Index Insights

Sustainable Investment | Carbon Tax

Cross border carbon & potential carbon border taxes

September 2021

AUTHORS

Guillaume Emin
Senior Sustainable Investment Manager
+33 0 1 87 44 88 92
guillaume.emin@lseg.com

Claire Hugo
Senior Sustainable Investment Analyst
+33 0 1 87 44 88 90
claire.hugo@lseg.com

Introduction

As the topics of climate disruption and carbon emissions rise toward the top of the political and regulatory agenda globally, some moves to impose a price on carbon are likely to impact sections of the economy. This paper assesses carbon border adjustment issues for investors in three steps:

- A description of the context and growing trend toward carbon border tax scenarios;
- Thoughts on implications for financial investment;
- Key data on assets' exposures to the risks and opportunities involved.

Contents

Executive summary 3

Context and growing trend toward carbon border tax scenarios 4

A rising tide of carbon pricing initiatives 4

The underestimated relevance of imported and exported GHG 5

Current dynamics and key global economies 6

Visible trends in the EU and other regions 8

Financial investment implications 11

Impact for investors 11

Overview of potential risks and opportunities 12

The need for scenarios and stress tests 14

Illustrative data on sovereigns and corporates 14

Macro assessments in relation to sovereign risk 14

Sector assessments in relation to macro and corporate risks 16

Appendix 19

Fifty focus countries 19

Geographical and sectoral concentration of GHG exports and imports 21

Exposure to imports and carbon intensity of imports 21

Country carbon intensities and share of exported/imported GHG in carbon exposures 23

Executive summary

Most investors ignore cross-border carbon flows as they concentrate on territorial emissions. However, they may be missing key risks that are becoming more material given current EU plans and other developments.

This paper explores the scenario of potential carbon border taxes and its materiality for investors. Carbon border taxes are becoming increasingly likely, particularly in Europe, as shown by the current work on a Carbon Border Adjustment Mechanism (CBAM) by the European Commission. In addition, recent developments on a global minimum corporate tax illustrate the potential for broader fiscal changes and standardization.

Implications for investors could be material as climate risks are growing, and other regions and countries could adopt similar policies. However, they often do not have the data to undertake detailed analyses. For example, the most common country carbon data are purely based on territorial emissions, which means that they do not include greenhouse gas (GHG) imports (i.e. GHG emitted to produce imported goods and services). In addition, distinguishing between strictly domestic and exported GHG can bring useful information to decision-makers.

The possibility of imposing carbon border taxes (or "adjustments") on imported goods is seriously being considered, particularly within the European Union. This trend is consistent with the development of carbon pricing[1] at the national level and the strengthening of climate policies. It also echoes, to some extent, some recent G20 and OECD developments in relation to global tax standardization and discussions on a global minimum tax on corporates.

In this context, **carbon border taxes represent a material scenario for investors**. Such taxes are aimed at correcting issues of insufficient global or local carbon pricing. Countries and sectors with high carbon intensities could be negatively impacted by carbon tariffs on their exports, while low-carbon economies and sectors could see benefits. Price competitiveness impacts of such mechanisms could lead to macroeconomic shifts in trade flows and affect the competitive position of sectors and companies, depending on the countries where they are located. Applying carbon taxes may partly redefine the international trade landscape.

The potential impacts could be increasingly included in stress-tests given their materiality, particularly for countries and sectors with both high carbon intensities and exposures to exports. Beyond shifts in relative competitiveness, carbon tariffs could also trigger increased energy transition investments, benefitting sectors such as low-carbon energy production, the energy renovation of buildings, public transportation, or energy efficiency in the industry.

Assessing carbon border tariffs is also highly consistent with the need to develop climate scenario thinking and stress tests, which is already a notable and developing trend (e.g. BoE, ACPR, DNB). Although scenario approaches have limits, they can support a better understanding of the macro context and raise awareness of risks: "Thinking about future uncertainty in terms of multiple plausible futures, rather than probability distributions, has implications in terms of the way uncertainty is quantified or described, the way system performance is measured and the way future strategies, designs or plans are developed."[2]

[1] Carbon pricing aims to take into account the environmental costs of climate disruption linked to GHG emitted through fossil fuels consumption. Without a pricing, those costs (or "negative externalities") are borne by society at large and not by the emitter.

[2] Maier et al. (2016). In: Bolton, P.; Després, M.; Pereira da Silva, L.A.; Samama, F.; Svartzman, R. (2020). The green swan – Central banking and financial stability in the age of climate change, BIS.

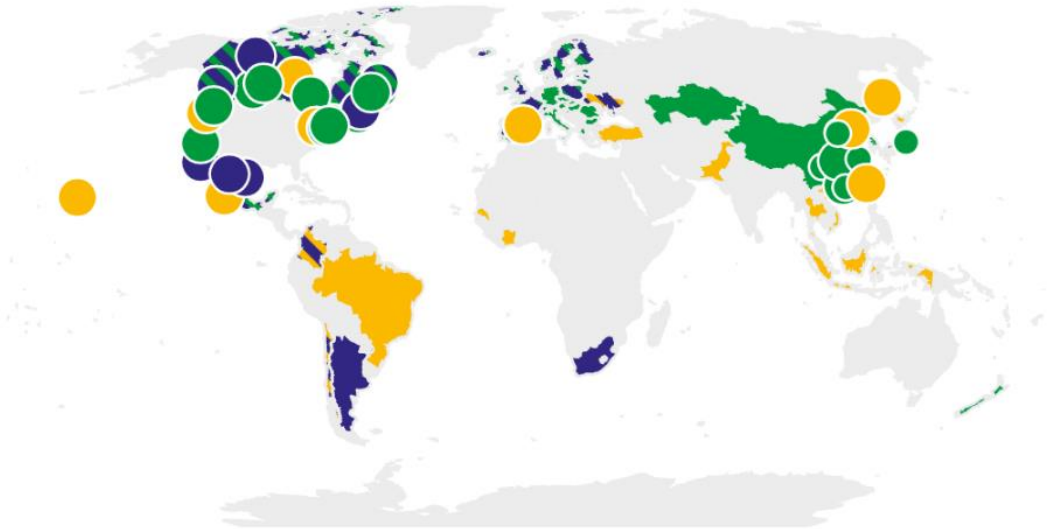
Context and growing trend toward carbon border tax scenarios

This section provides a brief overview of the current global situation regarding potential carbon border tax adjustments. Several aspects contribute to the economic materiality of this scenario for investors, such as the increase in exports in previous decades, or the share of imported GHG in carbon exposures. Independently from these considerations, it is also highly relevant for investors to include imported and exported GHG emissions in their sovereign climate assessments, both in order to evaluate their carbon exposures on a more comprehensive scope and to acquire more risk-related input in their analyses. Carbon border adjustments could indeed have various potential impacts on trade dynamics and country competitiveness positions. In addition, they can also be relevant for sectoral corporate assessments.

A rising tide of carbon pricing initiatives

First of all, the carbon border tax idea takes place in a context of more general development of carbon pricing. Carbon pricing initiatives are gaining traction globally, as detailed in Figure 1, with now more than 60 carbon pricing initiatives implemented or scheduled for implementation in 45 national jurisdictions, covering more than 20% of global GHG emissions.

Figure 1. Summary map of regional, national and subnational carbon pricing initiatives



Source: World Bank (2021).

As described by the World Bank, carbon pricing mechanisms focus today on emissions trading systems (ETS) and direct carbon taxes[3]:

- "An ETS – sometimes referred to as a cap-and-trade system – caps the total level of greenhouse gas emissions and allows those industries with low emissions to sell their extra allowances to larger emitters. By creating supply and demand for emissions allowances, an ETS establishes a market price for greenhouse gas emissions."
- "A carbon tax directly sets a price on carbon by defining a tax rate on greenhouse gas emissions or – more commonly – on the carbon content of fossil fuels."

As described by the World Bank, such mechanisms allow to: "capture what are known as the external costs of carbon emissions […] and tie them to their sources through a price on carbon."

Beyond the share of emissions covered by carbon pricing initiatives, the level of carbon prices is also an important aspect. Carbon pricing remains relatively heterogenous across countries and regions[4], resulting in potential competitive disadvantages in areas in which prices are higher, particularly for activities with high carbon exposures. However, carbon border taxes can represent a tool to support more convergence in global carbon pricing[5].

The underestimated relevance of imported and exported GHG

In many countries, the share of imported GHG emissions is significant, hence the need to include this scope to avoid underestimating carbon exposures.

As described in Figure 2, imported GHG emissions (*i.e.* GHG emitted to procure imported goods and services) account for more than 20% of territorial and imported GHGs in seven of the 10 main global economies. However, imported GHG emissions are seldom included in common carbon databases or policy commitments such as NDCs (Nationally Determined Contributions). Hence, there is a strong risk for investors to underestimate their carbon exposures if they do not use data incorporating GHG imports.

Regarding territorial emissions, it is important for investors to be able to distinguish between the purely domestic and the exported GHG exposures of their sovereign assets, as these segments can be exposed to different types of risks. In particular, exported emissions could be liable to carbon border tax risks.

