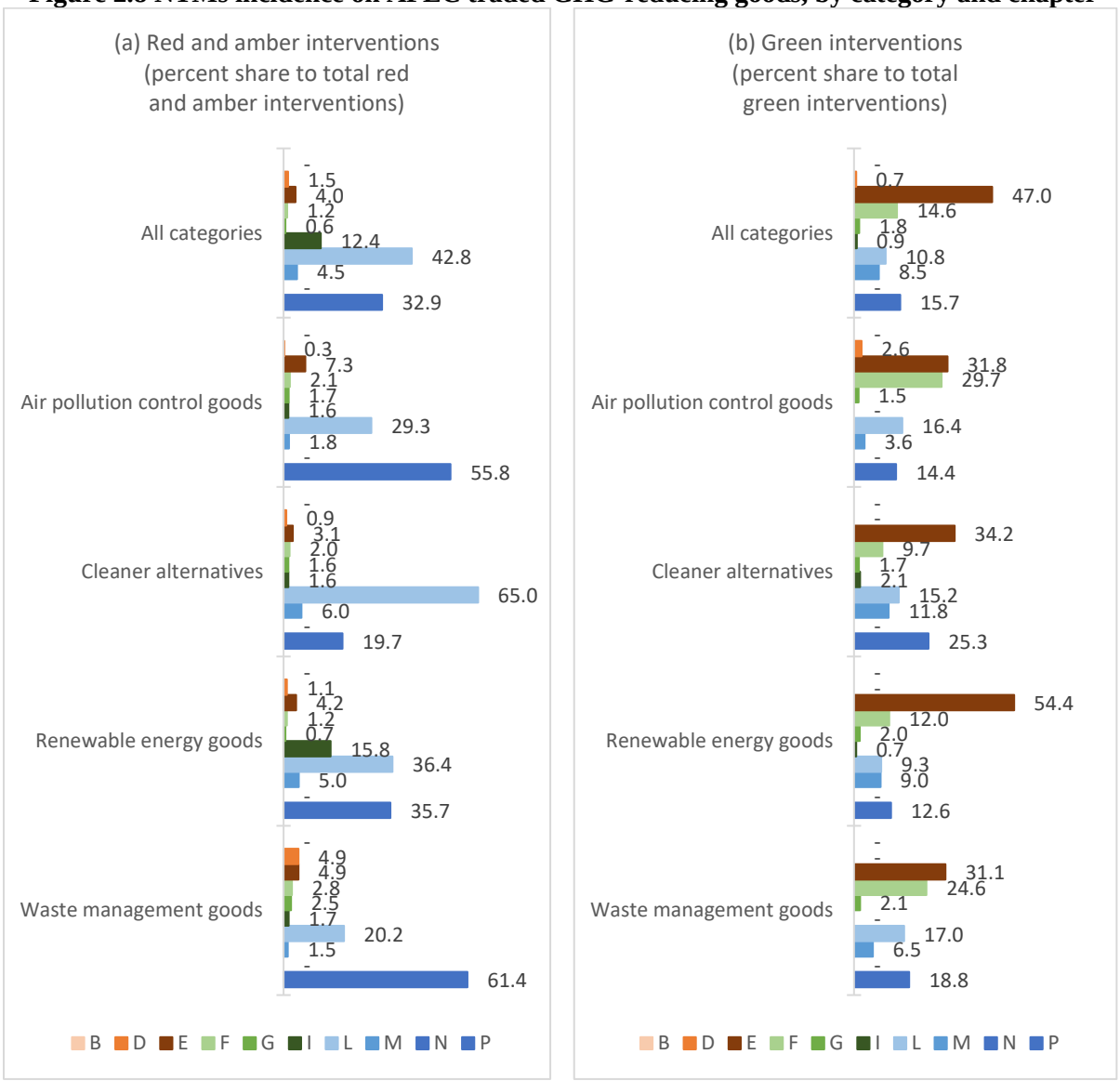
Figure 2.7 Number of NTMs affecting APEC GHG-reducing goods, by category and level of intervention



Note: Measures in force as of September 2022.
Source: APEC PSU calculations using data from the GTA database (https://www.globaltradealert.org/), downloaded 26 September 2022.

Among red and amber interventions, subsidies were noticeably greater compared to all other types of NTMs [Figure 2.8(a)], comprising 42.8 percent of total red and amber interventions. This is followed by export-related measures at 32.9 percent, trade-related investment measures at 12.4 percent, and government procurement restrictions at 4.5 percent. Among the individual categories, subsidies remained the most extensive NTM for both cleaner alternatives and renewable energy goods, but not for air pollution control goods and waste management goods, which saw more prominent export-related measures. Interestingly, only renewable energy goods had a significantly higher share of trade-related investment measures, whereas only waste management goods had a relatively prominent presence of contingent trade-protective measures compared to other categories.

Figure 2.8 NTMs incidence on APEC traded GHG-reducing goods, by category and chapter



(B) TBT measures; (D) contingent trade-protective measures; (E) non-automatic licensing, quotas, prohibitions, and quantity-control measures other than for SPS or TBT reasons; (F) price-control measures including additional taxes and charges; (G) finance measures; (I) trade-related investment measures; (L) subsidies, excluding export subsidies under P7; (M) government procurement restrictions; (N) intellectual property; and (P) export-related measures.
Note: Measures in force as of September 2022. Values marked as "-" are zero.
Source: APEC PSU calculations using data from the GTA database (https://www.globaltradealert.org/), downloaded 26 September 2022.

Among green interventions, non-automatic licensing, quotas, and prohibitions was the most dominant, reaching a percentage share of 47.0 percent [Figure 2.8(b)]. Examples would include the elimination of automatic import licensing requirements, weakening of import restrictions, or release of new information for transparency. This is followed by export-related measures (e.g., reduced export taxes) at 15.7 percent, price-control measures (e.g., elimination of tariffs and taxes) at 14.6 percent, subsidies (e.g., suspension of tax refunds) at 10.8 percent, and government procurement restrictions (e.g., waiver or exemption from minimum local content requirements) at 8.5 percent. Among the individual categories, non-automatic licensing, quotas, and prohibitions remained the most dominant, comprising around 31.1 percent (waste management goods) to 54.4 percent (renewable energy goods) of total green interventions. Meanwhile, price-control measures were the second most dominant for both air pollution control goods and waste management goods, whereas export-related measures were the second most dominant for cleaner alternatives and renewable energy goods. It is worth noting that only air pollution control goods had contingent trade-protective measures (e.g., removal of import inspection obligation on certain products).

2.2 INSIGHTS BASED ON FIRM SURVEY AND INTERVIEWS

2.2.1 Introduction

Firm perspectives and experiences with NTMs affecting trade in goods reducing GHG emissions were gathered through primary research. This section outlines the findings of the survey and series of follow-up interviews as the primary sources of this information.

Firms are the unit of analysis. They were deemed within scope if they imported or exported goods reducing GHG emissions, but the analysis takes a 'value chain' approach in accordance with the recommendations of the scoping study prepared for the APEC Market Access Group in 2021 to identify new and emerging environmental goods and consider approaches to updating the current APEC List of Environmental Goods, endorsed in 2012 (The Australian APEC Study Centre at RMIT University et al., 2021). As such, survey and interview targets were not limited to one part of the value chain, and instead covered firms from upstream, midstream and downstream components to ensure that both final products and essential intermediate goods were in scope. As shown in Figure 2.9, the sectoral composition of surveyed firms reflected this goal:

- **Mining, agriculture and forestry** firms captured the upstream components of the value chain. These sectors provide the inputs necessary for goods reducing GHG emissions
- **Manufacturing** firms captured the midstream components of the value chain, as they transform inputs from upstream into goods sold downstream
- **Wholesale trade** and **construction** firms captured downstream components of the value chain that use goods reducing GHG emissions
- **Transportation and storage services** firms move these goods throughout the value chain. They consequently enable trade in goods reducing GHG emissions and interact with many NTM-related procedures at the border.

Figure 2.9 Sectors targeted from different points in the supply chain

Source: Deloitte Access Economics.

The survey received 200 responses from firms in six APEC economies. Due to limited resources available, the survey and interviews could not cover all APEC economies but provide a glimpse of the type of NTMs that are mostly considered as barriers to trade, as well as those measures that are considered by firms to be enablers to trade. The survey questionnaire was developed by Deloitte Access Economics and delivered online with the support of Rakuten Insight. Information on the survey and its approach can be found in Appendix A.6. Survey responses were complemented by follow-up interviews sought to validate and expand on survey findings. Deloitte Access Economics leveraged its global network of Deloitte professionals to deliver a targeted series of interviews of industry stakeholders across the relevant value chains.

2.2.2 Firm Characteristics

To support the interpretation of the survey findings, a series of descriptive statistics are provided on the firms that were analysed through the survey. The sample of firms was drawn from six APEC member economies that capture diversity across regions, trade orientation, emissions intensity and NTM coverage. Appendix A.6 details the sampling and selection process. The scoping process described earlier in this chapter supported a definition of and reference point for representativeness.

Given the value chain approach to understanding trade in environmental goods reducing GHG emissions, firms across multiple sectors were considered in scope. The majority of firms operate in the manufacturing sector (66 percent). Of these manufacturing firms, half were involved in producing manufactured goods related to renewable energies and technologies, while energy-efficient technologies, emissions removal products and transportation inputs were also widely nominated as focuses of firms within the category (Table 2.7).

Table 2.7 Operating sector and sub-sector(s) of surveyed firms (percent share)

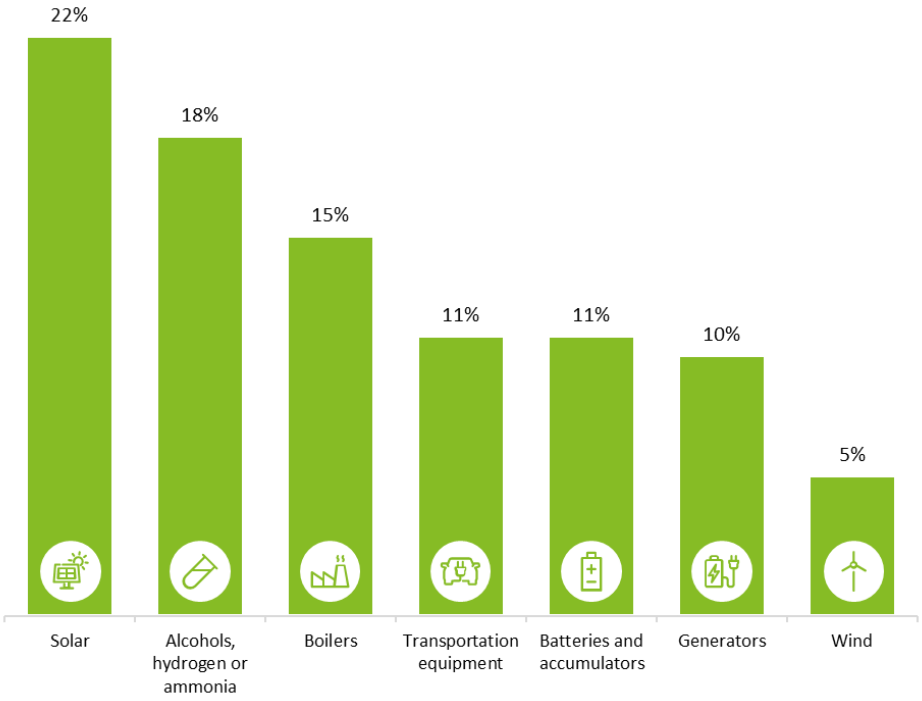
Sector	Share	Sub-sector	Share
Manufacturing	66	Renewable energies and technologies	50
		Cleaner and more resource efficient products and technologies	38
		Products and technologies that remove emissions from the atmosphere	28
		Transportation equipment	27
		Air pollution control	24
		Waste management	21
		Others	9
Mining, agriculture and forestry	10		
Transportation and storage services	12		
Wholesale trade and construction	12		

Notes: n=200. Firms in the manufacturing sector were asked to identify their sub-sector. The shares add to greater than 100 percent because firms were able to identify as belonging to multiple sub-sectors.
Source: Deloitte Access Economics.

A diverse range of products could be considered to meeting the definition of environmental goods reducing GHG emissions. Firms were asked to identify their NTM experiences at the origin and destination level (referred to as market pairs). Solar energy was the most-traded category of good among market pairs (Figure 2.10), in line with research that shows that products related to renewable energy production are the most traded goods that reduce GHG emissions (Kuriyama, 2021). Given the focus in many economies on decarbonising their electricity and energy sectors, high rates of trade in essential intermediate components in these sectors including batteries and generators are also represented in the sample.[10]

It is important to also note that the findings from the survey are more robust for mature goods markets, such as renewable energy components. Emerging technologies, such as green hydrogen, are not yet widely traded and are therefore not as readily observable through the survey. Well-designed NTMs could prove an important policy consideration in enabling their growth.

Figure 2.10 Share of respondent firms that traded goods reducing GHG emissions between market pairs, by product category (percent)

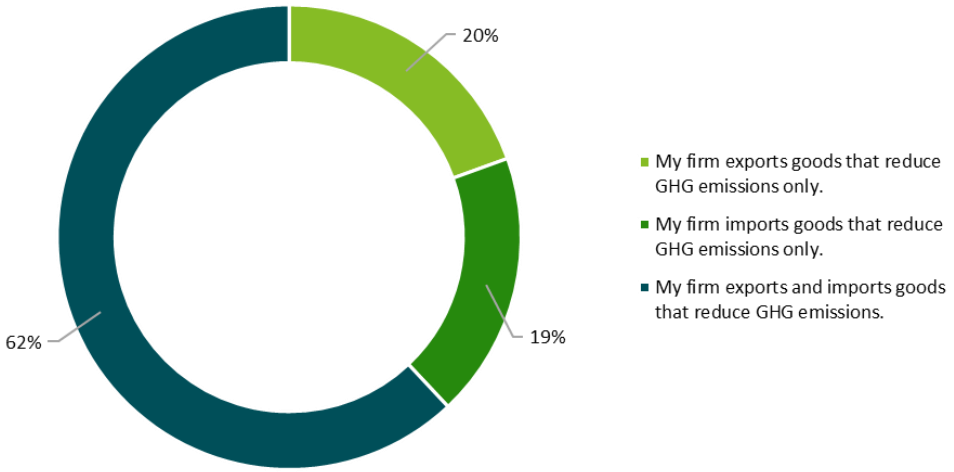


Notes: n=200 firms. A list of products based on the list in Appendix A.1 were presented to firms to select from. Free text responses were also accepted and recoded into the categories above where applicable.
Source: Deloitte Access Economics.

