SCOPING PAPER

A GAME CHANGING?

THE GEOPOLITICS OF DECARBONISATION THROUGH THE LENS OF TRADE

DARIA IVLEVA AND ANDRÉ MÅNBERGER,
WITH CONTRIBUTIONS BY JULIA KIRR, 2021

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ABSTRACT

Trade is a key lens to observe the dynamics associated with geopolitics of decarbonisation. For the European Union (EU) in particular, trade is a central element of its external action and decarbonisation agendas. Based on existing literature, this paper scopes the links of geopolitics and decarbonisation in the area of trade, provides illustrative examples, and reflects upon the implications for EU policy makers.

We suggest to structure the ways in which geopolitics of decarbonisation affects trade along three dimensions: the substance of trade; the institutions governing it; and the transportation making it possible. In an analogy to chess, we can expect the "trade game" to change profoundly: geopolitics of decarbonisation shapes the chess pieces (substance), the rules of how to move the pieces across the board (institutions) as well as the way the pieces get in motion (transportation).

Among the challenges this has in store for decision-makers are planning for an uncertain future, finding the right balance of priorities and achieving policy coherence. Therefore, the paper highlights selected entry points for EU policy makers to improve the analysis and to advance policy responses in order to prepare for a changing "trade game".

This scoping paper contributes to the geopolitics of decarbonisation work stream of the Mistra Geopolitcs Programme.

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Trade is a key lens to observe the dynamics of geopolitics of decarbonisation. Trade is used as an instrument to gain advantages on the international stage, and, vice versa, geopolitical strategies often seek to support national economies. As the global economy decarbonises, these interactions are likely to change. For the European Union (EU) in particular, the focus on trade is highly pertinent, as it marks a key pillar of both external action and decarbonisation ambitions.

Based on existing literature, **this paper scopes possible links of geopolitics and decarbonisation in relation to trade and reflects upon the implications for EU policy makers**. The inquiry reveals at least three relevant dimensions: the changing substance of trade; the institutions governing trade on different levels; and transportation making trade possible today and in the future. In all three areas, we see that decarbonisation and geopolitics affect each other: decarbonisation can have geopolitical effects while geopolitics can influence the course of climate action.[1]

In an analogy to chess, the "trade game" is likely to change profoundly: geopolitics of decarbonisation shapes the chess pieces (substance), the rules of how to move the pieces across the board (institutions) as well as the way the pieces get in motion (transportation). The following chapters look into these dynamics and some illustrative examples, often with an EU focus.

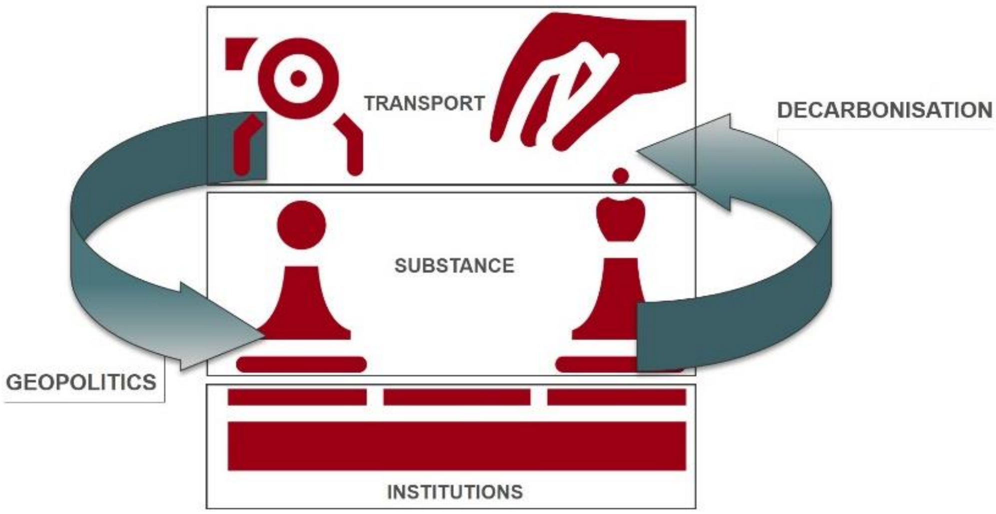

Figure 1: Three dimensions of trade affected by geopolitics of decarbonisation. Source: Own elaboration, icon by Ben Davis, RO/The Noun Project