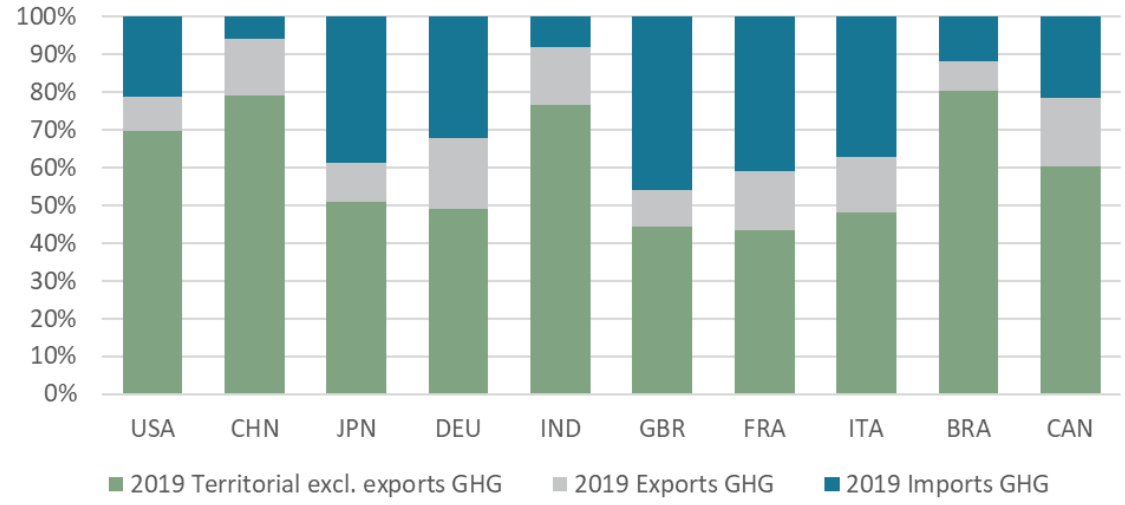
The weight of GHG imports and exports can reflect structural aspects. For example, in developed countries and regions such as Europe, the dynamics of these segments can be indicative of the de-industrialisation impacts in previous decades. This has important consequences on the capacity of countries to reduce these emissions given their economic dependencies on imports. Overlooking carbon imports can, thus, lead to underestimating structural dimensions of country carbon profiles and climate risk exposures.

[3] World Bank. Pricing Carbon. (Consulted on 20th July 2021).

[4] OECD. (May 2021). Effective Carbon Rates 2021.

[5] EURACTIV. (July 16, 2021). Climate-focused investors give warm welcome to EU masterplan.

Figure 2. Breakdown of [Territorial + Imported] GHG emissions for top 10 global economies by GDP



Source: Beyond Ratings & FTSE Russell.

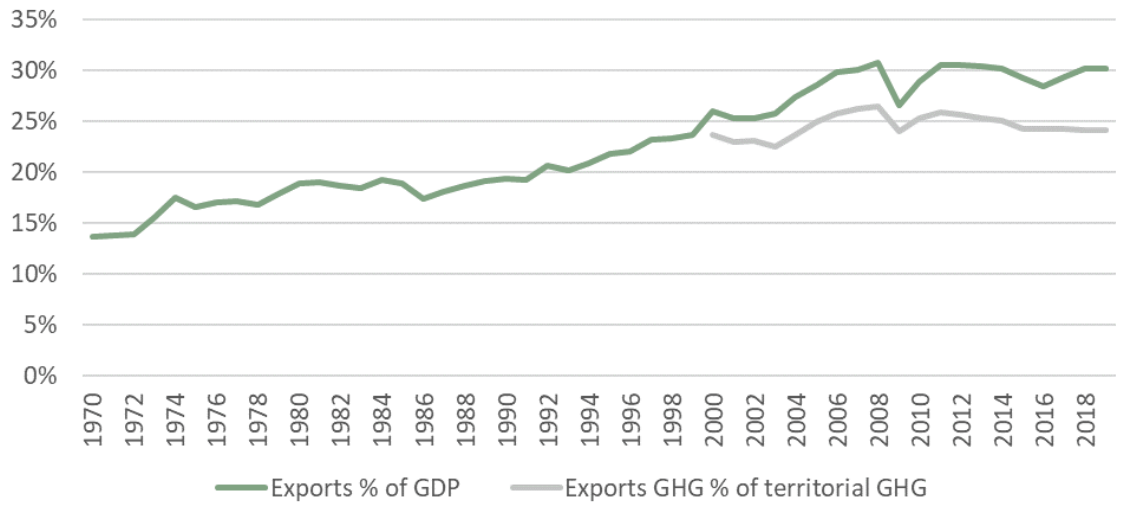
Therefore, it appears important that investors integrate more exports and imports GHG data into their analyses, to access a more comprehensive representation of their climate risk exposures and also to have adequate information to assess scenarios such as potential carbon border taxes.

Current dynamics and key global economies

The significance of imported and exported GHG emissions can be highlighted by historical and current dynamics. This is also one of the elements that explains why scenarios of potential carbon tariffs deserve attention.

The carbon border tax scenario is a growing trend in a context characterized by a significant increase of exports in global GDP in recent decades. Figure 3 shows that exports now account for 30% of global GDP, which is only slightly above the current 25% share of exported GHG, in total GHG.

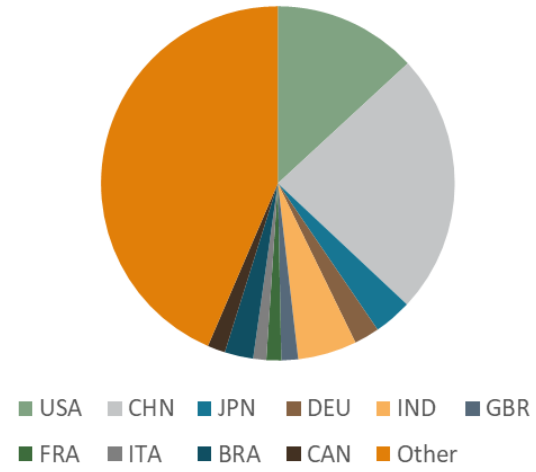
Figure 3. Share of exports in global GDP and share of exported GHG in territorial GHG



Source: Beyond Ratings & FTSE Russell.

Some countries are particularly important in this context. As described in Figure 4, most of today's GHG emissions are concentrated in a limited number of countries, with the top 10 global economies (by GDP) accounting for more than 50% of exposure to 2019 [Territorial + Imported] GHG emissions[6].

Figure 4. Breakdown of global 2019 [Territorial + Imported] GHG exposures



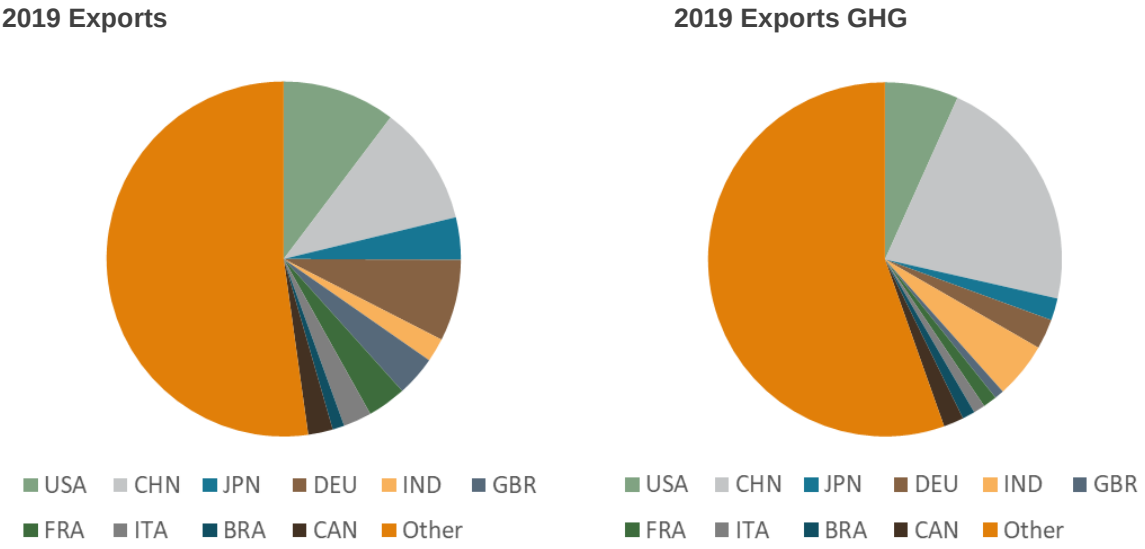
Source: Beyond Ratings & FTSE Russell.

This high concentration of emissions in a relatively limited number of countries can also be observed, based on exports and imports values as well as the carbon contents of country exports and imports. The US and China are by far the main global emitters and importers of emissions.

[6] Based on total territorial GHG emissions including exports.