Most firms both import and export environmental goods reducing GHG emissions (Figure 2.11). Each of the sectors from which firms were sampled tend to be reliant on intermediate goods, many of which must be imported from economies with a relevant comparative advantage. These are subsequently used as inputs to produce goods that firms then export. Further, the dominance of two-way traders is reflective of liberalisation in the APEC region, which has helped to globalise supply chains.

[10] Generators: often used in conjunction with boilers and turbines in electricity generation from renewable sources. Hence, this product is within scope of this project given that it can directly reduce GHG emissions through the displacement of an activity that would have otherwise produce GHG emissions.

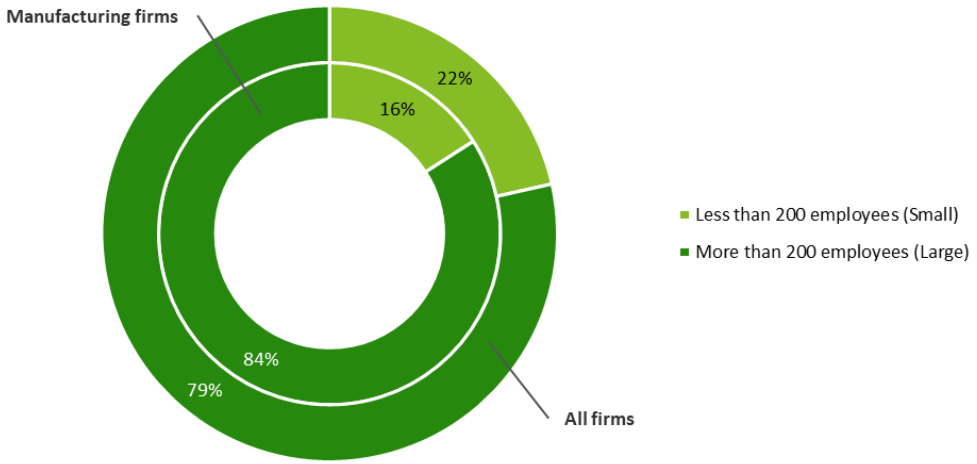
Figure 2.11 Share of respondent firms trade orientations (percent)



Notes: n=200 firms
Source: Deloitte Access Economics.

Most firms in the sample (79 percent) employed over 200 staff (Figure 2.12). The transportation costs involved in acquiring intermediate goods could dissuade smaller firms from being involved in the value chain of goods reducing GHG emissions. Small firms may lack the scale to minimise the per unit cost of these goods, thus leaving the market to large firms who can leverage economies of scale to decrease unit costs. Among manufacturing firms, this number was even higher, with 84 percent of firms employing 200 people or more. This was driven by firms focused on renewable energies, transportation equipment, air pollution control and cleaner and more resource efficient products and technologies. The sampling of SMEs was relevant in understanding whether NTMs affect these firms differently (see page 33 and Appendices A.9 and A.10 for further details on how NTMs affect SMEs and large firms differently).

Figure 2.12 Share of respondent firms' size by number of employees (percent)



Notes: n=200 firms, of which there are n=132 manufacturing firms
Source: Deloitte Access Economics.

2.2.3 Non-Tariff Measures: Barriers and Enablers to Trade

Barriers to trade

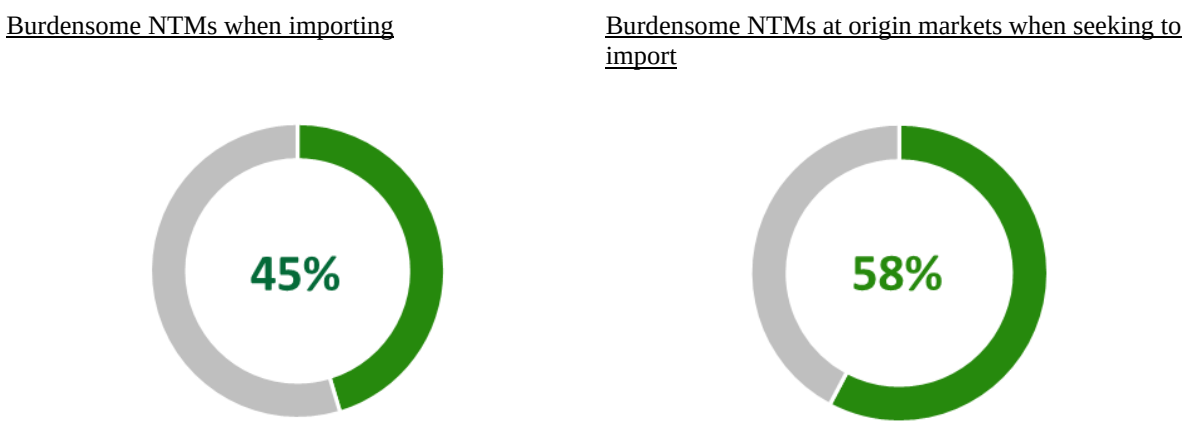
Overview of NTMs as a barrier to trade

Economies can impose NTMs on goods for a variety of reasons. For example, some governments may wish to impose NTMs to protect emerging and strategic industries. Alternatively, governments may wish to introduce NTMs to build confidence in product quality or to achieve better health, safety or environmental outcomes. Trade can be unnecessarily limited where the government design or implementation of NTMs do not seek to minimise impacts on trade in meeting legitimate policy outcomes. Nonetheless, the need to comply with these NTMs impose financial and time costs on firms. Results from the survey indicate that the lack of consistency of NTMs across borders, the frequency with which measures changed, and the level of detail required in reporting all affect the time required to comply with NTMs and thus the extent to which firms view NTMs as burdensome.[11]

As seen from Figure 2.13, firms trading in goods reducing GHG emissions can face NTMs at the origins and destinations of their transactions. For example, a majority of firms, especially firms in Australia; China; and Thailand reported that they faced burdensome export NTMs when exporting goods reducing GHG emissions. Similarly, most firms in Australia; Mexico; and Thailand encountered burdensome NTMs at the origin market when seeking to import goods. Notably, most firms in Singapore and the United States reported that they did not face burdensome export NTMs when exporting or at the origin market when seeking to import goods.

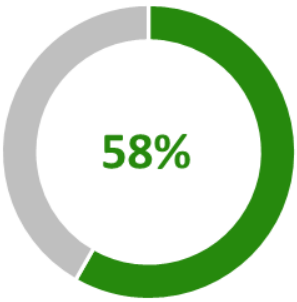
On the other hand, most firms, particularly those in China; Singapore; and the United States, reported that they did not face burdensome import NTMs, either when importing goods or at destination markets when exporting goods that reduce GHG emissions. This was not observed by most firms in Australia and Thailand.

Figure 2.13 Share of firms that faced burdensome NTMs when importing and exporting

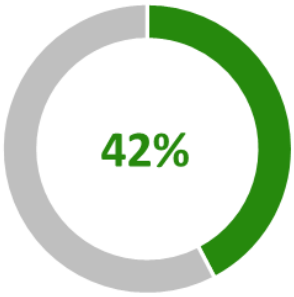


[11] 'Burdensome' had a particular meaning in the survey: 'a serious impediment to trade in goods that reduce GHG emissions'.

Burdensome NTMs when exporting



Burdensome NTMs at destination markets when seeking to export



Firm has faced burdensome NTMs

Firm has not faced burdensome NTMs

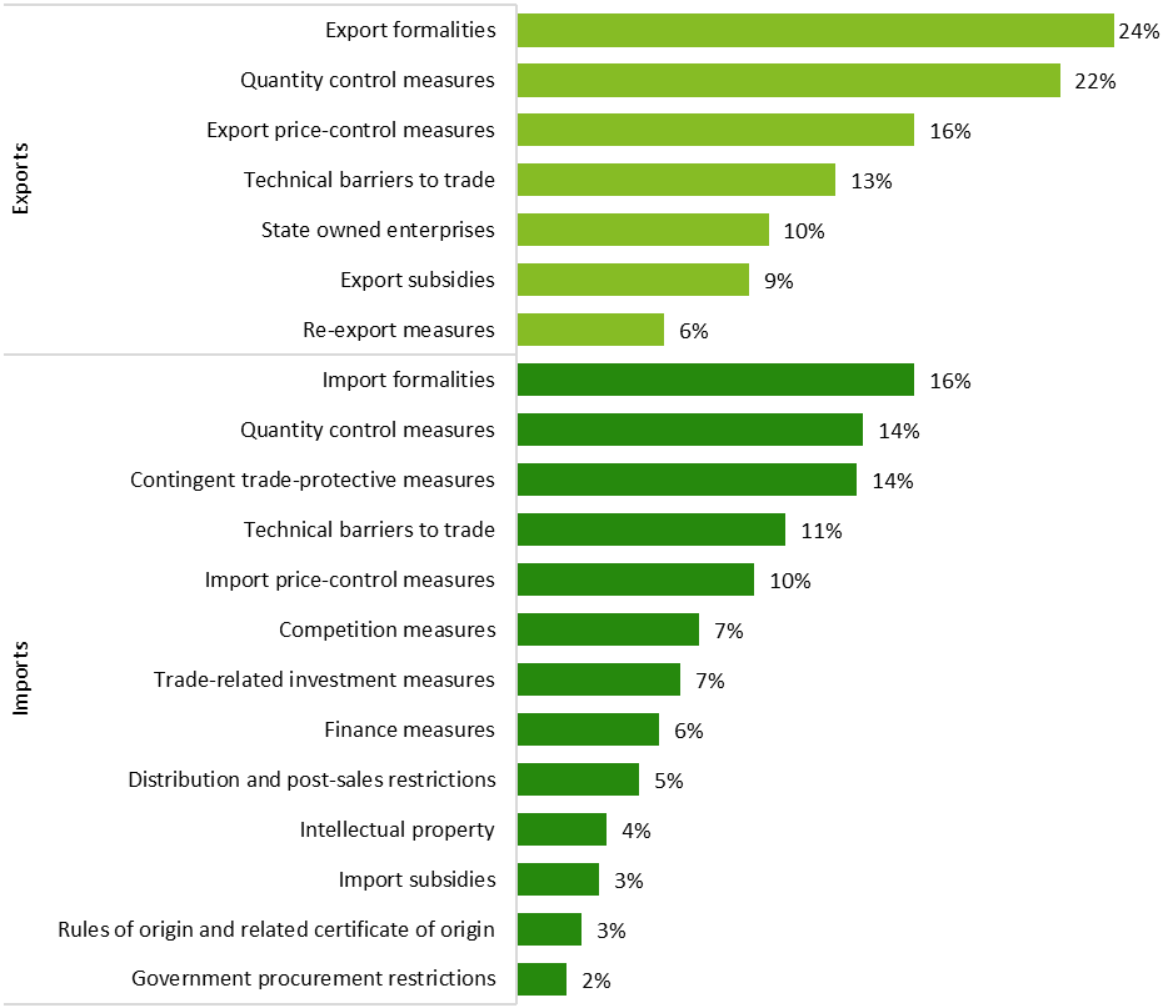
Notes: n=163 exporting firms; n=161 importing firms
Source: Deloitte Access Economics.

Prevalence of NTMs by type

A common view among both importers and exporters of goods reducing GHG emissions is that formalities and quantity control measures are most burdensome to their firm. These respectively rank first and second as barriers to trade for exporters (Figure 2.14), and apply to all sub-sectors within the manufacturing sector and sub-sectors. Firms identified a wide range of examples of export and import formalities, including:

- Burdensome documentation and bureaucracy (including an increasing need to document supply chain transactions);
- Varying approaches to carbon/GHG measurement;
- Numerous and/or repeated customs declarations procedures;
- Ambiguity in inspections processes causing delays; and
- Lack of clarity on the timing and process for verifying certifications.

Figure 2.14 Share of firms reporting categories of export and import NTMs burdensome (percent)



Notes: n=1,828 burdensome export market pairs and n=1,501 burdensome import market pairs; each market pair has at least one APEC member economy. These NTMs are presented here using shortened labels, but map to UNCTAD MAST classifications (although some categories have been combined. Export and import sanitary and phytosanitary measures come under technical barriers to trade. Import distribution restrictions and restrictions on post-sales services have been combined into distribution and post-sales restrictions). The summation of the labels may not add to 100 percent because firms could select multiple NTMs.
Source: Deloitte Access Economics.