First, we turn to changes in **commodity flows:** we take a brief look at the geopolitical dimension of an increased demand for low-emission commodities, focussing on critical raw materials for a low-emission transition and hydrogen. We then scrutinise geopolitical aspects of the expected decreased demand for high-emission commodities such as energy-intensive products and bio-based commodities. Second, we explore how the international trade regimes – specifically, in the World Trade Organisation (WTO) and trade agreements – can foster greener trade and how this relates to geopolitics. We also look at carbon border adjustments (CBA), as an important trade-related measure with potential geopolitical implications. Third, the paper identifies several possible links of geopolitics and trade-related transportation, which is bound to change in the course of decarbonisation. After a brief policy context on the European Green Deal, Trade Policy Review and the EU's external action, the closing section offers reflections for **EU policy makers.**

[1] This two-way interaction of geopolitics and decarbonisation is discussed in more detail in Ivleva and Tänzler 2019.

2. Three dimensions of trade affected by geopolitics of decarbonisation

2.1 Substance: changing commodity trade

Achieving the goals of the Paris Agreement will prompt a radical shift in the way societies use raw materials. Science and policy have been debating extensively both the positive geopolitical effects and the potential risks of this. In the following, we first discuss possible consequences of the increased demand for resources that are required for low-emission transformations (which we will refer to as “low-emission commodities”). This is followed by an overview of the possible effects of the declining demand for commodities needed in our high-emission economies (we refer to these as “high-emission commodities”).

2.1.1 Commodities for a low-emission transition

Transitioning to low-emission economies will increase the demand for commodities that are used in low-emission technologies (IRENA 2019a). Countries rich in such resources may therefore gain **economic benefits as new trade patterns emerge** (Vakulchuk et al. 2020). That stated, such natural resources also have been identified as **potential “conflict resources”** that can contribute to prolonging and intensifying local conflicts (Church and Crawford 2018).

More countries have the option to decide if they should “make or buy” the renewable energy they demand than in case of geographically concentrated fossil fuels (Scholten and Bosman 2016). Green energy systems can still include **cross-border trade in energy carriers** as some geographies have lower production costs than others. While regional renewable electricity trade (Lilliestam and Ellenbeck 2011) and global hydrogen trade (Van de Graaf et al. 2020) are less likely to become a tool to exert political pressure than fossil fuels,[2] among other potential geopolitical effects.

In order to explore the geopolitics of decarbonisation related to the increasing trade in low-emission commodities, the following sections look into the rising demand of critical raw materials and the possible futures of hydrogen trade.[3]

Critical raw materials

Renewable energy technologies use more materials in terms of weight and variety than has historically been used in fossil energy systems. For example, solar photovoltaics (PVs) can increase demand for silver and silicon, and lithium batteries often also contain cobalt. Known reserves of these metals are geographically concentrated in a handful of countries and these countries are therefore likely to be the main metal suppliers in a low-emission transition (see Table 1). Demand spreads out across the globe, and supply chain networks that facilitate future trade will have to develop to enable the transition (Månberger and Johansson 2019).

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[2] These conclusions are based on the assumption that producing countries behave as profit maximisers and they are indifferent if buyers gain more from the trade then themselves. There is a lack of research that models low-emission trade arrangements as a negative sum game or that a pay-off (benefit or loss) are valued differently by the exporter and the importer (for a theoretical discussion on different valuations using game theory, see von Neumann and Morgenstern (1944)).

[3] Explorative in scope, this paper does not aim to cover all cases for which a trade lens is relevant to survey the geopolitics of decarbonisation. It rather discusses selected examples. The authors discuss hydrogen, but not renewable electricity trade in more detail because the former could be more disruptive. While electricity trade is regional and bi-lateral and already occurs, hydrogen can be traded internationally and may expand significantly in a low emission future. The political discourse around hydrogen, including international trading options, has been highly dynamic in recent years, already surfacing in many debates relevant to this paper. Readers interested in renewable energy and geopolitics can find further insights in e.g. Scholten 2018, Månsson 2015.

Metal	Main reserve holders		
Cobalt	Congo (DRC) 51.4%	Australia 17.1%	Cuba 7.1%
Copper	Chile 23.0%	Australia 10.0%	Peru 10.0%
Lithium	Chile 50.6%	Australia 16.5%	Argentina 10.0%
Nickel	Indonesia 23.6%	Australia 22.5%	Brazil 12.4%

Table 1: Examples of metals used in electric vehicle batteries, main reserve holders and their respective share of the global reserve. Source: based on data from USGS 2020.