However, it can be observed in Figure 5 that the distribution of exports GHG is different from the breakdown of export values, with a particularly high share of China, accounting for an estimated 20% of the global total.

Figure 5. Breakdown of the value and GHG emissions of 2019 exports



Source: Beyond Ratings & FTSE Russell

The above results and the specific case of China reflect the fact that the breakdown of [Territorial + Imported] GHG exposures differs between countries. The share of exported GHG is for example significantly higher in China compared with the US. It can also be noted that, although the weight of territorial GHG in [Territorial + Imported] exposures tends to be similar across the main European countries, it tends to be higher in the developing countries covered in the global top 10 (China, India, Brazil) and, to a lesser extent, in the two countries of the scope that present the highest levels of GHG per capita (US and Canada).

Visible trends in the EU and other regions

The data help to measure the significance of exported and imported GHG emissions and show the need to integrate them further in climate analyses. However, the growing financial materiality of this subject also involves policy developments. Although cross-border carbon volumes have long been a rarely discussed issue, fiscal policy discussions in the EU and other regions show that this could become a key item in global trade and commercial policy evolutions.

Concrete policy developments in the EU

Carbon border taxes are associated with uncertainties as to both their probability and their implications, but they should be regarded as credible scenarios.

This is particularly the case in the European Union. In 2019, EU Commission President-designate Ursula von der Leyen stated that a carbon border adjustment would be part of her policy for the EU: “I will introduce a Carbon Border Tax to avoid carbon leakage.”[7] This move took place in a context of strengthening support for such fiscal policies. While countries like France and Italy had

[7] von der Leyen, U. (2019). A Union that strives for more - My agenda for Europe.

already supported this idea in the public debate – as illustrated several times by French President Emmanuel Macron[8] – the scope of countries endorsing such a mechanism has also progressively broadened[9].

Mrs. von der Leyen then asked several EU Commissioners[10] to design an applicable proposal and in July 2020, the EU Commission opened a public consultation on the considered new mechanism[11]. This instrument would apply, on imported products, the carbon pricing in force on the same emission-intensive European products, with several possible ways to structure it.

In March 2021, the European Parliament confirmed its support for the Carbon Border Adjustment Mechanism (CBAM) "provided that it is compatible with WTO rules and EU free-trade agreements (FTAs)" and that its objective is to "support the EU's green objectives, in particular to better address GHG emissions embedded in EU industry and in international trade."[12] A couple of weeks later, ministers from nine European countries – Austria, Czech Republic, Denmark, France, Lithuania, Luxembourg, Slovakia, Spain and the Netherlands – also expressed their support for a CBAM[13].

CBAM as part of the new European Commission 'Fit For 55' legislative package

The European Commission presented on the July 14, 2021, the "Fit for 55" legislative proposal, composed of interconnected policy initiatives intended to enable the EU to reach its objective of at least 55% GHG emissions reduction compared to 1990 levels by 2030, before going entirely carbon neutral by 2050[14]. These proposals must now be examined separately by the Council and the European Parliament, and then negotiated by the two co-legislators during a trialogue phase, which could take one to two years.

As one of the proposals, the CBAM's purpose would be to prevent carbon leakage by imposing on "EU importers to buy carbon certificates corresponding to the carbon price that would have been paid, had the goods been produced under the EU's carbon pricing rules. Conversely, once a non-EU producer can show that they have already paid a price for the carbon used in the production of the imported goods in a third country, the corresponding cost can be fully deducted for the EU importer."[15] In practice, the price of the carbon certificates would mirror that of EU ETS allowances, based on the weekly average auction price.

The CBAM would be implemented progressively, starting with a set of selected EU imports – electricity, iron and steel, cement, fertilisers, and aluminium – all sectors that are among the highest CO2 emitters. During a three-year transition period, starting from 2023, importers would have to report the amount of emissions linked to imported goods. At the end of this period, the European Commission would evaluate whether to extend the number of items covered by the CBAM or the scope of emissions, for example to potentially include 'indirect' emissions. Financial adjustments on importers would begin in 2026, with a gradual reduction in free EU ETS

[8] Simon, F. (2018). France to push for EU carbon price floor and border tariff, EURACTIV; some level of political consensus can be observed in France on this idea: Barbière, C. (2019). Most French parties agree on carbon tax at EU's borders, EURACTIV.

[9] See for example: Reuters Staff (2019). Spain proposes EU carbon tax on energy imports, Reuters.

[10] Including economic chief Paolo Gentiloni, energy boss Kadri Simson and trade Commissioner Phil Hogan.

See: Morgan, S. (2020). Moscow cries foul over EU's planned carbon border tax. EURACTIV.

[11] European Commission. Published initiatives, EU Green Deal (carbon border adjustment mechanism) (Consulted in October 2020).

[12] European Parliament (2021). A WTO-compatible EU carbon border adjustment mechanism.

[13] Blümel, G.; Gewessler, L. ; Schallenberg, A.; Wammen, N.; Le Drian, J.-Y.; Le Maire, B.; Pompili, B.; Gentvilas, S.; Gramegna, P.; Dieschbourg, C.; Heger, E.; Calviño, N.; Vijlbrief, H.; Van't Wout, B.; Petříček, T.; Kofod, J.; Jørgensen, D.; Hoekstra, W.; Asselborn, J. and Ribera, T. (2021). To fight climate change, fight carbon leakage, Politico.

[14] European Commission. (July 14, 2021). Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Fit for 55': delivering the EU's 2030 climate target on the way to climate neutrality. Brussels.

[15] European Commission. (July 14, 2021). Proposal for a Regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism. Brussels.

allowances until they are completely phased out in 2035. The pace of this reduction is expected to be one of the main debates in the Council and Parliament and then in the trialogue phase.

In the meantime, the CBAM would apply only to the proportion of emissions that does not benefit from free allowances, ensuring an equal price of carbon between importers and domestic producers, and WTO compatibility in this context. The CBAM would be managed by competent national authorities, and revenues could contribute to the EU's budget.

Although the CBAM proposal will continue to be further discussed, it has received some positive reactions. In addition, some investors support policy developments toward a global price of carbon[16], and the CBAM can be used as a tool in this context.

Notable interest in other regions

Carbon border tariffs have been considered in other regions beyond the EU. In January 2019, for example, more than 3,500 economists in the US backed carbon tariffs on key imports[17] (including 27 Nobel laureates, four former Chairs of the Federal Reserve, and two former Treasury Secretaries), before a similar call by European economists followed in June 2019[18]. Canada and Japan are planning initiatives, similarly to California, where an adjustment is applied to certain imports of electricity[19]. Significantly, it can also be noted that the IMF expressed public support in September 2020 to the EU's plan to introduce a carbon border tax mechanism[20].

At the political level, in 2017, various US Republican leaders had supported border carbon adjustments in "The conservative case for carbon dividends"[21]. Following a campaign promise, the Biden's administration is also exploring the border adjustment mechanism, such as taxing imports from countries with less stringent climate policies. This was confirmed in April 2021 by John Kerry, the White House special envoy for climate[22].

A widening consensus with broad economic consequences

In addition, support to carbon border taxes also sometimes comes from the industry, as illustrated by ArcelorMittal's proposal in 2019[23], which moreover reflects the potential for development of such schemes beyond regional legislation. Last but not least, support to the mechanism has also sometimes been expressed by citizens[24].

[16] EURACTIV. (July 16, 2021). Climate-focused investors give warm welcome to EU masterplan.

[17] Turner, A. (2019). The Case for Carbon Tariffs, Project Syndicate.

[18] Strauss, D. (2019). EU economists call for carbon taxes to hit earlier net zero goal, Financial Times.

[19] European Commission. (2021). Carbon Border Adjustment Mechanism: Questions and Answers.

[20] Gerretsen, I. (2020). IMF endorses EU plan to put a carbon price on imports, Climate Home News.

[21] Baker J.A.; Feldstein, M.; Halstead, T.; Mankiw, N.G.; Paulson, H.M.; Shultz, G.P.; Stephenson, T.; Walton, R. (2017). The Conservative Case for Carbon Dividends. Climate Leadership Council.

[22] Natter, A.; Dlouhy, J.A. and Westin, D. (2021). Biden Exploring Border Adjustment Tax to Fight Climate Change. Bloomberg.

[23] Lewis, B. and Twidale, S. (2019). ArcelorMittal says carbon border levy is just the start to greener steel. Reuters.

[24] As in the 2020 French Citizens convention for ecological transition, convened by the French public authorities. Final proposals of the convention included "carbon adjustment at EU borders (based on carbon footprint) and consideration of redistribution issues to avoid burdening the least advantaged households". Citizens' convention for ecological transition: https://www.conventioncitoyennepourleclimat.fr/ (Consulted in October 2020).

Despite uncertainties[25], scenarios in which international trade prices would be readjusted by carbon exposures could have a high level of materiality. In this context, macro-financial and sovereign analysis should closely consider such scenarios.