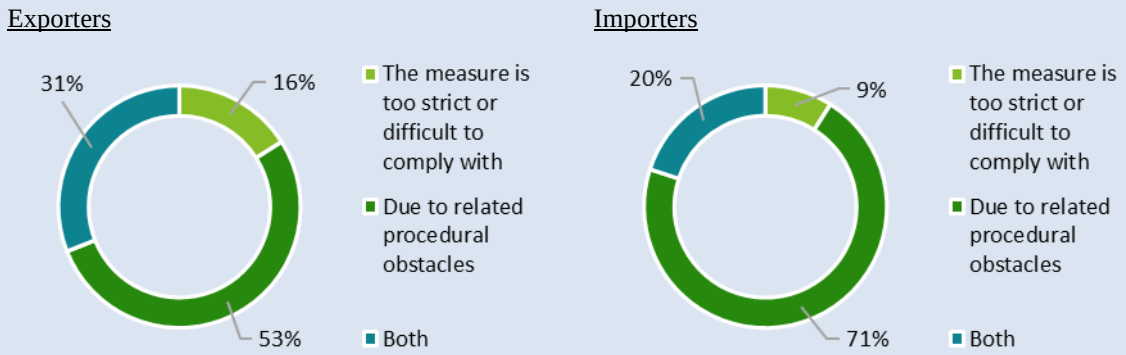
Further details on why exporters and importers in a specific economy view NTMs more broadly as burdensome can be found in Box 2.3.

Box 2.3 Exporters and Importers Perspectives on NTMs

In 2013, the International Trade Centre (ITC), working with Thailand's Ministry of Commerce, conducted a survey to elicit the views of the Thai business community regarding NTMs. Surveys were distributed to firms of various sizes and sectors (not just limited to goods that reduce GHG emissions), and were typically targeted at general managers or the company's employees responsible for the export and import process.

The majority of Thai exporters and importers view NTMs as burdensome due in part to procedural obstacles (Figure 2.15). In addition, most of the reported export (76 percent) and import (98 percent) procedural obstacles occurred in Thailand rather than the trading economy.

Figure 2.15 Why exporters and importers view NTMs as burdensome



Notes: n=862 exporters and n=40 importers
Source: ITC NTM Survey on NTMs in Thailand

More specifically, delays in obtaining relevant documents, certification or approval from concerned authorities is the most frequent procedural obstacle that hinder the export process, accounting for 29 percent of all procedural obstacles in Thailand and 28 percent in partner economies (Table 2.8). High fees and charges and the need to submit many different kinds of documents to authorities in the export process were also cited by a greater share of Thai exporters. Notably, these procedural obstacles were also the most commonly cited by exporters involved in cited by companies involved in manufacturing trade.

Table 2.8 Top 5 procedural obstacles and inefficient trade business environment faced by exporters in Thailand to partner economies (percent)

Procedural obstacles faced by exporters	Percentage share in Thailand	Percentage share in partner economies
Delays related to reported regulation	29	28
Unusually high fees and charges for reported certification / regulation	20	35
Large number of different documents	20	12
Numerous administrative windows / organisations involved, redundant documents	8	1
Arbitrary behaviour of officials with regards to report regulation and classification and valuation of product	6	3

Notes: n=1,179 export-related procedural obstacles lodged in Thailand, of which n=897 are experienced in Thailand and n=282 are experienced in partner economies; Top 5 procedural obstacles is based on the total number of procedural obstacles experienced in Thailand
Source: ITC NTM Survey on NTMs in Thailand

As seen in Table 2.9, Thai importers faced similar procedural obstacles during the import process to their export counterparts. By far, the arbitrary behaviour of officials is the most common procedural obstacle faced by Thai importers followed by delay related to reported regulation and high fees and charges for reported certificate/regulation.

Table 2.9 Top 5 procedural obstacles and inefficient trade business environment faced by importers in Thailand (percent)

Procedural obstacles faced by importers	Percentage share
Arbitrary behaviour of officials regarding classification and valuation of the reported product	34
Delay related to reported regulation	22
High fees and charges for reported certificate/regulation	15
Large number of different documents	7
(Tied) Selected regulations change frequently; Documentation is difficult to fill out; Informal payment	4

Notes: n=47 import-related POs lodged in Thailand
Source: ITC NTM Survey on NTMs in Thailand

Therefore, the results of the NTM survey highlight the fact that the domestic trade environment, particularly at the procedural level, are impediments to trade. This increases the need for reforms in customs procedures, particularly in regards to transparency and standardisation of procedures.

While formalities and quantity control measures also rank first and second among all importers, importers of goods reducing GHG emissions across all manufacturing sub-sectors also view contingent trade-protective measures designed to counteract the adverse domestic industrial effects of imports as burdensome to their firm.

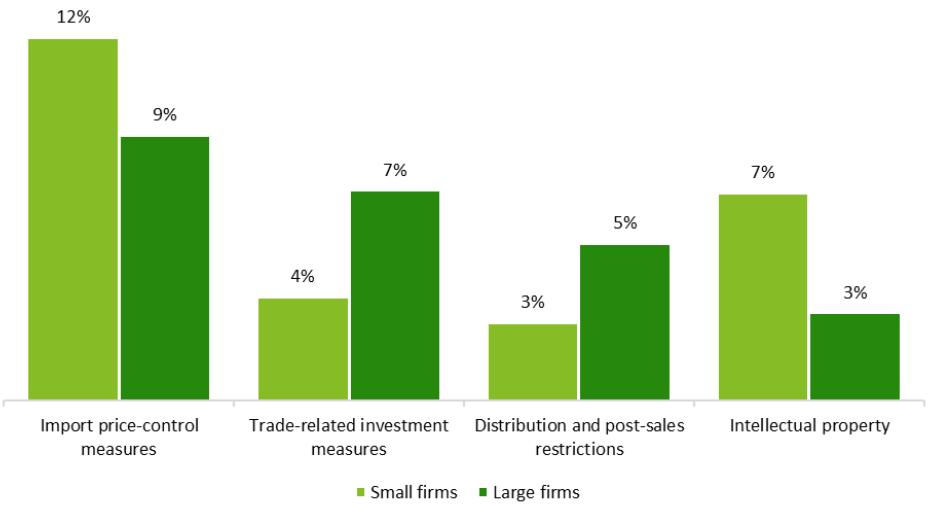
While there are growing efforts to harmonise technical regulations across a range of goods reducing GHG emissions, technical barriers to trade were perceived as burdensome by the fourth largest share of importing and exporting firms. While robust technical regulations are important for market confidence and product quality given the technological complexity of many goods that reduce GHG emissions, consultations with industry stakeholders highlighted that the dispersion of technical regulations in products such as solar panels resulted in confusing customs regulation for firms. Therefore, harmonisation, mutual recognition and equivalence across jurisdictions could help facilitate trade in goods reducing GHG emissions.

Firms' experience of NTMs by size

Analysis also investigated whether firms' perceptions of the burden associated with NTMs was affected by their size. Among respondent firms who exported goods reducing GHG emissions, size did not have a substantial effect on the perception of burdensome NTMs. A full list of the share of firms that viewed export NTMs as burdensome is provided in Appendix A.9.

Among importers, however, analysis revealed the size of the firm resulted in differences in firms' experience of NTMs. These differences were less prevalent among NTMs that were frequently cited as burdensome, and more pronounced among less commonly reported NTMs. Differences were greater among less frequently reported NTMs than they were among the most burdensome measures (Figure 2.16). More small firms viewed price control measures and intellectual property as burdensome than large firms. A greater share of large firms, meanwhile, perceived trade-related investment measures and distribution and post-sales services as more burdensome. In addition, there were also a number of small firms who identified the impact of higher fixed costs to paperwork and compliance as limiting their ability to export their products.

Figure 2.16 Share of selected burdensome import NTMs faced by small and large firms (percent)



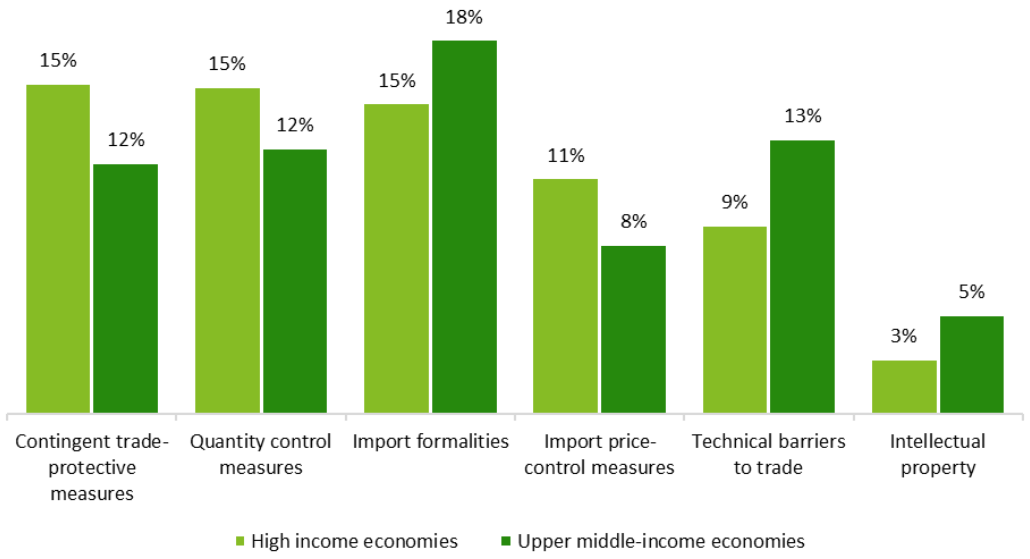
Notes: n=200 firms, of which 157 are large and 43 are small. Small firms are those with less than 200 employees while large firms have 200 employees or more. A full list of the share of respondents that viewed import NTMs as burdensome by firm size can be found in Appendix A.10.
Source: Deloitte Access Economics.

Firms' experience of NTMs differ by location

Firms' experience with NTMs also varies by the location of import or export. Grouping member economies by their World Bank income classifications (Hamadeh et al., 2022), firms trading in high income economies and upper middle-income economies had broadly similar perspectives on burdensome NTMs. Nonetheless, among exporters, it was notable that firms in Thailand were more likely to view formalities as burdensome, while firms in Singapore were twice as likely to view export subsidies as a serious impediment to trade on market pairs deemed burdensome compared to firms in other surveyed economies. A full list of the share of respondents that viewed export NTMs as burdensome at the member economy level can be found in Appendix A.11.

As seen in Figure 2.17, a larger share of importing firms in high income economies viewed contingent trade-protective measures, quantity and price controls as burdensome while firms in upper middle-income economies were more likely to view formalities, technical barriers and intellectual property as burdensome, especially firms in Thailand.

Figure 2.17 Share of firms that viewed selected import NTMs as burdensome, by income classification (percent)



Notes: n=200 firms; High income economies covers Australia; Singapore; and the United States while upper middle-income economies cover China; Mexico; and Thailand. A full list of the share of respondents that viewed import NTMs as burdensome by economy can be found in Appendix A.12.
Source: Deloitte Access Economics.

Experiences of NTMs by market pair

Table 2.10 summarises the top three market pairs by value of goods traded by firms located in each specific economy included in this survey (top five market pair rankings in Appendix A.13). It should be noted that these rates are not necessarily representative of the true extent of NTM barriers imposed between these market pairs, but simply highlight the diversity of experiences faced by firms in this survey. Based on the data below, the most valuable trade took place within the APEC region, often between two APEC member economies that are geographically close together. In addition, each respondent location's largest market pairs in environmental goods were generally reflective of their largest trading partners across the broader economy.

Table 2.10 Share of largest and most burdensome origin-destination market pairs of goods reducing GHG emissions, by respondent location (percent)

Australia

Most nominated trading pairs	Most nominated burdensome pairs
Australia-New Zealand (20%)	Australia-New Zealand (23%)
Australia-Canada (13%)	Australia-Canada (20%)
Australia-China (10%)	United States-Australia (13%)

China

Most nominated trading pairs	Most nominated burdensome pairs
China-Japan (28%)	China-Japan (25%)
China-United States (20%)	China-United States (18%)
China-Australia (15%)	China-Australia (18%)

Mexico

Most nominated trading pairs	Most nominated burdensome pairs
Mexico-United States (37%)	Mexico-United States (20%)
United States-Mexico (20%)	United States-Mexico (10%)
Mexico-Hong Kong, China (13%)	Mexico-Hong Kong, China (10%)

Singapore

Most nominated trading pairs	Most nominated burdensome pairs
Singapore-Malaysia (23%)	Singapore-Indonesia (20%)
Singapore-Australia (20%)	Hong Kong, China-Singapore (13%)
Hong Kong, China-Singapore (17%)	Singapore-Malaysia (13%)

Thailand

Most nominated trading pairs	Most nominated burdensome pairs
Thailand-Hong Kong, China (20%)	Thailand-Malaysia (23%)
Thailand-Japan (17%)	Thailand-Japan (23%)
Thailand-Malaysia (17%)	Thailand-Hong Kong, China (20%)

United States

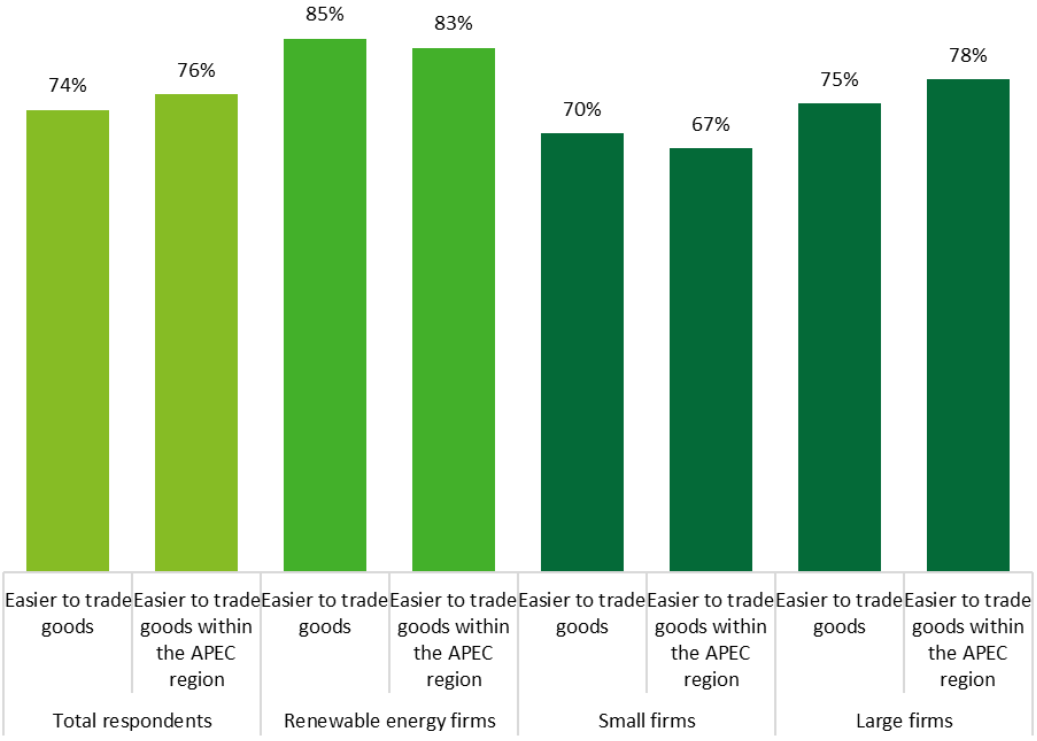
Most nominated trading pairs	Most nominated burdensome pairs
United States-Canada (43%)	United States-Canada (30%)
United States-Mexico (25%)	United States-Mexico (15%)
United States-Australia (10%)	United States-Australia (10%)

Notes: n=200; For each economy above, the top 3 market pairs that were the most commonly cited as burdensome by respondents were listed. However, for Australia; Mexico; and the United States, there were several market pairs with the same share of respondents in that economy that listed the market pair as burdensome. For a fuller list of the most traded and most burdensome market pairs, please see Appendix A.13.
Source: Deloitte Access Economics.