Raw material importers

Different **strategies for managing imports exist** (Humphreys 2013). At one end of the spectrum are market-oriented approaches with minimal intervention (*laissez-faire*), where it is up to the industry to manage the issue. At the other end are direct state involvements – as investor, for example. In the past, periods with increasing raw material prices and perceived scarcity had motivated importers to secure their own supply using foreign direct investment in the upstream parts of supply chains. One historic example is the Japanese state involvement in foreign mine investments in the late 1960s and 70s (Kolenda 1985).

Countries importing metals for low-carbon energy adopt **different strategies to secure their access** (Lee et al. 2020). China supports domestic mining to the extent that their depletion rate for some metals is higher than in many other countries (see Table 1). China has also supported domestic metal refining, and is the major refiner for cobalt, copper, lithium and nickel. The metal concentrates are traded and shipped from the mining countries to mainland China. Some metal refineries also recover by-products, making the country important to the supply of many by-product metals used in modern technologies. For example, selenium and tellurium, used in some solar PVs, is mainly recovered from copper (Nassar et al. 2015). China is also a major consumer of the refined metals, for example, battery manufacturing.

Metal	Reserve[a]	Mining	Refining[b]	Manufacturing[c]
Cobalt	1.1%	1.4%	60%	45%
Copper	3.0%	8.0%	43%	N/A
Lithium	5.9%	9.7%	57%	39%
Nickel	3.1%	4.1%	30%	45%

Table 2: China's share of global reserves, mining, metal refining and manufacturing (use). Sources: [a]USGS 2020 (note: the mining share is for domestic mining only (i.e. mainland China), while China and Chinese companies also control mining in other countries); [b]IEA 2019; [c]Sun et al. 2019.

The EU depends on the import of many raw materials and finished and semi-finished goods, while China is one of the EU's suppliers. The Union has different policies to manage its dependence and provide access to raw materials. The raw materials initiative presents the three main pillars (EU 2008):

- Fair and sustainable supply of raw materials from global markets;
- Sustainable supply of raw materials within the EU;
- Resource efficiency and supply of "secondary raw materials" through recycling.

The emphasis is on the internal market for supply, efficiency and secondary materials. The first pillar emphasises tackling market barriers. This differs from the strategies adopted by China and Japan that put less trust in international market-based approaches and instead put forth bilateral trade deals.

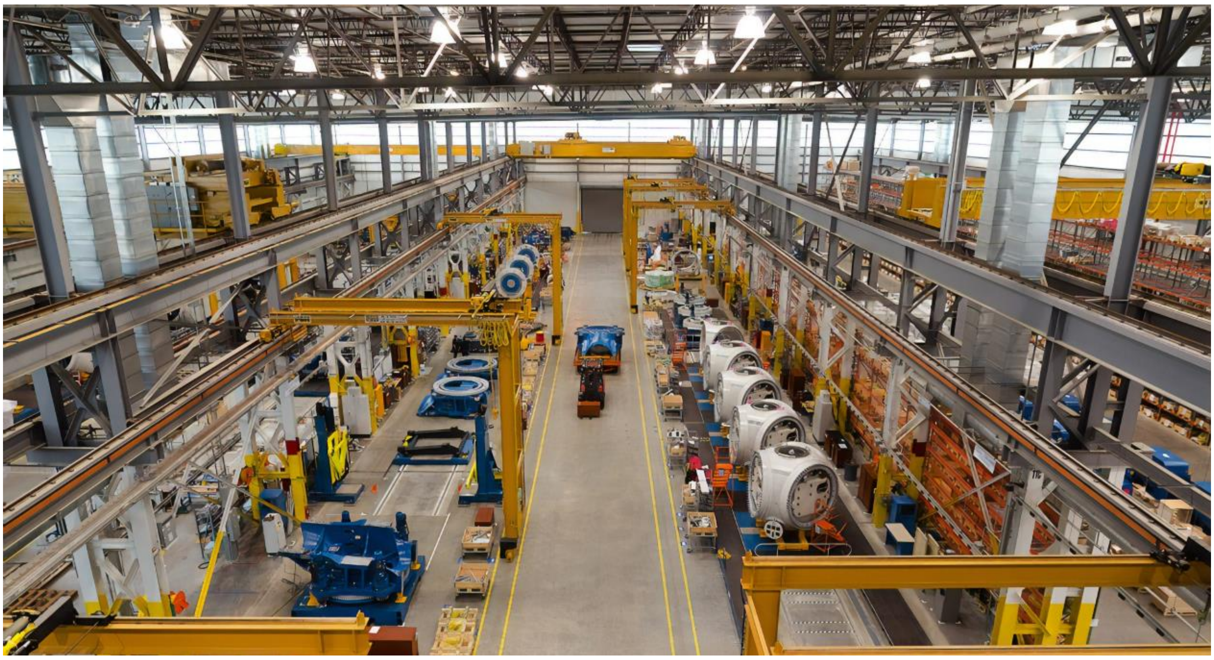
As of 1 January 2021, the EU requires importers of commodities defined as "**conflict minerals**" to source these from "responsible and conflict-free sources only" (EU Conflict Mineral Regulation (EU 2017/821)). The legislation mimics earlier US legislation (Section 1502 of the Dodd-Frank Wall Street Reform and Consumer Act of 2010) and only includes four resources referred to as 3TG (tin, tantalum, tungsten and gold). These resources are used in many consumer electronic products, notably, mobile phones, rather than low-emission technologies. However, this legislation could be expanded to include additional metals or new requirements such as restricting resources environmental footprint.