This approach is relevant at the EU level but also more broadly. Not only does the interest in such mechanisms extend beyond Europe, but implementation of such a tax at EU borders could also prompt other regions and countries to consider similar schemes more seriously. Awareness of the impact of imported goods' GHG emissions is also growing, with increasing recognition of the limits of traditional territorial measurements. Lastly, the issues stemming from the COVID-19 pandemic are still calling for strong economic policy action, which could continue to stimulate resorting to new unconventional policy tools.

It can also be noted that, even when climate change mitigation was not in the political agenda, some redefinition of international trade relations has been observed, as for example in the case of the US and China's relationship under the Trump presidency. Carbon border adjustments could, thus, gain further traction for various reasons—they represent a policy tool that will probably become increasingly considered and deserves close attention from investors. In the recent period, in June 2021, IMF analysis suggested adopting an international carbon price floor (ICPF). This mechanism would include a group of large emitting countries and negotiations would focus on setting an acceptable minimum carbon price to which they would all commit[26].

Financial investment implications

Impact for investors

Some countries' exports could become less competitive because of carbon-intensive energy mixes, poor energy efficiency of their industrial systems, or their strong reliance on highly carbon-intensive sectors and products. It is therefore in the investors' interest to assess countries based on indicators such as the weight of exports in an economy or the greenhouse gas (GHG) emissions intensity of its exports.

Carbon border taxes may lead to shifts in the economic structure of countries and in corporate investment decisions. Such schemes could support investment toward energy efficiency improvements in the industry, or low-carbon power production capacities, or in countries and regions that already benefit from a low carbon intensity of the economy and the energy mix. Countries and sectors with high carbon intensities could, however, become less competitive on exports, and therefore less attractive for investors.

Investment stress tests are another channel through which carbon tariff scenarios could affect investors. As scenario analysis and stress tests expand in the financial sector (*e.g.* TCFD, Bank of England, French ACPR, ECB supervisory expectations, etc.), investment stress tests are expected to develop accordingly. Carbon border adjustments represent a type of risk that could become more material in these assessments.

[25] In part related to the challenges linked to the design of border adjustments: e.g. technical feasibility, data availability, risk of retaliation from some countries, compatibility with World Trade Organization rules, etc.

See for example: Rocchi, P.; Serrano, M.; Roca, J.; Arto, I. (2017). Border Carbon Adjustments Based on Avoided Emissions: Addressing the Challenge of Its Design, Elsevier.

[26] Parry, I., Black, S., and Roaf, J. (2021). Proposal for an International Carbon Price Floor among Large Emitters. IMF Staff Climate Notes 2021/001, International Monetary Fund, Washington, DC.

Overview of potential risks and opportunities

Assessing carbon tariffs impacts for investors in scenario analyses and stress tests requires taking a number of macro risks into consideration. Potential risks at stake straddle various dimensions, including the following factors:

- Price competitiveness (potential tax impacts);
- Pricing power and price-elasticity of demand;
- Redistributive aspects of fiscal mechanisms (*e.g.* management of social risks related to carbon pricing);
- Intensity of the exposure to exports and imports (*e.g.* share in GDP);
- Potential supply chain impacts (availability of alternatives, price and costs, possible level of diversification);
- Geopolitics (potential impacts on geopolitical relationships, potential links to climate-related international foreign aid);
- Energy independence (potential factor of resilience) but also independence on other key categories of supply; or
- The nature of products and services sold: for example, some sectors are more likely to be exposed to potential carbon tariffs, and some products and services could become increasingly restricted independently from carbon tariffs issues (*e.g.* SUVs or airline flights[27]).

Material impacts on sovereign and corporate assets

The analysis of carbon border adjustments is material for sovereign investors, as such policies could contribute to reshuffling cards between countries, regions and sectors in the global economy, translating into impacts on investors' assets valuation. In addition, said policies would be material for the long-term financial analysis of corporates, particularly in some concentrated and carbon-intensive sectors that are significantly exposed to exports (*e.g.* steel and other similar materials, capital goods, automotive, etc.). In this context, the analysis should be conducted at the sector level and by taking into account specific companies' positions and value chains (*e.g.* competitive advantages, supply chain exposures, etc.).

Both for companies and countries, the analysis of the carbon intensity of traded goods and services should be a starting point rather than the only metric for assessing risks and opportunities. It is certain that carbon border adjustments would result in some trade adjustments as well as changes in economic structures, given that such policies target the development of less carbon-intensive economic production. However, as described above, other factors can drive country, sector and company-specific impacts of carbon tariffs, with various potential implications on assets valuations.

Opportunities

In this regard, carbon border adjustments can also be linked to opportunities. This is the case not only for countries and companies offering good levels of carbon performance, but also in relation with the potential development of green economic activities and exporting capacities (*e.g.* energy renovation of buildings, railway, public transportation, energy efficiency in the industry, or low-

[27] See for example the terms of the French aid package for Air France, according to which the airline company should cut flights when an alternative rail journey exists not exceeding two and a half hours. (per Morgan, S. (2020). France's short-haul flight ban to target low-cost flyers, EURACTIV.)

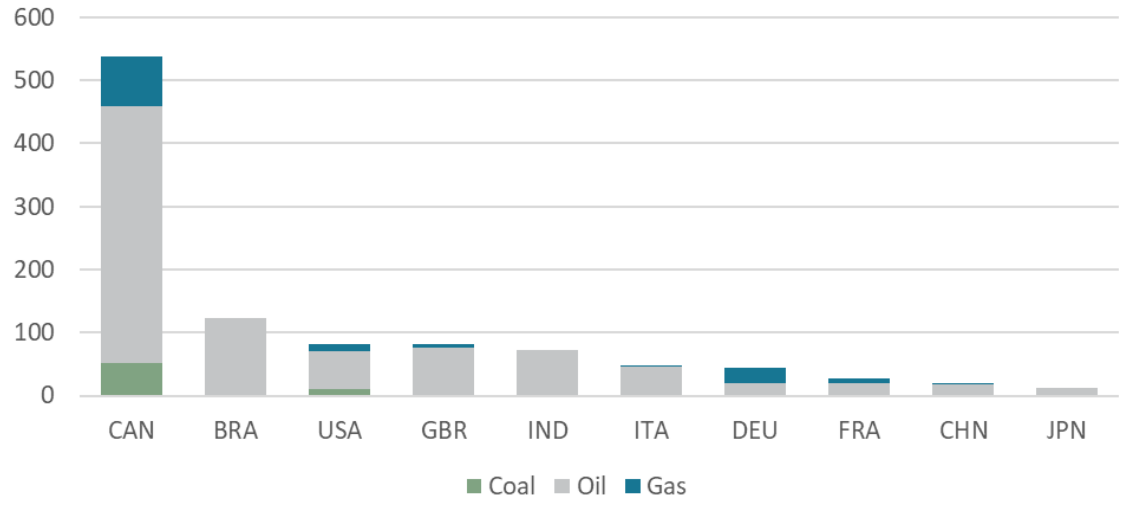
carbon energy production). Such activity segment could be associated with having a strong competitive advantage in international trade, therefore improving the economic outlook for some financial assets. Even if they can also induce GHG emissions, green products and services would indeed benefit from strong competitive advantages in the decarbonization of economies, and they can represent a significant growth opportunity for investors.

Regarding carbon performance, although international carbon pricing at country or regional borders would have trade impacts, it could also represent opportunities by stimulating green investment in impacted countries and, thus, by supporting improvements of their climate resilience and induced investments (see details in the appendix on green products and services).

Fossil fuel trade

Lastly, it should be noted that the carbon intensity does not fully reflect risks associated with fossil fuels exports. These exports can already be carbon-intensive because of production emissions. However most emissions related to fossil energy occur in the importing and consuming country. This is also a dimension to consider when assessing the potential international impacts that would result from a deeper integration of climate considerations into international trade. Investments in countries with a high reliance on fossil fuel reserves could be exposed to growing sovereign and country risks, particularly when they present low levels of diversification. As described in Figure 6, based on the GHG emissions of fossil fuel exports from the 10 main global economies, Canada has particularly significant reserves and is more exposed to such risks than other nations. Nonetheless, it should also be noted that it has a relatively diversified economy compared with a number of large energy producers (10% share of the energy sector in the country's GDP[28]).

Figure 6. Potential GHG emissions of 2019 fossil fuel exports for top 10 global economies by GDP



Source: Beyond Ratings & FTSE Russell.

Note: GHG/GDP in tCO2e / USD million

In summary, the development of carbon tariffs is a scenario to consider in the fundamental analysis of both sovereign and corporate assets. It is associated with uncertainties, as illustrated

[28] Government of Canada. Energy and the economy. (Consulted on August 13, 2021).

for example by the 2019 trade deal between the EU and Mercosur[29], and related debates as to how environmental considerations should have been taken into account in this context. If climate issues are further integrated in future policies and trade, there will be losers and winners, as well as capital reallocation needs, with country and sector implications. Such changes could be more or less gradual or sudden, strong or moderate, but they would be economically meaningful. To some extent, such risks and opportunities can already be anticipated.