Experiences of NTM barriers to trade over time

There is a broad consensus among respondent firms that trading goods reducing GHG emissions has become easier over the past five years (Figure 2.18). In fact, 74 percent of firms agreed or strongly agreed that trade in these goods has become easier, with the number rising to 76 percent when the question was localised to the APEC region. The consensus is stronger among firms focused on renewable energy wherein 85 percent agreed that trade has become easier globally, while 83 percent agreed that it has become easier within APEC. Such strong consensus was also observed among firms that are focused on cleaner and more resource efficient technologies and air pollution control. This may reflect the reductions in tariffs within APEC or other NTMs. Nonetheless, it does appear that some more work needs to be done, particularly amongst small firms (67 percent), who were relatively less likely than large firms (78 percent) to find that trade in goods reducing GHG emissions has become easier in the APEC region over the past five years.

Figure 2.18 Share of firms that agreed and strongly agreed that it has become easier to trade goods reducing GHG emissions, by selected sub-sectors and size (percent)



Notes: n=200 firms, of which 157 are large and 43 are small. Small firms are those with less than 200 employees while large firms have 200 employees or more.
Source: Deloitte Access Economics.

Survey respondents and interviews with stakeholders identified the disruptions of the pandemic and geopolitical tensions within and outside the APEC region as reasons for NTMs recently becoming more burdensome.

Enablers of trade

Firms have found that environmental regulation is the strongest enabler of trade in goods reducing GHG emissions (Table 2.11). Environmental regulation that creates incentives to decarbonise has facilitated trade of these goods, especially for firms focused on air pollution control with more than 80 percent of respondents in this sub-sector finding that environmental

regulation has facilitated trade by creating demand for their products. Transparency, as well as alignments of technical regulation and conformity assessments, have also streamlined compliance processes to facilitate trade. In addition, it is notable that sub-sectors with products and technologies that can help other sectors decarbonise (e.g., cleaner and more resource efficient technologies, air pollution control) are more likely to view efforts to promote research and development as key to facilitating trade compared to the wider sample. Further details on sub-sectors' views on the strongest enablers of trade is provided in Appendix A.14.

Table 2.11 Share of firms that considered these policies as enablers of trade in goods reducing GHG emissions (percent)

Policy	All respondents	Small firms	Large firms
Implementation of environmental regulations	62	65	61
Promotion of research and development	50	35	54
Greater transparency of domestic measures	48	37	50
Alignment of technical regulations and conformity assessment procedures	41	19	46
Strengthening supply chain resilience	40	30	43
Facilitation of patent procedures	36	28	38
None of the above	2	2	1

Notes: n=200 firms, of which 157 are large and 43 are small. Small firms are those with less than 200 employees while large firms have 200 employees or more
Source: Deloitte Access Economics.

However, the view that government policies have enabled trade in goods reducing GHG emissions is mainly held by larger firms, with a similar proportion of small and large firms viewing the implementation of environmental regulation as helping them facilitate trade. In all other policy areas, the share of small firms that viewed these policies as enablers of trade is notably less than large firms.

More widely, consultations with stakeholders throughout the value chain suggest that government policies and regulations that can create demand and develop the market for goods reducing GHG emissions are more important than policies that can help facilitate trade in the long run.

Interviews with stakeholders identified that the maturity of the market for a particular good reducing GHG emissions influenced how significant NTMs were in affecting their trade. The use of domestic regulation and interventions could be especially beneficial in emerging industries or the commercialisation of new technologies, where government policies can help create incentives for switching away from emissions-intensive substitute products. For many firms and products that are not widely traded, NTMs were not necessarily the main barrier to trade — domestic regulation or carbon pricing would be required to create the market in the first place. An example of how environmental regulation could help an emerging industry can be seen in Box 2.4.

In high income markets, a range of government policies could directly or indirectly increase trade of goods that reduce GHG emissions. It should be noted that while such policies may only affect firms in a particular industry, they could have wider implications throughout the value chains of goods reducing GHG emissions. For example, government incentives for firms in

emissions-intensive industries to switch to lower carbon alternatives can help increase demand and consequently trade for goods reducing GHG emissions and its related inputs. Alternatively, policies that help develop industries involved in the value chain of goods reducing GHG emissions can help facilitate trade.

Box 2.4 Environmental Regulation and International Trade in Clean Hydrogen

Clean hydrogen[12] is a good example of an emerging industry where government measures can support the creation of a market for international trade. Clean hydrogen is expected to facilitate decarbonisation in 'hard-to-abate' industries, like aviation, steel and shipping. Despite this, it is not yet traded because production costs exceed those of its emissions-intensive competitors. As a result, there is a role for government to stimulate demand in order to create a market for trading clean hydrogen. Consultations with stakeholders identified contracts for difference and regulatory standardisation as two means of advancing this objective.

Contracts for difference help to match buyers and sellers in a market. They pay out the difference between buyers' maximum willingness to pay and sellers' minimum sale price thereby bridging the 'gap' between buyers and sellers. Germany's 'H2Global' is a contract for difference mechanism for clean hydrogen trade which has committed EUR 900 million to matching energy consumers with hydrogen producers and subsidising the difference (BMWK, 2021). Through this, the German government stimulates demand to create a market that would not otherwise exist. This gives investors the confidence that the upfront costs of investments will be recoverable (H2Global Stiftung, 2022).

Regulatory standardisation can enable trade in clean hydrogen by helping to reduce uncertainty. Disagreement over this definition has inhibited the clean hydrogen trade. Some proponents of stricter definitions argue that hydrogen producers should demonstrate that their product uses *additional* renewable electricity, not that which is required by the grid (Parkes, 2022). Critics counter that this stricter definition would stifle industry growth (Hydrogen Europe, 2022). Disagreement creates uncertainty for investors, who know that 'green' certification will lead to increased demand. As such, a consensus on the definition of clean hydrogen or establishing criteria to consider when hydrogen could be considered as clean could improve the tradability of clean hydrogen by enshrining consistent credentialing across markets.

Likewise, policies that could directly reduce trading costs could make firms throughout the value chain more willing and able to trade. One stakeholder noted that Viet Nam's recent decisions to introduce import tax relief for firms involved in solar energy and the temporary lowering of the value-added tax from 10 percent to 8 percent have played a role in influencing them to expand their presence in this economy. In contrast, another stakeholder highlighted that NTMs were not used to facilitate trade in goods reducing GHG emissions more than any other types of goods. They recognised that in some products, the government has used NTMs in ways that limit imports to protect fossil fuel-based generators.

Through the issuing of green bonds, financial institutions can also play a crucial role in helping to increase demand for renewable energy projects and, consequently, facilitate trade. In asset-heavy products such as solar power generation projects, with high capital expenditure and an environment where interest rates are increasing, financial instruments, such as green bonds that can help firms obtain intermediate inputs without paying all of the upfront costs, can increase the demand for such products and, consequently, the viability for renewable energy projects.

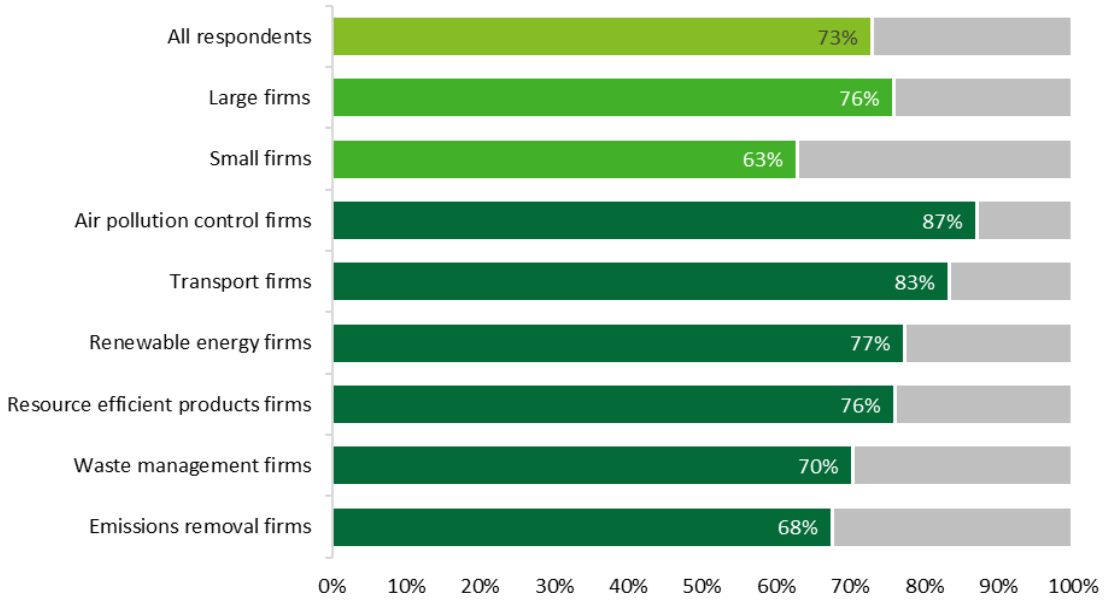
[12] There are a range of standards and definitions on what constitutes 'clean', 'green' and 'low-emissions' hydrogen. Clean hydrogen is used here because it aligns with this study's definition of environmental goods. Clean hydrogen tends captures a broader range of hydrogen products than other definitions, which reflects the broad approach to environmental goods adopted for this report.

FTAs can also help facilitate trade in goods reducing GHG emissions. Most firms (73 percent) used FTAs to export or import these goods, with uptake relatively higher among firms focused on transportation equipment and air pollution control than other manufacturing firms (Figure 2.19).The usefulness of FTAs to firms was reinforced during stakeholder interviews, with one firm noting that the high number of FTAs that Singapore has with key partners has influenced their decision to be based in the economy.[13] Another stakeholder based in Mexico raised that without FTAs, they would expect NTM reforms for goods reducing GHG emissions to move much more slowly in certain economies.

The most utilised FTAs were not necessarily those with the largest share of market pairs. For example, firms based in Canada; Mexico; and the United States were more likely to utilise the United States-Mexico-Canada Agreement alongside Australia's agreements with China and Japan. Smaller firms (63 percent) are less likely to utilise FTAs compared to larger firms (76 percent).

Consultations with industry stakeholders also suggest that increasing the scope of FTAs to cover green sectors could be another ground for bilateral and multilateral cooperation. A blueprint for how economies can work together to facilitate trade in goods reducing GHG emissions can be seen in the Singapore-Australia Green Economy Agreement. This Agreement will see both economies embark on 17 joint initiatives, which include promoting business engagements and research collaborations in areas such as green and transition finance, carbon markets, decarbonisation and technology, standards and conformance and skills and capabilities. Both economies have also jointly developed a non-exhaustive list of 372 environmental goods and 155 environmental services and will seek to cut tariff and non-tariff barriers facing these goods (Zhang, 2022). It is hoped that this Agreement could be used as a framework that other APEC economies could use to further increase trade in these goods.

Figure 2.19 Share of firm use of FTAs in the 2021 calendar year (percent)

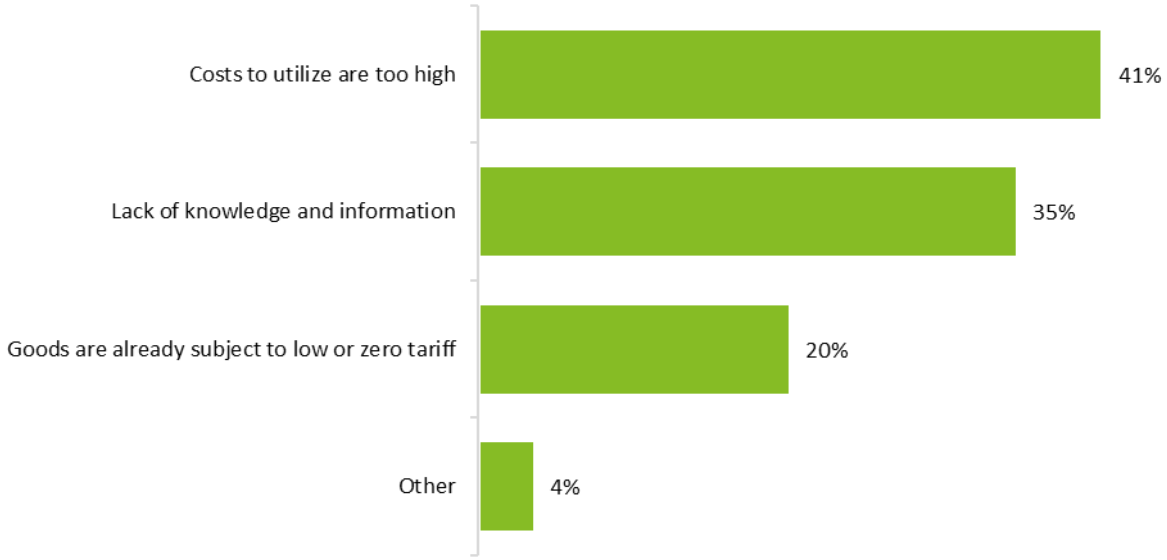


Notes: n=200 firms, of which 157 are large and 43 are small. Small firms are those with less than 200 employees while large firms have 200 employees or more.
Source: Deloitte Access Economics.

[13] According to data from the Asian Development Bank, Singapore has signed 45 FTAs, the highest when compared against other economies in the Asia-Pacific region.

Among firms that did not use FTAs, the costs of utilization, unawareness of the agreements and the pre-existence of low or zero-tariffs affecting goods are commonly cited reasons for nonparticipation (Figure 2.20).

Figure 2.20 Share of firms with reasons why to not use FTAs (percent)



Notes: n=54 firms
Source: Deloitte Access Economics.

3. WAYS FORWARD: AREAS OF REGULATORY COOPERATION AND POLICY RECOMMENDATIONS

The report findings through the analysis of trade databases and firm survey and interviews show that NTMs could either represent a barrier of trade in goods reducing GHG emissions. Many of the findings analysing trade databases have been corroborated by firms through the survey and interviews. In fact, all these sources show that most of the NTMs affecting trade are related to import and export formalities (for example, licensing procedures), quantity or price-control measures, contingency trade-protective measures and technical requirements.

However, the survey findings and interviews also noted that NTMs could be enablers of trade in goods reducing GHG emissions. Domestic policy and regulations are essential to create new markets and develop existing markets for goods reducing GHG emissions. In fact, most of the firms acknowledge that environmental regulations play a big role in encouraging trade relating to those goods. In addition, a significant percentage of firms acknowledged that measures on transparency of domestic measures and alignment of technical regulations and conformity assessment procedures could facilitate more trade as well.

What could be done to create momentum and contribute positively to climate change alleviation and mitigation by encouraging trade in goods to reduce GHG emissions? A wide range of technologies are required to support reducing GHG emissions. Efforts to reduce trade-restrictive NTMs should support this diversity and not just cover renewable energy production, but also goods for air pollution control, waste management, resource/energy efficiency, cleaner technologies, among others. In addition, governments need to put more emphasis on the implementation of NTMs that could enable trade. APEC economies could consider implementing actions from many different angles:

- In the short run, cooperation could prioritize reducing trade-restrictive NTMs affecting mature technologies that have the greatest potential to reduce emissions. According to a report by PwC, solar energy, wind energy and green hydrogen production are among the technologies with greater potential to reduce GHG emissions (PwC, 2021).
- It is important to continue to monitor the emergence of NTMs in emerging technologies as their trade grows (e.g., electric vehicles), while implementing policies to drive demand for those products.
- Changes to current NTMs restricting trade of goods reducing GHG emissions need to take into account their global value chains. Lowering barriers to trade, not just to the final goods but also to other components in the production process, could improve access to markets to upstream suppliers, intermediaries and downstream buyers, thus benefitting multiple APEC economies.
- While not unique to goods reducing GHG emissions, streamlining processes, reducing paperwork and ineffective customs formalities associated with burdensome NTMs would facilitate greater trade, particularly for SMEs. As indicated in this report, these procedures/formalities have been identified as one of the most critical issues affecting several products and billions of dollars in terms of trade. Firm perspectives have to be considered when designing effective trade policies.
- To take into account the APEC Cross-Cutting Principles on NTMs agreed in 2018, which establishes guidelines for the process to develop NTMs in a transparent and WTO-consistent manner. These principles state that NTMs cannot be more trade-restrictive than necessary to achieve an objective and should preferably focus on

outcomes, rather than mandating prescriptive approaches. Furthermore, this initiative emphasizes that NTMs should be based on international standards, when appropriate, and should not pose unjustified barriers to innovation, among others (APEC, 2018). Environmental regulations, which could enable trade in goods reducing GHG emissions, should take into account these principles.

- Diverging technical regulations could represent an impediment to trade. APEC could promote initiatives to align technical regulations and implement conformity assessment procedures to facilitate trade in goods reducing GHG emissions. APEC could take a leading role in promoting good regulatory practices in the application of standards for new emerging technologies.
- Many firms use FTAs to have preferential access to markets and alleviate the impact of trade-restrictive NTMs. The most extensively used FTAs can provide a basis for lessons that can be adopted more widely across APEC. Besides FTAs, there are new bilateral initiatives that also offer opportunities to increase trade in goods reducing GHG emissions. For example, the new Green Economy Agreement between Australia and Singapore include a mechanism to identify and address non-tariff barriers and a strong collaboration in standards and conformance (e.g., through the mutual recognition of certification and conformity assessment procedures in relation to the green economy).[14]
- The list of environmental products designed to reduce GHG emissions can be optimized and improved. Any product not conducive to reducing GHG emissions should not be part of this list.

[14] For more on the Singapore Australia Green Economy Agreement, see: https://www.gea.gov.sg/sagea/.

BIBLIOGRAPHY

Asia-Pacific Economic Cooperation (APEC). *Annex C – APEC list of environmental goods*. 2012. https://www.apec.org/meeting-papers/leaders-declarations/2012/2012_aelm/2012_aelm_annexc

———. *Annex A: Cross cutting principles on non-tariff measures (NTMs).* 2018. https://www.apec.org/meeting-papers/annual-ministerial-meetings/2018/2018_amm/cross-cutting-principles-on-non-tariff-measures

———. *Annex 2 – Reference list of environmental and environmentally related services.* 2021a. https://www.apec.org/meeting-papers/annual-ministerial-meetings/2021/2021-apec-ministerial-meeting/annex-2---reference-list-of-environmental-and-environmentally-related-services

———. *Policy discussion on trade-related policies to promote trade in environmental products and technologies including regulatory issues contributing to global carbon neutrality – presentation.* 2021b. http://mddb.apec.org/Documents/2021/CTI/PD/21_cti_pd_002.pdf

Bundesministerium für Wirtschaft und Klimaschutz (BMWK). "900 million euros for hydrogen project H2Global – Habeck "Starting with the ramp-up of the hydrogen economy." 23 December 2021. https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2021/12/20211223-900-millionen-euro-fuer-wasserstoffprojekt-h2global.html

Evenett, Simon and Johannes Fritz. *The Global Trade Alert database handbook.* Manuscript, 21 October 2022. https://www.dropbox.com/s/i5hnf27nnnz21nq/GTA%20handbook.pdf?dl=1

Fransen, Taryn, Katie Ross, and Jamal Srouji. "5 ways the Glasgow Climate Pact aims to reduce greenhouse gas emissions." *World Resources Institute,* 10 March 2022. https://www.wri.org/insights/glasgow-climate-pact-reduce-ghg-emissions

H2Global Stiftung. "The H2Global Mechanism". 2022. https://www.h2-global.de/project/h2g-mechanism

Hamadeh, Nada, Catherine van Rompaey, Eric Metreau, and Shwetha Grace Eapen. "New World Bank country classifications by income level: 2022-2023." *World Bank Blogs,* 1 July 2022. https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2022-2023

Hoekman, Bernard and Alessandro Nicita. "Trade policy, trade costs, and developing country trade." *World Development, 39*(12) (2011): 2069-2079. https://doi.org/10.1016/j.worlddev.2011.05.013

Hydrogen Europe. "Historical day for green hydrogen." 2022. https://hydrogeneurope.eu/historical-day-for-green-hydrogen/

Kee, Hiau Looi, Alessandro Nicita, and Marcelo Olarreeaga. "Estimating trade restrictiveness indices." *The Economic Journal, 119*(534) (2008): 172-199. https://doi.org/10.1111/j.1468-0297.2008.02209.x

Kuriyama, Carlos, Bernadine Zhang Yuhua, and Azul Ogazón. *Perceptions on the use of non-tariff measures within the APEC region.* Singapore: Asia-Pacific Economic Cooperation, 2014. https://www.apec.org/publications/2014/06/perceptions-on-the-use-of-non-tariff-measures-within-the-apec-region

Kuriyama, Carlos. *A review of the APEC list of environmental goods.* Singapore: Asia-Pacific Economic Cooperation, 2021. https://www.apec.org/docs/default-source/publications/2021/10/a-review-of-the-apec-list-of-environmental-goods/221_psu_review-of-apec-list-of-environmental-goods.pdf?sfvrsn=42cdd8b7_1

Parkes, Rachel. "EU green hydrogen sector still needs additionality, but hour-by-hour rules were impossible." *Recharge*, 30 September 2022. https://www.rechargenews.com/energy-transition/eu-green-hydrogen-sector-still-needs-additionality-but-hour-by-hour-rules-were-impossible/2-1-1324462

PwC. *State of Climate Tech 2021: Scaling breakthroughs for net zero.* 2021. https://www.pwc.com/gx/en/sustainability/publications/assets/pwc-state-of-climate-tech-report.pdf

Shapiro, Joseph. "The environmental bias of trade policy." *The Quarterly Journal of Economics, 136*(2) (2020): 831-886. https://doi.org/10.1093/qje/qjaa042

The Australian APEC Study Centre at RMIT University, The Australian National University, and Article Three. *Scoping study on new and emerging environmental goods.* Singapore: Asia-Pacific Economic Cooperation, 2021. https://www.apec.org/publications/2021/12/scoping-study-on-new-and-emerging-environmental-goods

United Nations Conference on Trade and Development (UNCTAD). *Non-tariff measures to trade: Economic and policy issues for developing countries.* 2013. https://unctad.org/webflyer/non-tariff-measures-trade-economic-and-policy-issues-developing-countries

———. *International classification of non-tariff measures.* 2019. https://unctad.org/webflyer/international-classification-non-tariff-measures-2019-version

World Trade Organization (WTO). "Members still falling behind on subsidy notifications, committee hears." 25 October 2022. https://www.wto.org/english/news_e/news22_e/scm_25oct22_e.htm

Zhang, Lim Min. "Singapore, Australia sign trailblazing Green Economy Agreement with 17 joint initiatives." *The Strait Times,* 18 October 2022. https://www.straitstimes.com/singapore/singapore-australia-sign-trailblazing-green-economy-agreement-with-17-joint-initiatives

APPENDICES

A.1. LIST OF GHG-REDUCING GOODS

Table A.1.1 Air pollution control goods

No.	HS 2017	Product Description
1	840420	Boilers; condensers, for steam or other vapour power units
2	840490	Boilers; parts of auxiliary plant, for use with boilers of heading no. 8402 and 8403 and parts of condensers for steam or other vapour power units
3	840510	Generators; producer gas, water gas, acetylene gas and similar water process gas generators, with or without their purifiers
4	841410	Pumps; vacuum
5	841430	Compressors; of a kind used in refrigerating equipment
6	841440	Compressors; air compressors mounted on a wheeled chassis for towing
7	841459	Fans; n.e.c. in item no. 8414.51
8	841960	Machinery; for liquefying air or gas, not used for domestic purposes
9	841989	Machinery, plant and laboratory equipment; for treating materials by change of temperature, other than for making hot drinks or cooking or heating food
10	842139	Machinery; for filtering or purifying gases, other than intake air filters for internal combustion engines

Source: APEC PSU compilation based on various sources.

Table A.1.2 Cleaner alternatives

No.	HS 2017	Product Description
1	732111	Cooking appliances and plate warmers; for gas fuel or for both gas and other fuels, of iron or steel
2	732190	Domestic appliances; non-electric, parts thereof, of iron or steel
3	840731	Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity not exceeding 50cc
4	840732	Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity exceeding 50cc but not exceeding 250cc
5	840733	Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity exceeding 250cc but not exceeding 1000cc
6	840734	Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity exceeding 1000cc
7	840790	Engines; rotary internal combustion piston engines, for other than aircraft or marine propulsion
8	850680	Cells and batteries; primary, (other than manganese dioxide, mercuric oxide, silver oxide, lithium or air-zinc)
9	850690	Cells and batteries; primary, parts thereof
10	870240	Vehicles; public transport type (carries 10 or more persons, including driver), with only electric motor for propulsion, new or used
11	870380	Vehicles; with only electric motor for propulsion

Source: APEC PSU compilation based on various sources.