The need for scenarios and stress tests

The development of carbon border adjustments remains recent or tentative, and there are also uncertainties as to how they would be precisely implemented and what their impacts would be. This situation calls for scenario and stress test approaches in assessing the risks and opportunities involved.

Scenario analysis can help to go beyond "traditional backward-looking risk assessment models that merely extrapolate historical trends" but which also "prevent full appreciation of the future systemic risk posed by climate change." Uncertainties and challenges are significant, so that "no single model or scenario can provide a full picture of the potential macroeconomic, sectoral and firm-level impacts caused by climate change"[30]. However, even though they are only a "partial solution," scenarios such as carbon tariffs can contribute to a better understanding of the potential non-linear impacts of climate risks and policies on financial assets.

Indeed, potential carbon tariffs require to think more in terms of possible sudden shifts or shocks. This could lead, for example, to better taking into consideration the rationale and qualitative dimensions of risks for the calibration of quantitative assessments, or to further integrating structural fundamentals into the evaluation of assets. Scenarios are an appropriate framework to this end. Climate scenarios other than carbon tariffs can be relevant, but the latter could clearly become a game-changer in the event of ambitious policy action. In addition, scenarios allow to take into account the complexity of possible pathways, as they can potentially reflect the uncertainties at stake (*e.g.* unpredictable political choices), the strong limits of trying to estimate averages between very different future potential pathways, and the complex interrelations between climate risks and dimensions such as socio-political factors, or even between scenarios themselves. Such scenarios can help reinforce investors' long-term approaches to risk management.

Illustrative data on sovereigns and corporates

Macro assessments in relation to sovereign risk

To illustrate the risks, it is important above all to assess the implications of potential carbon border taxes at a macro level. Countries with both high levels of exports and high carbon intensities of their exports could be particularly at risk. It can be noted that macro risks could also materialize in relation with imports' exposures, geographical and sectoral concentration aspects (see appendix), or the energy resilience and structure of countries' energy mixes. Still, exposure to exports and the carbon intensity of exports are key indicators.

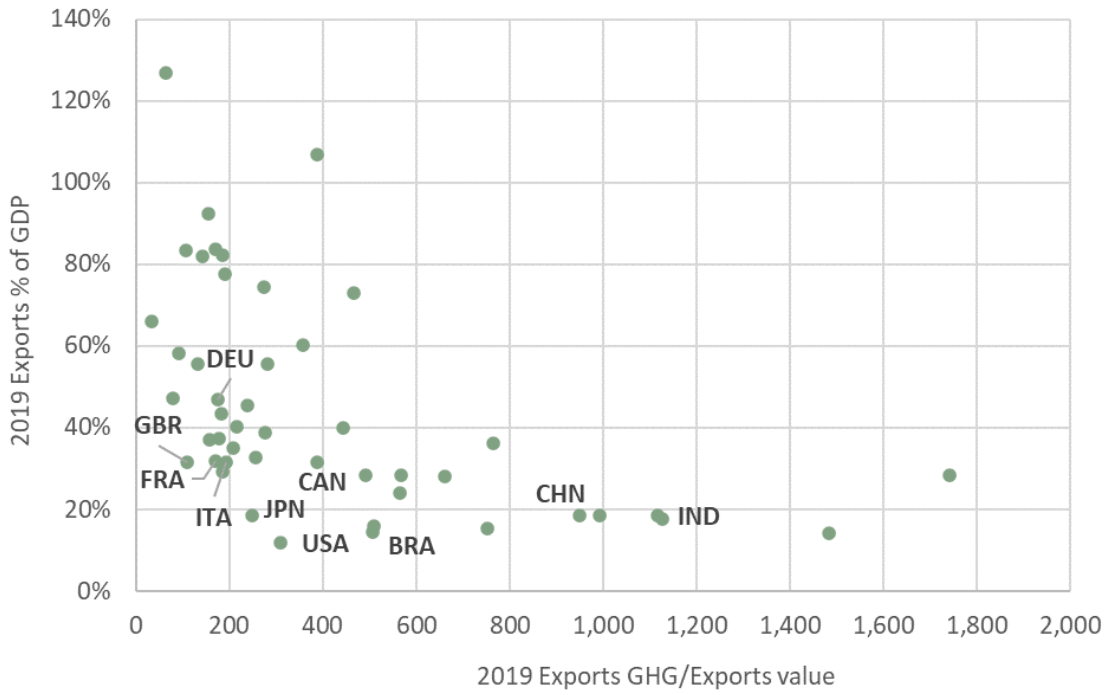
[29] Brunsden, J. (2019). EU and South American bloc reach trade deal to cut tariffs, Financial Times.

[30] Bolton, P.; Després, M.; Pereira da Silva, L.A.; Samama, F.; Svartzman, R. (2020). The green swan – Central banking and financial stability in the age of climate change, BIS.

Figure 7 presents the GHG content of exports (by unit of exports value) and the size of exports in the economy (in % of GDP) for 50 focus countries (see Appendix for the criteria in retaining those larger economies). The positions of countries appear to be diversified in both indicators.

- For example, Germany has a notable exposure to exports (47% of GDP), but the average carbon intensity of its exports tends to be relatively moderate (176 tCO2e / USD million of value), in line with other European countries like France or Italy.
- In comparison, countries like the US or Canada present higher carbon intensities of exports (respectively 309 and 389 tCO2e / USD million), which in the case of Canada is combined with a relatively significant exposure to exports in the economy (32% of GDP).
- Developing countries like China or India present even higher carbon contents of exports, reflecting various factors such as energy mix aspects or the value added generated by their exports based on current terms of trade.

Figure 7. GHG content of exports and exports/GDP ratios for the study's 50 focus countries



Source: Beyond Ratings & FTSE Russell.

Note: GHG/Exports value in tCO2e / USD million. Three countries are not shown due to high values, i.e. Pakistan (3,530 tCO2e / USD m and 10% values), Ethiopia (15,429 tCO2e / USD m and 8%) and Luxembourg (36 tCO2e / USD m and 209%).

It should be noted that Figure 7 does not include information on the level of carbon pricing. That dimension should also be considered in the case of more developed analyses of exposures and risks. For example, carbon pricing tends to be higher in Europe than in other areas. This could mitigate the risk exposure of European activities and exports in a scenario of increased convergence toward more homogenous carbon pricing globally.

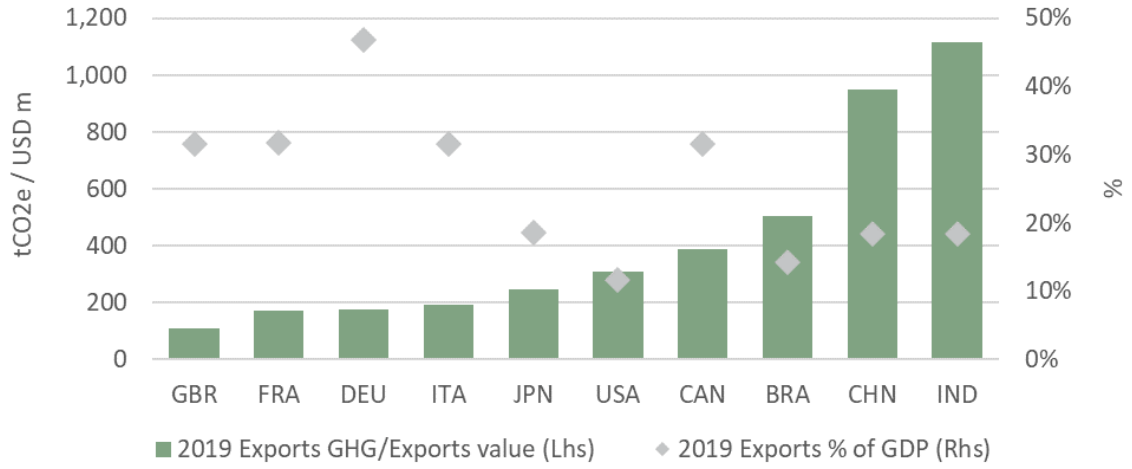
Most of the countries with the highest exposures to exports (above 60% of GDP) have relatively moderate levels of carbon intensity of exports compared with other countries, which mitigates

their risks. The two countries within this category with the highest carbon intensity of exports are Estonia (466 tCO2e / USD million) and Vietnam (387 tCO2e / USD million).

However, even when the size of exports is below 60% (*e.g.* Germany) or 40% (*e.g.* UK, France, Canada, China) of GDP, carbon border adjustments could have material impacts. Many countries have a share of exports between 10% and 40%, which corresponds to a material exposure, where the dispersion of GHG/exports value ratios is significant. Within this segment, it can be noted that countries beyond a threshold of 400 tCO2e / USD million of exports (based on the above scope), are almost all emerging markets. This illustrates the specific risks that these countries could face given the carbon-intensive positioning of their exports. With a 24% exports/GDP ratio and a carbon intensity of exports around 564 tCO2e / USD million, Australia[31] is a specific case and appears to be exposed to risks similar to Canada's.

Based on the 10 main global economies, Figure 8 highlights that, except in the case of Canada, countries with high carbon intensities of exports tend to have lower economic exposures to exports as a % of their GDPs than countries such as the United Kingdom, France or Germany. In this context, countries with a high exposure to the two dimensions of this assessment are relatively specific cases, and no country presents an extreme exposure to the two dimensions, although a high exposure to only one of these two aspects is sufficient to lead to material risks.

Figure 8. GHG content of exports and exports/GDP ratios for top 10 global economies by GDP (sorted by GHG/exports value ratios)



Source: Beyond Ratings & FTSE Russell.

Note: GHG/Exports value in tCO2e / USD million.

Sector assessments in relation to macro and corporate risks

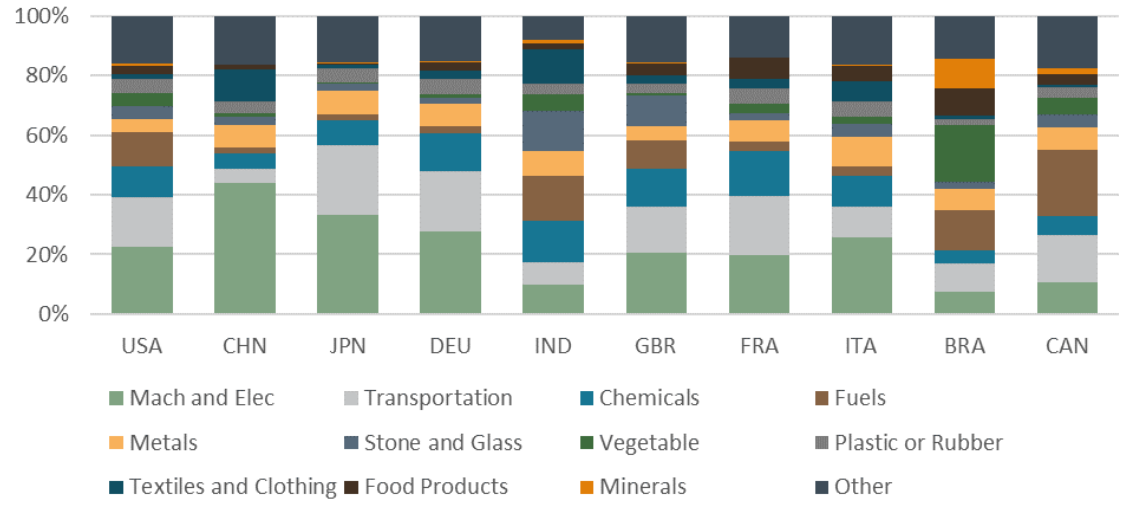
Sector exposures

It is also relevant to assess risks at the sector level, although this paper does not analyse these aspects in detail. As detailed in Figure 9, the sector breakdown of exports can strongly vary across countries, with various potential implications involving sectors' strategic characteristics such as their carbon intensities, likelihood of potential sectoral carbon tariffs, negotiating power with suppliers and customers, etc.

[31] Beyond the top 10 global economies identified on Figures 7 and 8.

The breakdown of exports by sector (in value) is shown in Figure 9 for the top 10 global economies by GDP. For example, the share of machinery and transportation tends to be significant overall.

Figure 9. 2018 breakdown of exports by sector in the top 10 global economies by GDP

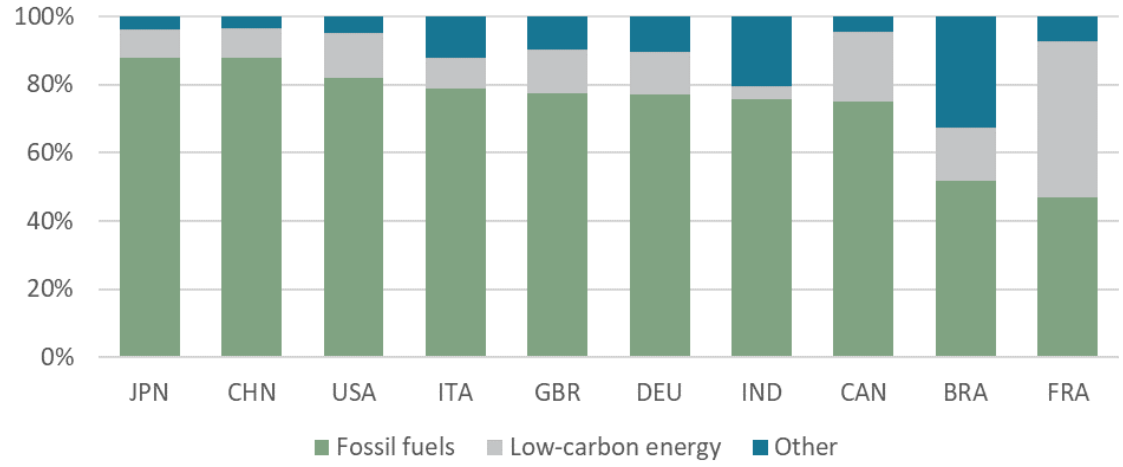


Source: Beyond Ratings & FTSE Russell, based on World Bank's World Integrated Trade Solution.

Exposures to fossil fuels

To assess sectors, it is also relevant to take into consideration exposure to fossil fuels. For example, the share of fossil sources in electricity can significantly vary across countries. This also highlights the competitive edge that low-carbon energy mixes can provide to countries and their companies.

Figure 10. 2019 fossil fuels' share in primary energy use for top 10 global economies by GDP



Source: Beyond Ratings & FTSE Russell.

Note: The "other" segment corresponds to biomass and power trade.

Green products and services

Sectoral analysis also calls for assessments of exposures to green products and services. Carbon intensities have limitations in assessing the resilience and strategic importance of exporting economic activities. This may be because the availability of alternative products in some sectors is limited and/or price elasticity is low, so that carbon border adjustments would not necessarily have a strong impact. It can also reflect the fact that some products have significant carbon footprints but are also strongly in line with the needs of low-carbon scenarios.

For example, buildings' insulation products, railway equipment or low-carbon energy infrastructure can be carbon-intensive to produce given the industrial processes, but they are also much needed to address energy transition challenges. Countries' and corporates' positions in such industries could be more resilient than in other sectors from the perspective of carbon border adjustment risks, even if these sectors could also be exposed to potential carbon pricing impacts.

FTSE Russell has developed an extensive database of green revenues for a significant number of listed companies[32]. At the country level, Eurostat has developed data on value added from the environmental goods and services sector[33]. Figure 11 shows the share of this sector's value added in total GDP in Europe, including details on the share of exports in this value added. This breakdown illustrates an interesting complementary analysis to carbon intensities, with differentiating results across countries, although the share of environmental goods and services tends to still be relatively moderate overall.

Figure 11. Share of the environmental goods and services sector in the 2018 value added (VA) of top 10 EU countries

Source: Beyond Ratings & FTSE Russell.

Note: Based on total environmental protection and resource management activities (*e.g.* waste management, management of energy resources, etc.)

[32] FTSE Russell, Green Revenues 2.0 Data Model.

[33] Eurostat, Environmental economy – statistics by Member State. Please note that activities like public transports, for instance, are not included in the scope of Eurostat's Environmental economy.

Appendix

Fifty focus countries

In some cases, the present study has focused on 50 large economies, based on the combination of the following criteria:

- largest countries by GDP, up to an 80% share of the world's total;
- largest countries by government debt up to an 80% share of the world's total;
- largest countries by population up to a 66% share of the world's total.

Fifty countries are selected on this basis. They cover about 90% of global GDP, 95% of government debt, and 75% of population based on 2019 data, as well as about 80% of territorial greenhouse gas (GHG) emissions. In addition, all the 37 OECD countries are included in this scope.

The full list of these 50 countries is itemized below. In some cases, we present results only for the top 10 countries (by GDP) globally and within this scope, *i.e.* the US, China, Japan, Germany, India, the United Kingdom, France, Italy, Brazil and Canada.