Table A.1.3 Renewable energy goods

No.	HS 2017	Product Description
1	220710	Undenatured ethyl alcohol; of an alcoholic strength by volume of 80 percent vol. or higher
2	280410	Hydrogen
3	281410	Ammonia; anhydrous
4	281420	Ammonia; in aqueous solution
5	290511	Alcohols; saturated monohydric, methanol (methyl alcohol)
6	730820	Iron or steel; structures and parts thereof, towers and lattice masts
7	731100	Containers for compressed or liquefied gas, of iron or steel
8	761100	Aluminium; reservoirs, tanks, vats and similar containers, for material (not compressed or liquefied gas), of a capacity over 300l, whether or not lined, not fitted with mechanical/thermal equipment
9	761300	Aluminium; containers for compressed or liquefied gas
10	840681	Turbines; steam and other vapour turbines, (for other than marine propulsion), of an output exceeding 40MW
11	840690	Turbines; parts of steam and other vapour turbines
12	841011	Turbines; hydraulic turbines and water wheels, of a power not exceeding 1000kW
13	841090	Turbines; parts of hydraulic turbines and water wheels, including regulators
14	841181	Turbines; gas-turbines (excluding turbo-jets and turbo-propellers), of a power not exceeding 5000kW
15	841182	Turbines; gas-turbines (excluding turbo-jets and turbo-propellers), of a power exceeding 5000kW
16	841480	Pumps and compressors; for air, vacuum or gas, n.e.c. in heading no. 8414
17	841490	Pumps and compressors; parts, of air or vacuum pumps, air or other gas compressors and fans, ventilating or recycling hoods incorporating a fan
18	841581	Air conditioning machines; containing a motor driven fan, other than window or wall types, incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)
19	841861	Heat pumps; other than air conditioning machines of heading no. 8415
20	841869	Refrigerating or freezing equipment; n.e.c. in heading no. 8418
21	841911	Heaters; instantaneous gas water heaters, for domestic or other purposes
22	841919	Heaters; instantaneous or storage water heaters, non-electric, other than instantaneous gas water heaters
23	841990	Machinery, plant and laboratory equipment; parts of equipment for treating materials by a process involving a change of temperature
24	848340	Gears and gearing; (not toothed wheels, chain sprockets and other transmission elements presented separately); ball or roller screws; gear boxes and other speed changers, including torque converters
25	848360	Clutches and shaft couplings (including universal joints)
26	850161	Generators; AC generators, (alternators), of an output not exceeding 75kVA
27	850162	Electric generators; AC generators, (alternators), of an output exceeding 75kVA but not exceeding 375kVA
28	850163	Electric generators; AC generators, (alternators), of an output exceeding 375kVA but not exceeding 750kVA
29	850164	Electric generators; AC generators, (alternators), of an output exceeding 750kVA
30	850231	Electric generating sets; wind-powered, (excluding those with spark-ignition or compression-ignition internal combustion piston engines)
31	850300	Electric motors and generators; parts suitable for use solely or principally with the machines of heading no. 8501 or 8502
32	850440	Electrical static converters
33	850720	Electric accumulators; lead-acid, (other than for starting piston engines), including separators, whether or not rectangular (including square)
34	853710	Boards, panels, consoles, desks and other bases; for electric control or the distribution of electricity, (other than switching apparatus of heading no. 8517), for a voltage not exceeding 1000 volts
35	854140	Electrical apparatus; photosensitive, including photovoltaic cells, whether or not assembled in modules or made up into panels, light-emitting diodes (LED)
36	854330	Electrical machines and apparatus; for electroplating, electrolysis or electrophoresis
37	900190	Optical elements; lenses n.e.c. in heading no. 9001, prisms, mirrors and other optical elements, unmounted, of any material (excluding elements of glass not optically worked)
38	900290	Optical elements; n.e.c. in heading no. 9002 (e.g. prisms and mirrors), mounted, being parts or fittings for instruments or apparatus, of any material (excluding elements of glass not optically worked)

Source: APEC PSU compilation based on various sources.

Table A.1.4 Waste management goods

No.	HS 2017	Product Description
1	392010	Plastics; plates, sheets, film, foil and strip (not self-adhesive), of polymers of ethylene, non-cellular and not reinforced, laminated, supported or similarly combined with other materials
2	701990	Glass fibres; n.e.c. in heading no. 7019
3	840410	Boilers; auxiliary plant, for use with boilers of heading no. 8402 or 8403 (e.g. economisers, super-heaters, soot removers, gas recoverers)
4	841780	Furnaces and ovens; including incinerators, non-electric, for industrial or laboratory use, n.e.c. in heading no. 8417
5	841790	Furnaces and ovens; parts of non-electric furnaces and ovens (including incinerators), of industrial or laboratory use
6	842199	Machinery; parts for filtering or purifying liquids or gases
7	851410	Furnaces and ovens; electric, for industrial or laboratory use, resistance heated
8	851420	Furnaces and ovens; electric, for industrial or laboratory use, functioning by induction or dielectric loss
9	851430	Furnaces and ovens; electric, for industrial or laboratory use, other than those functioning by induction, dielectric loss or resistance heated
10	851490	Furnaces, ovens and heating equipment; parts of the industrial or laboratory equipment of heading no. 8514

Source: APEC PSU compilation based on various sources.

A.2. SHARE OF EXPORTED GHG-REDUCING GOODS SUBJECT TO NTMS, BY ECONOMY

Table A.2.1 Share of exported GHG-reducing goods subject to domestic NTMs, by economy and by category (percent)

Domestic NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	100.0	100.0	100.0	100.0	100.0
Brunei Darussalam	62.7	90.0	-	62.4	77.3
Canada	7.0	2.4	19.9	6.9	-
Chile	-	-	-	-	-
China	100.0	100.0	100.0	100.0	100.0
Hong Kong, China	1.7	-	-	3.1	-
Indonesia	0.6	-	-	1.2	-
Japan	65.6	91.0	32.3	66.5	68.5
Korea	94.4	86.4	100.0	96.1	92.1
Malaysia	11.6	16.1	17.6	6.5	19.4
Mexico	0.7	-	-	1.3	-
New Zealand	100.0	100.0	100.0	100.0	100.0
Papua New Guinea	9.3	-	25.0	11.0	-
Peru	0.1	-	-	0.2	-
The Philippines	100.0	100.0	100.0	100.0	100.0
Russia	100.0	100.0	100.0	100.0	100.0
Singapore	100.0	100.0	100.0	100.0	100.0
Thailand	3.9	-	22.2	1.1	-
United States	100.0	100.0	100.0	100.0	100.0
Viet Nam	100.0	100.0	100.0	100.0	100.0

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.2.2 Share of exported GHG-reducing goods subject to foreign NTMs, by economy and by category (percent)

Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	9.5	10.3	7.3	9.5	10.4
Brunei Darussalam	7.5	11.1	-	7.4	9.1
Canada	9.4	10.5	8.3	9.3	9.8
Chile	11.0	10.7	11.6	11.4	9.6
China	11.4	12.3	10.4	11.3	11.9
Hong Kong, China	9.2	9.5	6.8	9.6	9.0
Indonesia	11.4	14.0	8.8	11.0	12.0
Japan	11.6	13.7	9.5	11.5	11.7
Korea	10.4	11.2	9.9	10.6	9.4
Malaysia	11.8	13.5	8.5	11.7	12.7
Mexico	7.2	9.1	5.1	7.4	6.0
New Zealand	9.6	12.5	6.2	9.4	10.0
Papua New Guinea	12.7	21.9	-	11.0	19.0
Peru	7.6	7.9	8.4	7.4	7.5
The Philippines	6.9	8.3	7.2	6.4	7.3
Russia	8.7	10.5	5.0	8.9	7.7
Singapore	11.5	12.3	9.9	11.4	12.1
Chinese Taipei	8.7	9.3	7.3	9.0	8.4

Thailand	10.7	10.6	10.7	10.6	11.0
United States	9.9	11.1	9.2	9.9	9.4
Viet Nam	11.4	14.4	6.7	11.4	11.9

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.2.3 Share of exported GHG-reducing goods subject to NTMs, by economy and by category (percent)

Domestic and Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	100.0	100.0	100.0	100.0	100.0
Brunei Darussalam	63.9	91.1	-	64.0	77.3
Canada	15.5	12.5	25.6	15.3	9.8
Chile	11.0	10.7	11.6	11.4	9.6
China	100.0	100.0	100.0	100.0	100.0
Hong Kong, China	10.7	9.5	6.8	12.4	9.0
Indonesia	12.0	14.0	8.8	12.1	12.0
Japan	68.5	91.6	38.3	69.4	71.1
Korea	94.8	87.6	100.0	96.5	92.7
Malaysia	22.1	27.6	24.1	17.5	29.9
Mexico	7.9	9.1	5.1	8.6	6.0
New Zealand	100.0	100.0	100.0	100.0	100.0
Papua New Guinea	21.5	21.9	25.0	21.5	19.0
Peru	7.7	7.9	8.4	7.6	7.5
The Philippines	100.0	100.0	100.0	100.0	100.0
Russia	100.0	100.0	100.0	100.0	100.0
Singapore	100.0	100.0	100.0	100.0	100.0
Thailand	14.0	10.6	30.0	11.5	11.0
United States	100.0	100.0	100.0	100.0	100.0
Viet Nam	100.0	100.0	100.0	100.0	100.0

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

A.3. VALUE OF EXPORTED GHG-REDUCING GOODS SUBJECT TO NTMS, BY ECONOMY

Table A.3.1 Value of exported GHG-reducing goods subject to domestic NTMs, by economy and by category (USD million)

Domestic NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	1,042.5	97.8	135.1	721.2	88.5
Brunei Darussalam	10.1	1.7	-	8.0	0.4
Canada	1,325.5	2.3	1,193.5	129.7	-
Chile	-	-	-	-	-
China	89,269.0	9,212.6	7,399.3	67,280.2	5,377.0
Hong Kong, China	3.4	-	-	3.4	-
Indonesia	51.0	-	-	51.0	-
Japan	26,041.5	3,309.0	10,797.5	10,647.1	1,287.9
Korea	17,923.2	2,565.1	4,344.0	10,109.9	904.2
Malaysia	423.4	203.3	7.9	113.1	99.0
Mexico	23.2	-	-	23.2	-
New Zealand	445.5	33.2	25.2	351.7	35.4
Papua New Guinea	0.5	-	0.1	0.5	-
Peru	0.0	-	-	0.0	-
The Philippines	2,704.5	97.7	44.8	2,487.0	74.9
Russia	2,843.5	190.4	106.0	2,413.7	133.5
Singapore	8,364.7	769.7	435.3	6,822.2	337.6
Thailand	290.8	-	258.8	32.0	-
United States	52,449.7	6,578.4	11,797.0	29,661.9	4,412.4
Viet Nam	4,520.3	226.2	66.9	4,124.4	102.8

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.3.2 Value of exported GHG-reducing goods subject to foreign NTMs, by economy and by category (USD million)

Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	49.4	6.3	3.0	36.3	3.8
Brunei Darussalam	7.6	0.5	-	7.1	0.0
Canada	170.3	18.3	18.5	120.2	13.4
Chile	39.4	3.4	0.3	28.1	7.5
China	5,825.9	669.2	348.2	4,518.1	290.3
Hong Kong, China	276.2	11.2	15.9	245.4	3.8
Indonesia	269.6	57.5	90.1	111.4	10.6
Japan	1,588.4	148.3	767.5	579.3	93.3
Korea	690.7	106.7	206.5	313.7	63.9
Malaysia	340.5	42.2	19.0	235.0	44.3
Mexico	208.8	25.6	81.6	98.0	3.5
New Zealand	61.1	15.7	1.7	41.5	2.3
Papua New Guinea	0.8	0.4	-	0.4	0.0
Peru	3.9	0.2	0.1	2.8	0.8
The Philippines	83.2	1.5	3.0	76.7	2.0
Russia	44.2	3.1	3.2	36.2	1.7
Singapore	424.4	59.6	16.0	326.8	22.1
Chinese Taipei	294.9	37.6	4.5	147.3	105.5
Thailand	688.9	170.8	94.0	338.4	85.6

United States	2,564.8	325.3	282.6	1,783.6	173.3
Viet Nam	248.7	8.2	2.2	228.7	9.6

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.3.3 Value of exported GHG-reducing goods subject to NTMs, by economy and by category (USD million)

Domestic and Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	1,042.5	97.8	135.1	721.2	88.5
Brunei Darussalam	16.9	1.7	-	14.7	0.4
Canada	1,474.4	20.5	1,195.3	245.3	13.4
Chile	39.4	3.4	0.3	28.1	7.5
China	89,269.0	9,212.6	7,399.3	67,280.2	5,377.0
Hong Kong, China	279.5	11.2	15.9	248.6	3.8
Indonesia	284.7	57.5	90.1	126.5	10.6
Japan	26,288.6	3,311.2	10,867.2	10,811.4	1,298.8
Korea	17,932.7	2,572.0	4,344.0	10,111.6	905.0
Malaysia	742.0	231.3	26.0	342.6	142.2
Mexico	231.9	25.6	81.6	121.2	3.5
New Zealand	445.5	33.2	25.2	351.7	35.4
Papua New Guinea	1.4	0.4	0.1	0.9	0.0
Peru	3.9	0.2	0.1	2.8	0.8
The Philippines	2,704.5	97.7	44.8	2,487.0	74.9
Russia	2,843.5	190.4	106.0	2,413.7	133.5
Singapore	8,364.7	769.7	435.3	6,822.2	337.6
Thailand	915.4	170.8	309.9	349.0	85.6
United States	52,449.7	6,578.4	11,797.0	29,661.9	4,412.4
Viet Nam	4,520.3	226.2	66.9	4,124.4	102.8

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

A.4. SHARE OF IMPORTED GHG-REDUCING GOODS SUBJECT TO NTMS, BY ECONOMY

Table A.4.1 Share of imported GHG-reducing goods subject to domestic NTMs, by economy and by category (percent)

Domestic NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	100.0	100.0	100.0	100.0	100.0
Brunei Darussalam	59.8	85.3	6.3	57.1	81.8
Canada	100.0	100.0	100.0	100.0	100.0
Chile	93.6	100.0	100.0	91.3	88.6
China	100.0	100.0	100.0	100.0	100.0
Hong Kong, China	13.6	16.2	54.7	6.6	4.1
Indonesia	71.8	87.9	44.4	70.0	80.4
Japan	68.3	88.6	24.8	69.6	79.8
Korea	96.7	96.2	100.0	95.2	100.0
Malaysia	74.6	100.0	59.9	73.8	60.2
Mexico	100.0	100.0	100.0	100.0	100.0
New Zealand	100.0	100.0	100.0	100.0	100.0
Papua New Guinea	100.0	100.0	100.0	100.0	100.0
Peru	36.6	33.4	8.7	36.7	57.5
The Philippines	100.0	100.0	100.0	100.0	100.0
Russia	100.0	100.0	100.0	100.0	100.0
Singapore	100.0	100.0	100.0	100.0	100.0
Thailand	32.3	38.8	71.2	27.5	11.4
United States	100.0	100.0	100.0	100.0	100.0
Viet Nam	100.0	100.0	100.0	100.0	100.0