Figure 12. List of the 50 countries considered in the data analysis (sorted by GDP)

Country	ISO	2019 GDP (USD M)	2019 Population (M)	2019 Govt debt (USD M)
United States	USA	21 433 230	329.1	23 293 420
China	CHN	14 401 730	1 433.8	7 579 486
Japan	JPN	5 079 920	126.9	12 087 924
Germany	DEU	3 861 550	83.5	2 298 588
India	IND	2 868 930	1 366.4	2 075 499
United Kingdom	GBR	2 830 760	67.5	2 416 110
France	FRA	2 715 820	65.1	2 664 763
Italy	ITA	2 001 470	60.6	2 698 062
Brazil	BRA	1 839 080	211,0	1 645 443
Canada	CAN	1 736 430	37.4	1 538 807
Russia	RUS	1 702 500	145.9	236 903
Korea	KOR	1 646 740	51.2	690 379
Spain	ESP	1 394 270	46.7	1 331 054
Australia	AUS	1 387 090	25.2	641 904
Mexico	MEX	1 258 210	127.6	676 275
Indonesia	IDN	1 120 140	270.6	341 531
Netherlands	NLD	907 151	17.1	438 916
Saudi Arabia	SAU	792 967	34.3	180 717
Turkey	TUR	760 940	83.4	251 004

Country	ISO	2019 GDP (USD M)	2019 Population (M)	2019 Govt debt (USD M)
Switzerland	CHE	704 825	8.6	296 999
Poland	POL	592 401	37.9	272 321
Sweden	SWE	530 884	10,0	184 886
Belgium	BEL	529 665	11.5	523 034
Nigeria	NGA	448 120	201,0	130 591
Austria	AUT	446 309	9,0	313 965
Norway	NOR	403 336	5.4	166 376
Ireland	IRL	398 469	4.9	228 446
Israel	ISR	394 652	8.5	236 708
Philippines	PHL	376 795	108.1	139 297
Denmark	DNK	347 031	5.8	102 003
Vietnam	VNM	329 537	96.5	142 904
Colombia	COL	323 561	50.3	169 174
Bangladesh	BGD	302 525	163,0	108 361
Egypt	EGY	302 335	100.4	253 357
Chile	CHL	282 254	19,0	78 769
Pakistan	PAK	276 114	216.6	236 229
Finland	FIN	269 327	5.5	158 933
Czech Republic	CZE	250 681	10.7	75 821
Portugal	PRT	237 714	10.2	279 877
Greece	GRC	209 875	10.5	379 695
New Zealand	NZL	205 217	4.8	64 730
Hungary	HUN	160 957	9.7	106 785
Slovak Republic	SVK	105 434	5.5	50 608
Ethiopia	ETH	92 796	112.1	53 453
Luxembourg	LUX	71 113	0.6	15 685
Lithuania	LTU	54 225	2.8	20 424
Slovenia	SVN	53 748	2.1	35 544
Latvia	LVA	34 121	1.9	12 542
Estonia	EST	31 475	1.3	2 643
Iceland	ISL	24 224	0.3	8 962

Source: Beyond Ratings & FTSE Russell.

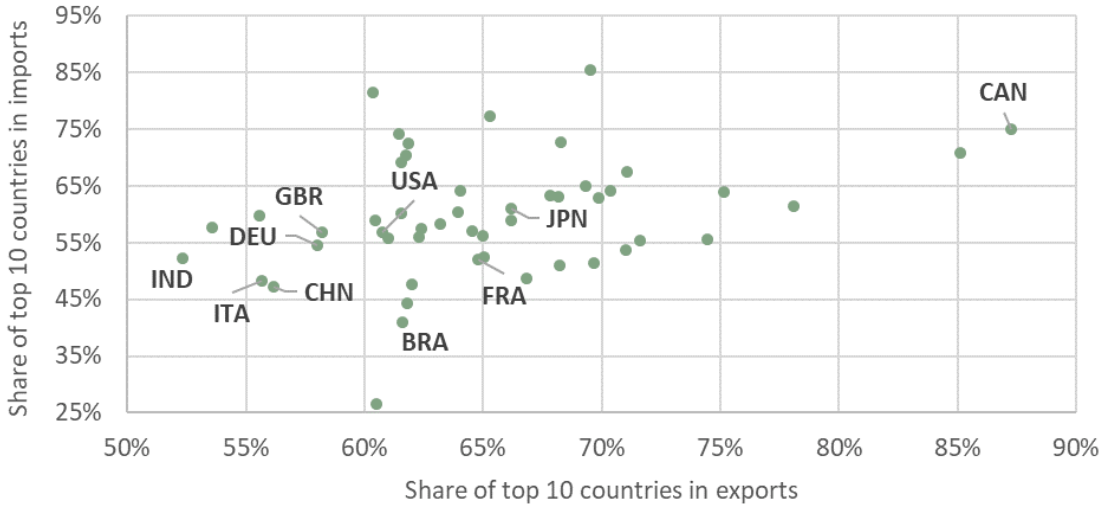
Geographical and sectoral concentration of GHG exports and imports

Specific risks may be associated with high levels of geographical and sectoral concentration of GHG exports and imports. Although countries have adaptive capacities regarding the geographical origin of their imports or the countries of destination of their exports (i.e. potential changes of trade partners), such flexibility could face limits and induce economic costs.

Some such risks might be mitigated by regional cooperation, which could be assessed by further analysis (e.g. different impacts of an EU carbon border adjustment on EU and non-EU countries), but it remains interesting to assess the interdependence at an individual country level within key regions, given the international issues in terms of distribution of decarbonization efforts.

Out of the top 10 global economies, Canada appears to have a particularly high level of geographical concentration, mainly due to its exports' exposure to the US and its imports' exposure to the US and China. For example, Figure 13 shows that more than 85% of its exported GHG are in its top 10 countries of destination, and 75% of its imported GHG emissions come from its top 10 imports partners[34].

Figure 13. Share of top 10 countries of destination in exported GHG and of top 10 countries of origin in imported GHG emissions



Source: Beyond Ratings & FTSE Russell.

Exposure to imports and carbon intensity of imports

Figure 14 presents the GHG content of imports (by unit of value) and the size of imports in the economy (by unit of GDP). Although the analysis of potential carbon border adjustments is particularly relevant for the analysis of exports, the analysis of imports data is also interesting, as it enables to assess carbon-related dependencies and interdependencies in more detail.

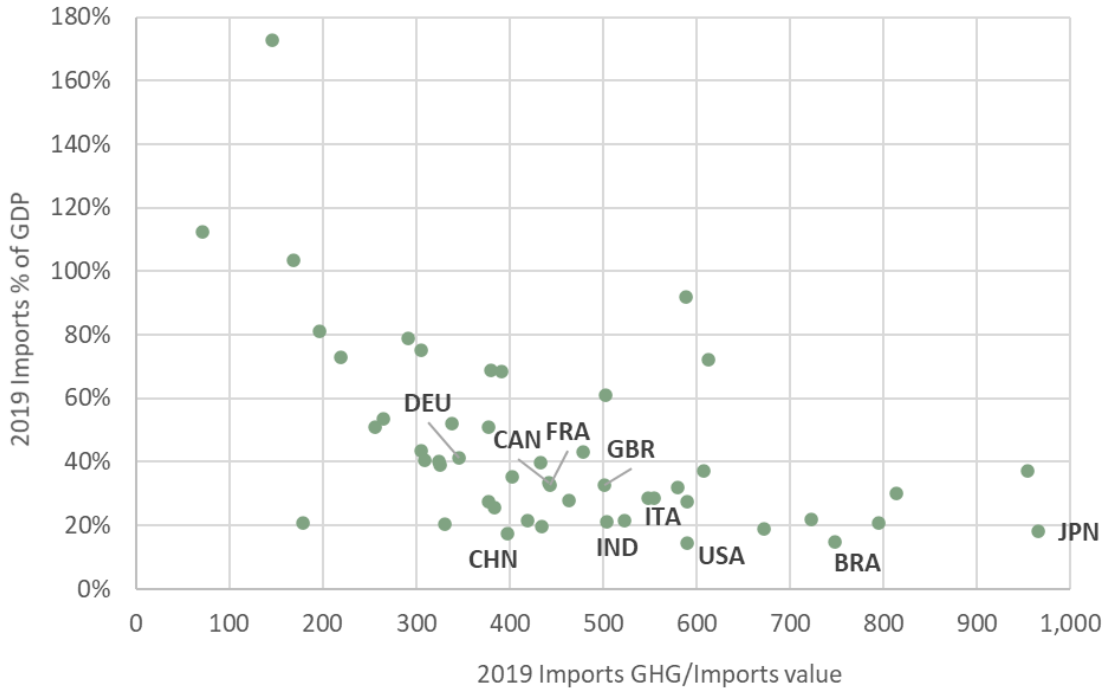
Country positions are diversified on these indicators.

- Among the top 10 economies, the carbon intensity of imports is particularly high for Japan (and to a lesser extent for Brazil) and relatively low in the case of Germany.

[34] Although it should be noted that the share of the top 10 countries of destination in exported GHG tends to be significant overall across countries, beyond the gaps that exist between them.

- However, Germany remains highly exposed to international trade flows based on imports, with imports representing 41% of its GDP.
- Canada, France and the United Kingdom present notable levels of imports in GDP, but the carbon intensity of their imports is relatively moderate compared with peers (in particular Canada and France).

Figure 14. GHG content of imports and imports/GDP ratios for the 50 countries considered in the study

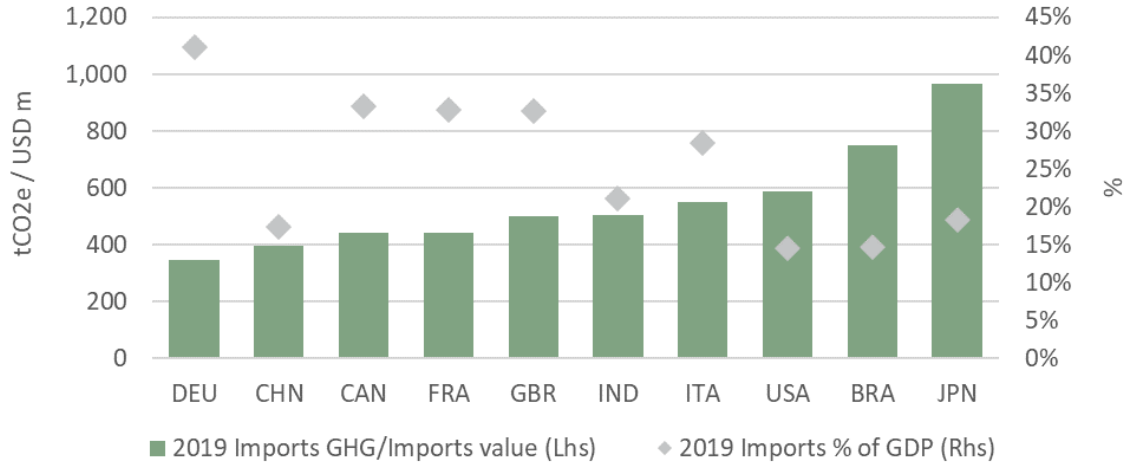


Source: Beyond Ratings & FTSE Russell.

Note: GHG/Imports value in tCO2e / USD million.

Figure 15 also compares the positioning of the top 10 global economies by GDP. Data are sorted by GHG content of imports in ascending order.

Figure 15. GHG content of imports and imports/GDP ratios for top 10 global economies by GDP



Source: Beyond Ratings & FTSE Russell.

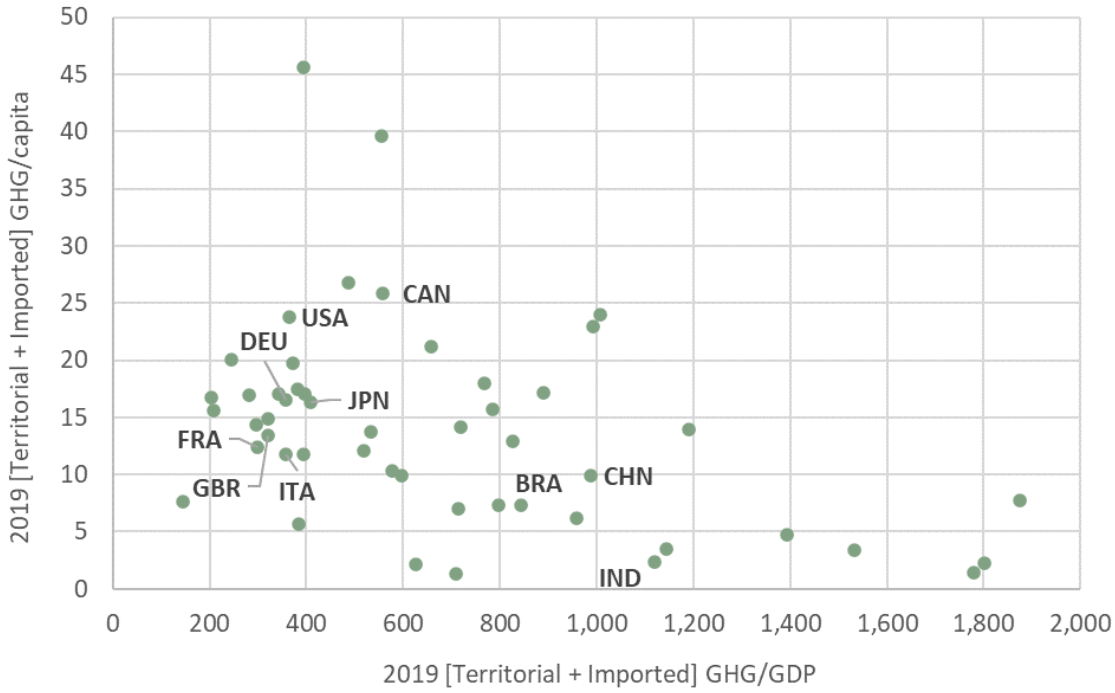
Country carbon intensities and share of exported/imported GHG in carbon exposures

To put exported GHG into perspective, it is also relevant to take into consideration the overall carbon exposure of countries. As described in Figure 16, carbon exposures can, for example, be assessed per capita or based on GDP units. While measurements by GDP unit are economic metrics, they may also reflect factors such as differences in the value of goods and services between countries, hence the relevance of both indicators.

Exposures to exports- or imports-related GHG is indeed particularly significant when countries have high levels of carbon intensity. At the same time, it can be noted that carbon intensity is not always high or moderate in both per capita and GDP terms. Countries with high carbon intensity on both terms and a high exposure to exported and imported GHG deserve particular attention in the analysis. For example, Canada or the US (GHG/capita) or China and India (GHG/GDP) thus present significant GHG intensities.

Carbon intensities have been calculated based on [Territorial + Imported] GHG. This scope includes both emissions emitted on the territory of the country (territorial scope) and emissions emitted in other countries to produce the goods and services imported by the country.

Figure 16. [Territorial + Imported] GHG per GDP unit and per capita for the 50 countries considered in the study

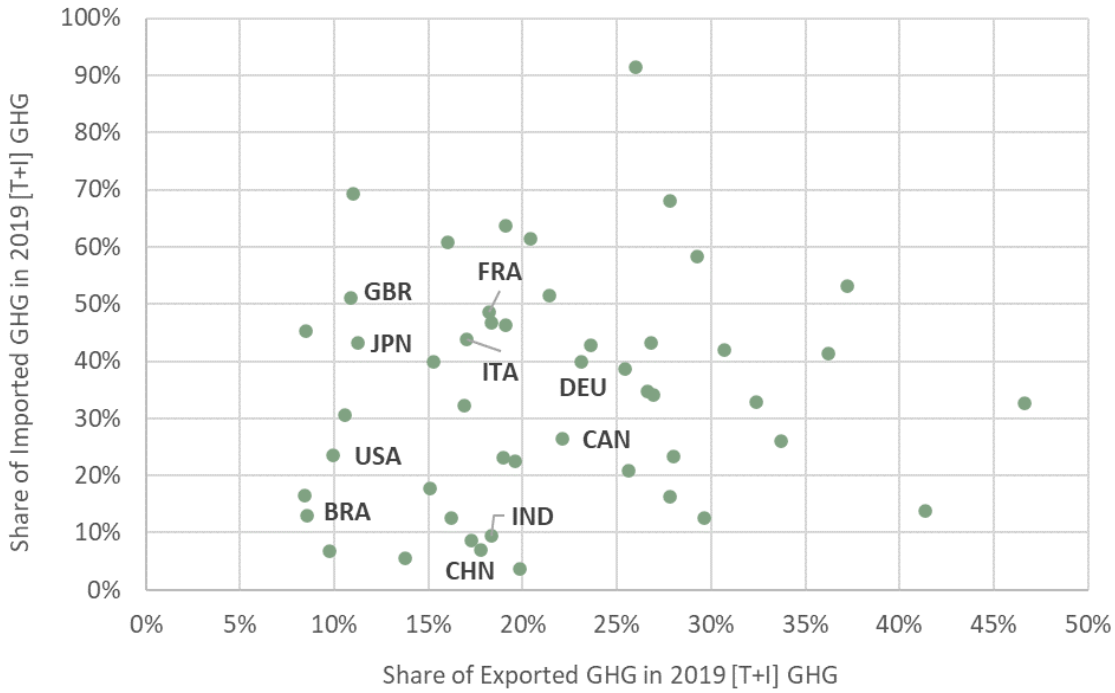


Source: Beyond Ratings & FTSE Russell.

Note: GHG/GDP in tCO2e / USD million and GDP/capita in tCO2e / capita.

To complement Figure 16, the next chart presents the share of exported and imported GHG in total [Territorial + Imported] GHG. This allows us to see to what extent the carbon intensities of countries come from their traded GHG emissions.

Figure 17. Share of exported and imported GHG in total [Territorial + Imported] GHG



Source: Beyond Ratings & FTSE Russell.

Note: Ethiopia is not shown due to a high value on the share of Exported GHG in 2019 [T+I] GHG (69%), although the share of Imported GHG is low (2%).

About FTSE Russell

FTSE Russell is a leading global provider of benchmarks, analytics and data solutions with multi-asset capabilities, offering a precise view of the markets relevant to any investment process. For over 30 years, leading asset owners, asset managers, ETF providers and investment banks have chosen FTSE Russell indexes to benchmark their investment performance and create investment funds, ETFs, structured products and index-based derivatives. FTSE Russell indexes also provide clients with tools for performance benchmarking, asset allocation, investment strategy analysis and risk management.

To learn more, visit ftserussell.com; email info@ftserussell.com; or call your regional Client Service Team office

EMEA
+44 (0) 20 7866 1810

North America
+1 877 503 6437

Asia-Pacific
Hong Kong +852 2164 3333
Tokyo +81 3 4563 6346
Sydney +61 (0) 2 8823 3521