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.4.2 Share of imported GHG-reducing goods subject to foreign NTMs, by economy and by category (percent)

Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	1.6	2.6	1.1	1.6	1.4
Brunei Darussalam	1.3	2.0	-	1.3	1.6
Canada	1.4	1.8	0.7	1.5	1.3
Chile	4.6	5.3	4.5	4.6	4.3
China	1.5	1.8	0.9	1.5	1.5
Hong Kong, China	0.5	0.6	-	0.5	0.4
Indonesia	1.5	2.7	1.0	1.4	1.2
Japan	3.5	3.6	3.3	3.7	3.0
Korea	3.2	3.6	3.0	3.1	3.1
Malaysia	1.8	2.0	0.7	1.9	2.1
Mexico	1.8	1.8	2.0	1.9	1.7
New Zealand	4.0	4.2	4.1	3.9	4.0
Papua New Guinea	1.6	1.5	0.9	1.5	2.5
Peru	2.2	3.2	1.5	2.1	2.2
The Philippines	1.6	2.0	1.1	1.5	2.1
Russia	1.3	2.3	-	1.4	0.7
Singapore	3.8	4.6	3.1	3.7	3.8
Chinese Taipei	0.6	0.5	-	0.6	0.8

Thailand	3.6	4.3	3.1	3.5	3.8
United States	1.3	1.6	1.6	1.2	1.4
Viet Nam	1.4	1.9	0.5	1.3	1.3

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.4.3 Share of imported GHG-reducing goods subject to NTMs, by economy and by category (percent)

Domestic and Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	100.0	100.0	100.0	100.0	100.0
Brunei Darussalam	59.8	85.3	6.3	57.1	81.8
Canada	100.0	100.0	100.0	100.0	100.0
Chile	93.9	100.0	100.0	91.7	89.0
China	100.0	100.0	100.0	100.0	100.0
Hong Kong, China	14.0	16.5	54.7	7.1	4.5
Indonesia	72.0	88.1	45.1	70.2	80.4
Japan	69.3	88.6	27.5	70.6	80.4
Korea	96.7	96.2	100.0	95.3	100.0
Malaysia	75.1	100.0	60.3	74.3	61.4
Mexico	100.0	100.0	100.0	100.0	100.0
New Zealand	100.0	100.0	100.0	100.0	100.0
Papua New Guinea	100.0	100.0	100.0	100.0	100.0
Peru	38.0	35.6	10.3	38.0	58.2
The Philippines	100.0	100.0	100.0	100.0	100.0
Russia	100.0	100.0	100.0	100.0	100.0
Singapore	100.0	100.0	100.0	100.0	100.0
Thailand	34.8	41.4	72.0	30.0	14.8
United States	100.0	100.0	100.0	100.0	100.0
Viet Nam	100.0	100.0	100.0	100.0	100.0

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

A.5. VALUE OF IMPORTED GHG-REDUCING GOODS SUBJECT TO NTMS, BY ECONOMY

Table A.5.1 Value of imported GHG-reducing goods subject to domestic NTMs, by economy and by category (USD million)

Domestic NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	7,806.1	1,143.7	1,035.7	5,092.6	534.2
Brunei Darussalam	133.7	29.6	4.4	85.8	13.8
Canada	18,391.3	2,146.7	6,374.5	8,742.4	1,127.7
Chile	2,199.9	198.8	115.2	1,672.2	213.8
China	45,661.9	4,873.5	5,739.6	31,266.5	3,782.3
Hong Kong, China	402.7	82.9	313.0	5.2	1.6
Indonesia	3,721.5	809.7	73.9	2,282.2	555.7
Japan	11,411.4	1,898.5	739.5	7,644.5	1,128.9
Korea	15,334.4	1,827.3	1,374.0	11,271.2	862.0
Malaysia	4,562.9	626.0	318.3	3,356.7	261.8
Mexico	18,421.6	2,991.5	3,152.5	10,958.5	1,319.1
New Zealand	1,003.9	95.9	254.8	508.0	145.2
Papua New Guinea	166.0	14.0	7.8	128.1	16.0
Peru	456.1	82.1	52.6	229.1	92.3
The Philippines	2,581.3	222.4	560.7	1,699.3	98.9
Russia	13,808.4	5,895.2	1,919.5	5,064.0	929.8
Singapore	7,266.1	752.2	516.8	5,490.5	506.5
Thailand	2,813.7	730.2	557.2	1,406.9	119.4
United States	83,626.6	9,018.9	20,344.4	50,241.3	4,022.0
Viet Nam	6,088.7	616.5	339.2	4,583.2	549.8

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.5.2 Value of imported GHG-reducing goods subject to foreign NTMs, by economy and by category (USD million)

Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	13.4	9.2	0.1	3.1	1.0
Brunei Darussalam	0.4	0.2	-	0.2	0.0
Canada	8.9	2.6	0.1	5.9	0.3
Chile	48.8	4.2	0.3	29.0	15.4
China	10.5	3.4	0.0	5.3	1.8
Hong Kong, China	0.4	0.0	-	0.4	0.0
Indonesia	6.0	1.1	0.1	3.3	1.5
Japan	33.3	4.6	0.4	24.8	3.6
Korea	153.2	6.3	18.5	121.6	6.7
Malaysia	6.0	1.0	0.0	4.4	0.5
Mexico	5.7	3.2	0.1	2.0	0.3
New Zealand	65.3	11.8	2.7	38.7	12.0
Papua New Guinea	0.2	0.0	0.0	0.1	0.1
Peru	11.5	4.5	0.0	4.0	3.0
The Philippines	2.6	0.1	0.1	2.3	0.1
Russia	14.7	4.0	-	10.3	0.4
Singapore	34.8	3.7	4.7	20.2	6.2
Chinese Taipei	0.0	0.0	-	0.0	0.0

Thailand	68.7	3.6	8.0	53.1	4.0
United States	68.9	12.4	3.9	51.6	1.0
Viet Nam	1.6	0.2	0.0	1.0	0.3

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

Table A.5.3 Value of imported GHG-reducing goods subject to NTMs, by economy and by category (USD million)

Domestic and Foreign NTMs					
Economy	**All categories**	**Air pollution control**	**Cleaner alternatives**	**Renewable energy**	**Waste management**
Australia	7,806.1	1,143.7	1,035.7	5,092.6	534.2
Brunei Darussalam	133.7	29.6	4.4	85.8	13.8
Canada	18,391.3	2,146.7	6,374.5	8,742.4	1,127.7
Chile	2,200.2	198.8	115.2	1,672.2	214.0
China	45,661.9	4,873.5	5,739.6	31,266.5	3,782.3
Hong Kong, China	403.0	82.9	313.0	5.5	1.6
Indonesia	3,721.7	809.9	74.0	2,282.2	555.7
Japan	11,413.7	1,898.5	739.6	7,646.2	1,129.4
Korea	15,334.4	1,827.3	1,374.0	11,271.2	862.0
Malaysia	4,564.2	626.0	318.3	3,357.6	262.2
Mexico	18,421.6	2,991.5	3,152.5	10,958.5	1,319.1
New Zealand	1,003.9	95.9	254.8	508.0	145.2
Papua New Guinea	166.0	14.0	7.8	128.1	16.0
Peru	462.4	82.4	52.6	232.4	95.0
The Philippines	2,581.3	222.4	560.7	1,699.3	98.9
Russia	13,808.4	5,895.2	1,919.5	5,064.0	929.8
Singapore	7,266.1	752.2	516.8	5,490.5	506.5
Thailand	2,870.1	733.3	557.3	1,457.5	122.1
United States	83,626.6	9,018.9	20,344.4	50,241.3	4,022.0
Viet Nam	6,088.7	616.5	339.2	4,583.2	549.8

Note: NTM data is the latest year available for each economy. Trade data is the average of trade during the period 2013–2021. Values marked as "-" are zero, whereas those marked as 0.0 are small values above zero. Data for Chinese Taipei is unavailable.
Source: APEC PSU calculations using data from WITS (https://wits.worldbank.org/), downloaded 9 June 2022.

A.6. SURVEY METHODOLOGY: SAMPLING AND SELECTION PROCESS

The survey sampled 200 qualifying firms across the APEC region.[15] The regional breakdown of these 200 firms follows:

- Australia (n=30)
- China (n=40)
- Mexico (n=30)
- Singapore (n=30)
- Thailand (n=30)
- United States (n=40)

Several considerations factored into the sample selection. Principal among these was the need to compile a sample representative of APEC's 21 member economies. The need for representation was constrained by the need for sufficiently large samples within each market, so that market-level inferences and conclusions could be justifiably drawn.

These considerations shaped the composition of the sample. Regional diversity was realised by selecting at least one economy from each of the following four regions:

- Southeast Asia (Singapore; Thailand)
- North Asia (China)
- Oceania (Australia)
- Americas (Mexico; United States)

While the regional diversity of the sample economies ensured some representativeness, the six-economy sample constrained the extent to which the survey could precisely capture the experiences of all APEC members. The greater weighting for China and the United States (n=40) reflected their larger shares of the environmental goods trade. The estimation of proportional representation was deliberately moderate so that each surveyed economy would deliver significant market-level results.

Further criteria solidified the relevance of each economy and guaranteed representation of different trade structures. Markets selections favoured regions with a high value and volume of trade in APEC's 54 identified environmental goods, and achieved a balance between net exporters (e.g., Singapore) and net importers (e.g., Australia).

Selections also considered the share of manufacturing trade covered by non-tariff measures. Leveraging data from UNCTAD, the sample selection captured economies whose manufacturing sectors are relatively more affected (e.g., China) and less affected (e.g., Thailand) by NTMs.

Emissions intensity also factored into selections. Economies were ranked according to the Emissions Intensity Index, which measures emissions per unit of GDP. Selections reflected a balance of markets with low emissions intensity (e.g., Singapore) and high emissions intensity (e.g., Mexico).

At the firm level, discussions with market research firms and a scoping discussion with the APEC PSU confirmed that firms would be filtered based on whether they were importers, exporters, or two-way traders of environmental goods.

[15] An additional 138 ineligible respondents were filtered out by two 'terminating' questions that preceded the substantive content of the survey. The first filtered out 84 firms who did not qualify for the survey because they did not import or export goods reducing GHG emissions. The second terminating question filtered out 54 additional firms because the respondent did not identify themselves as occupying a management or operational role that would enable them to respond to the survey effectively. Due to resources available, the survey was only conducted in six APEC economies.

Each sector justified its place in the survey with a different rationale. The strength and relevance of the rationale informed the quantity of firms to be targeted from that sector.

Manufacturers (n=130) composed the largest portion of surveyed firms because they produce the environmental goods reducing GHG emissions. The depth and complexity of many manufacturers' supply chains also mean that they often have experience as both importers and exporters.

Transportation and storage services firms (n=30) were included because they are responsible for moving goods reducing GHG emissions between buyers and sellers and are a therefore an important link within GVCs.

Mining, agriculture and forestry firms (n=20) were surveyed because they provide the inputs to manufacturers that produce goods reducing GHG emissions. They are consequently uniquely positioned to capture the upstream portions of the supply chain and identify barriers that may inhibit supply of manufacturers' inputs.

Wholesale trade and construction (n=20) were the final surveyed sectors. Firms in this sector category are the end users of environmental goods reducing GHG emissions, and they can thus comment on NTMs affecting the downstream components of the supply chain.

Where practical, each sector will contain a firm from each economy. In some cases, however, the distribution will be weighted based on the relative size of the sector in each economy. Australia, for example, has a relatively larger mining, agriculture and forestry sector, so Australian firms will be proportionally more represented in that sector. To align with APEC's list of environmental goods, firms in these target sectors will be further categorised into groups composed of goods in the list:

- Renewable energy (generation and storage);
- Transportation;
- Cleaner and more resource efficient products and technologies;
- Management of solid and hazardous waste and recycling systems;
- Air pollution control; and
- Products and technologies that remove emissions from the atmosphere.

The survey, conducted by subcontracting market research firm Rakuten, targeted managers and above, specifically those in trade-exposed roles such as procurement and logistics.

The survey was also designed to accommodate diverse levels of analysis. Beyond high-level analysis of environmental goods across the APEC region, market-level analysis was conducted to inform policy recommendations. On a more granular scale, analysis by good and sector was performed at the APEC level where the sample size was sufficient. Trade exposure and firm size analysis was also conducted at the supranational level, with firms split into those with 200 or more employees, and those with fewer than 200.

A.7. SURVEY QUESTIONNAIRE

Deloitte compiled the content of this survey, and subcontracted Rakuten for coding and distribution. The questionnaire below is not a verbatim transcript of the contents viewed by each firm, but a simplification that balances transparency with clarity for the reader.

Block 1: Filtering Questions	
Question	*Response*
3. Based on the definition below, does your firm export or import environmental goods reducing GHG? This can include both final products or essential intermediate components. The main purpose of **environmental goods reducing GHG emissions** is to either**:** 1. directly reduce GHG emissions 2. directly remove GHGs from the atmosphere.	• Yes • No
4. Within your firm, do either of the following statements best describe your role. • I am a manager (or hold a higher occupational rank) in my firm with responsibilities that include trading internationally. • I am a manager (or hold a higher occupational rank) in my firm with responsibilities within the operations function in my firm.	• Yes • No
Block 2: About your firm	
Question	*Response*
1. Which of the following best characterises your firm's operations?	• My firm exports goods reducing GHG emissions only. • My firm imports goods reducing GHG emissions only. • My firm exports and imports goods reducing GHG emissions.
2. Which of the following categories best describe the sector your firm operates in?	• Manufacturing • Mining, agriculture and forestry • Transportation and storage services • Wholesale trade and construction • Other, please specify
3. [If Manufacturing in (2)] Which of the following categories best describe the industry your firm operates in?	• Renewable energy generation and/or storage • Transportation equipment • Cleaner and more resource efficient products and technologies • Air pollution control • Management of solid and hazardous waste and recycling systems

	• Products and technologies that remove emissions from the atmosphere • Other, please specify
4. Where is your firm headquartered?	Respondents selected from list of all economies
5. What was the total number of full-time equivalent employees in your firm?	• Less than 200 employees • 200 employees or more
6. In the calendar year 2021, which were the three largest market pairs by value between which your firm traded goods reducing GHG emissions?	Respondents selected an origin economy and a destination economy for every pair. At least one had to be an APEC member
7. Please list up to three market pairings where non-tariff measures (NTMs) limited an expansion of trade or resulted in a material reduction in trade in goods reducing GHG emissions.	Respondents selected pairs, which could either come from the previous question or alternates.
8. To what extent do you agree with the following statements?	On a five-point scale from 'strongly disagree' to 'strongly agree': • Over the last 5 years, it has become easier to trade goods reducing GHG emissions • Over the last 5 years, it has become easier to trade goods reducing GHG emissions within the APEC region
9. In the calendar year 2021, which of these goods reducing GHG emissions did your firm trade between the market pairings previously identified?	Respondents used a search bar to select their goods from APEC's list of 54 environmental goods.
10. If you could not find a product that your firm trades on the list in the previous question, please describe that product (or those products) below.	Free text response
11. Which of these goods reducing GHG emissions represent the largest share of your trade in the previously identified markets?	Respondents used a search bar to select from APEC's list of 54 environmental goods
Block 3: Experience with NTMs (exports)	
Question	*Response*
13. In the calendar year 2021, did you face burdensome NTMs [when exporting/in an origin market when importing] goods reducing GHG emissions?	• Yes • No
14. For each of the market pairings previously identified where your firm exports [/imports] goods reducing GHG emissions, what are the top three most burdensome NTMs [/in origin markets]?	Previously selected market pairings listed, and respondents selected most burdensome NTMs for each pairing
15. For each of the unique NTMs identified in the earlier questions, could you explain how such non-tariff measures are burdensome	Free text response for all unique NTMs previously selected

when exporting or importing goods reducing GHG emissions?	
Block 4: Experience with NTMs (imports)	
Question	*Response*
16. In the calendar year 2021, did you face burdensome NTMs when importing goods reducing GHG emissions?	• Yes • No
17. For each of the market pairings previously identified, what are the top three most burdensome NTMs faced when importing goods reducing GHG emissions?	Previously selected market pairings listed, and respondents selected most burdensome NTMs for each pairing
18. For each of the unique NTMs identified in the earlier questions, could you explain how such non-tariff measures are burdensome when exporting or importing goods reducing GHG emissions?	Free text response for all unique NTMs previously selected
Block 5: Identifying enablers of trade	
Question	*Response*
19. In the calendar year 2021, to the best of your knowledge, which of the following policies have been implemented to facilitate trade of goods reducing GHG emissions?	• Implementation of environmental regulations • Alignment of technical regulations and conformity assessment procedures • Greater transparency of domestic measures • Promotion of research and development • Facilitation of patent procedures • Strengthening supply chain resilience • None of the above
20. List up to five markets where these policies have been implemented.	Respondents searched for and listed up to five economies.
21. In the calendar year 2021, did your firm use free trade agreements to export or import goods reducing GHG emissions?	• Yes • No
22. If so, please indicate which free trade agreements your firm most frequently uses to support trade of goods reducing GHG emissions.	Respondents searched and selected up to five from a list of relevant free trade agreements.
23. If not, why?	• Lack of knowledge/information • Costs to utilise are too high • Goods are already subject to low or zero tariff and non-tariff treatment • Other [free text box]

A.8. SAMPLE QUESTIONS FOR INTERVIEWS

Preliminary questions for discussion

1. Could you provide an overview of the types of environmental goods reducing GHG emissions that your firm trades in?
2. Could you give examples of the types of NTMs that you encountered when trading such goods?
3. Which were the most burdensome to your firm and what aspect of the NTMs did you view as the most burdensome for your business? What kinds of costs did these impose on your firm?
4. What regulation and government policies have been implemented to help facilitate trade of goods reducing GHG emissions?
5. Do you use Free Trade Agreements (FTAs) to trade goods reducing GHG emissions and what aspect of FTAs do you find most beneficial to the firm? If not, why not?

Post-presentation questions for validation and discussions

1. Were there any survey results that stood out to you as surprising based on your experiences?
2. Based on the previous chart findings on non-tariff measures, did the results on the most common burdensome NTMs match with your experiences? If not, why?
3. Do you agree with our survey findings that it has become easier to trade goods reducing GHG emissions over the last 5 years? If not, why? Which NTMs have become less/more burdensome over time?
4. What more can governments do to further facilitate trade in goods reducing GHG emissions?

A.9. BURDENSOME EXPORT NON-TARIFF MEASURES, BY FIRM SIZE (PERCENT)

Non-Tariff Measure	All respondents	Small firms	Large firms
Export formalities	24	24	24
Quantity control measures	22	24	22
Export price-control measures	16	16	16
Technical barriers to trade	13	10	13
State owned enterprises	10	10	10
Export subsidies	9	10	9
Re-export measures	6	8	6

Notes: n=200 firms, of which 157 are large and 43 are small. Small firms are those with less than 200 employees while large firms have 200 employees or more.
Source: Deloitte Access Economics.

A.10. BURDENSOME IMPORT NON-TARIFF MEASURES, BY FIRM SIZE (PERCENT)

Non-Tariff Measures	All respondents	Small firms	Large firms
Import formalities	16	16	16
Quantity control measures	14	14	14
Contingent trade-protective measures	14	12	14
Technical barriers to trade	11	11	11
Import price-control measures	10	12	9
Competition measures	7	6	8
Trade-related investment measures	7	4	7
Finance measures	6	7	5
Distribution and post-sales restrictions	5	3	5
Intellectual property	4	7	3
Import subsidies	3	4	3
Rules of origin and related certificate of origin	3	3	3
Government procurement restrictions	2	2	2

Notes: n=200 firms, of which 157 are large and 43 are small. Small firms are those with less than 200 employees while large firms have 200 employees or more.
Source: Deloitte Access Economics.

A.11. BURDENSOME EXPORT NON-TARIFF MEASURE, BY ECONOMY

By income classification (percent)

Non-Tariff Measure	All respondents	High income economies	Upper middle-income economies
Export formalities	24	23	25
Quantity control measures	22	22	22
Export price-control measures	16	15	16
Technical barriers to trade	13	13	13
State owned enterprises	10	11	9
Export subsidies	9	10	9
Re-export measures	6	6	6

Notes: n=200 firms; High income economies covers Australia; Singapore; and the United States while upper middle-income economies cover China; Mexico; and Thailand.
Source: Deloitte Access Economics.

By economy (percent)

Non-Tariff Measure	All respondents	AUS	PRC	MEX	SGP	THA	USA
Export formalities	24	25	21	24	24	33	19
Quantity control measures	22	25	28	13	21	20	17
Export price-control measures	16	14	18	15	18	14	17
Technical barriers to trade	13	14	10	20	9	12	13
State owned enterprises	10	9	8	12	9	9	15
Export subsidies	9	8	11	8	11	7	11
Re-export measures	6	4	5	7	8	6	8

Notes: n=200 firms.
Source: Deloitte Access Economics.

A.12. BURDENSOME IMPORT NON-TARIFF MEASURES BY ECONOMY

By income classification (percent)

Non-Tariff Measure	All respondents	High-income economies	Upper middle-income economies
Import formalities	16	15	18
Quantity control measures	14	15	12
Contingent trade-protective measures	14	15	12
Technical barriers to trade	11	9	13
Import price-control measures	10	11	8
Competition measures	7	7	8
Trade-related investment measures	7	7	6
Finance measures	6	6	5
Distribution and post-sales restrictions	5	5	5
Intellectual property	4	3	5
Import subsidies	3	3	4
Rules of origin and related certificate of origin	3	2	3
Government procurement restrictions	2	2	2

Notes: n=200 firms; High income economies covers Australia; Singapore; and the United States while upper middle-income economies cover China; Mexico; and Thailand.
Source: Deloitte Access Economics.

By economy (percent)

Non-Tariff Measure	All respondents	AUS	PRC	MEX	SGP	THA	USA
Import formalities	16	15	15	19	14	20	15
Quantity control measures	14	18	11	11	11	16	13
Contingent trade-protective measures	14	17	8	15	17	13	11
Technical barriers to trade	11	10	10	12	5	16	10
Import price-control measures	10	11	9	8	11	7	12
Competition measures	7	7	11	5	9	6	5
Trade-related investment measures	7	8	8	7	6	5	6
Finance measures	6	5	5	9	7	3	8
Distribution and post-sales restrictions	5	5	6	4	5	3	5
Intellectual property	4	0	5	1	7	7	3
Import subsidies	3	2	6	3	4	2	4
Rules of origin and related certificate of origin	3	2	3	4	3	2	3
Government procurement restrictions	2	0	2	2	2	2	5

Notes: n=200 firms.
Source: Deloitte Access Economics.

A.13. TOP 5 MARKET PAIR RANKING

Largest origin-destination market pairs of goods reducing GHG emissions, by respondent location (percent)

Respondent Location	Australia	China	Mexico	Singapore	Thailand	United States
Market pairs ranked by share of respondents in that economy that listed the market pair as a top market pair by value of goods traded.	Australia-New Zealand (20)	China-Japan (28)	Mexico-United States (37)	Singapore-Malaysia (23)	Thailand-Hong Kong, China (20)	United States-Canada (43)
	Australia-Canada (13)	China-United States (20)	United States-Mexico (20)	Singapore-Australia (20)	Thailand-Japan (17)	United States-Mexico (25)
	Australia-China (10)	China-Australia (15)	Mexico-Hong Kong, China (13)	Hong Kong, China-Singapore (17)	Thailand-Malaysia (17)	United States-Australia (10)
	Indonesia-New Zealand (10)	China-Hong Kong, China (15)	United States-Japan (10)	Singapore-China (13)	Thailand-China (17)	United States-Hong Kong, China (10)
	Australia-Hong Kong, China (10)	China-Canada (13)	Mexico-Canada (10)	Malaysia-Singapore (10)	Thailand-Australia (17)	United States-Japan (10)
	Australia-Japan (10)		Canada-Mexico (10)	Australia-Singapore (10)		United States-China (10)
	New Zealand-Australia (10)			China-Singapore (10)		
	New Zealand-Hong Kong, China (10)			Singapore-Indonesia (10)		

Notes: n=200; For each economy above, the top 5 market pairs by value of goods traded were listed. However, for Australia; Mexico; Singapore; and the United States, there were more than 5 market pairs shown as there were several market pairs with the same share of respondents that listed as a top market pair by value of goods traded. For completeness, all applicable market pairs were shown.
Source: Deloitte Access Economics.

Perception of firms on the most burdensome origin-destination market pairs of goods reducing GHG emissions, by respondent location (percent)

Respondent location	Australia	China	Mexico	Singapore	Thailand	United States
Market pairs ranked by share of respondents in that economy that listed that market pair as burdensome.	Australia-New Zealand (23)	China-Japan (25)	Mexico-United States (20)	Singapore-Indonesia (20)	Thailand-Malaysia (23)	United States-Canada (30)
	Australia-Canada (20)	China-United States (18)	United States-Mexico (10)	Hong Kong, China-Singapore (13)	Thailand-Japan (23)	United States-Mexico (15)
	United States-Australia (13)	China-Australia (18)	Canada-Mexico (10)	Singapore-Japan (13)	Thailand-Hong Kong, China (20)	United States-Australia (10)
			Mexico-Canada (10)	China-Indonesia (13)	Thailand-China (17)	China-United States (10)
			Japan-Mexico (10)	Singapore-Malaysia (13)	Thailand-Australia (13)	Canada-United States (8)
			Mexico-Hong Kong, China (10)			United States-Korea (8)
						United States-Chile (8)
						United States-Hong Kong, China (8)
						United States-Japan (8)
						Canada-New Zealand (8)

Notes: n=200; For each economy above, the top 5 market pairs that were the most commonly cited as burdensome by respondents were listed. However, for Australia; Mexico; and the United States, there were more than 5 market pairs shown as there were several market pairs with the same share of respondents in that economy that listed the market pair as burdensome. For completeness, all applicable market pairs were shown.
Source: Deloitte Access Economics.

A.14. SHARE OF FIRMS THAT CONSIDERED THESE POLICIES AS ENABLERS OF TRADE IN GOODS REDUCING GHG EMISSIONS, BY SUB-SECTOR (PERCENT)

Policy	All respondents	Renewable energy	Transport equipment	Resource efficient products	Air pollution control	Waste management	Emissions removal
Implementation of environmental regulations	62	71	61	62	84	78	68
Promotion of research and development	50	64	53	70	71	74	51
Greater transparency of domestic measures	48	61	61	54	71	63	51
Alignment of technical regulations and conformity assessment procedures	41	52	56	56	58	56	41
Strengthening supply chain resilience	40	32	36	42	45	22	32
Facilitation of patent procedures	36	52	39	42	48	44	35
None of the above	2	0	3	0	0	0	3

Notes: n=200 firms
Source: Deloitte Access Economics.