Governance arrangements to reduce this risk are complex. For instance, regulations that focus on limiting artisanal mining can have negative consequences for rural regions that rely on small-scale mining for jobs and livelihoods, as certification can be too costly for small-scale producers. Sovacool (2019) proposed that different actors need to cooperate to successfully address the policy conflicts related to the livelihoods of small-scale miners.

EU companies sourcing (critical) raw materials

Automotive manufacturers rely on a hierarchy of sub-suppliers that produce components according to certain specifications. Suppliers compete on cost and performance of their product, which favours sourcing raw materials from low-cost sources, such as China. Supply security was taken for granted and absent from the automotive industries agenda. But this changed partly in 2010 following experiences of higher prices and competing demand for raw materials used in electric mobility (Schmid 2020).

It is difficult and impractical for small companies to invest in upstream supply in foreign countries or secure long-term supply contracts. To overcome this, **some companies and branches have formed joint ventures and interest groups** to: i) develop technologies with materials that are more abundant or ii) create consortiums for coordinated upstream investment in mines and hence supply. The German Raw Material Alliance included both manufacturers (e.g. BMW and Volkswagen) and suppliers (e.g. Bosch and Thyssenkrupp) but was dissolved after a few years (Schmid 2020). Later, Volkswagen tried to negotiate a deal directly with cobalt miners but the parties could not agree on prices and distribution of demand risk[4] (Desai 2017).



Several factors have compromised the automotive sector's supply security of raw materials, including political decisions made in producer countries (such as China's export reduction of rare earths) and supply deficits due to increased demand and competition. Mercedes and Jaguar had to reduce production of their EVs due to a battery shortage (Collingridge 2020; Murphy and Hubik 2020). Recently, the COVID-19 pandemic underlined the vulnerability of some supply chains, e.g. microchips, especially if these depend on specific countries and regions (Raza et al. 2021).

The European Commission has identified batteries as a key technology for enabling electric mobility and launched the European battery alliance (EBA 2020) in 2017. The initiative aims at developing a battery value chain in Europe with participants from all parts of the supply chain (from mining to recycling). However, mining within the union is unlikely to satisfy demand if sales of electric vehicles take off. Some member countries have also formulated their own raw material strategies (see Schmid (2021) for an overview of Germany's revised strategy).

[4] Contracts including a take-or-pay clause require buyers to take delivery of a minimum quantity or pay the seller. This transfers some of the demand risk from the supplier to the customer.

Case study: supply of rare earth elements from China

Rare earth elements (REEs) – not so rare?

REEs are a group of 16 elements. Their crustal abundance differs by two orders of magnitude (Wall 2014). However, even the scarcest REEs are still several orders of magnitudes more common than the precious metals (gold, silver) and platinum. REEs are seldom found in high concentration ores, and the extraction process is therefore expensive. REEs are used in small quantities in many modern technologies such as communication, some batteries and military technologies (Hedrick 2004). Their magnetic properties make them ideal for generators in wind power plants and electric motors in electric vehicles because they enhance performance in terms of weight, size and efficiency.

China's rise as the major supplier of REEs

United States was the dominant supplier of RREs between the mid-1960s and up to mid-1980s when China's output started to increase. China has the biggest reserve (37%) and mining (63%) in the world (USGS 2020). The US has for a long-time perceived China's influence of REE supply as a security issue; see e.g. USGS (2002).

China's REE goals and policies have changed over the years (Zhang et al. 2015). In the 1980, when mining commenced, China supported the REE sector with tax rebates. The level of rebates gradually declined and, in the mid-2000s, was eventually replaced with export tariffs on REE metals, quotas restricting export volumes and requirements for export licenses. These regulations originally targeted only lower value products (metals and unrefined oxides), but in 2008 permanent magnets with rare earths also became subject to export restrictions.

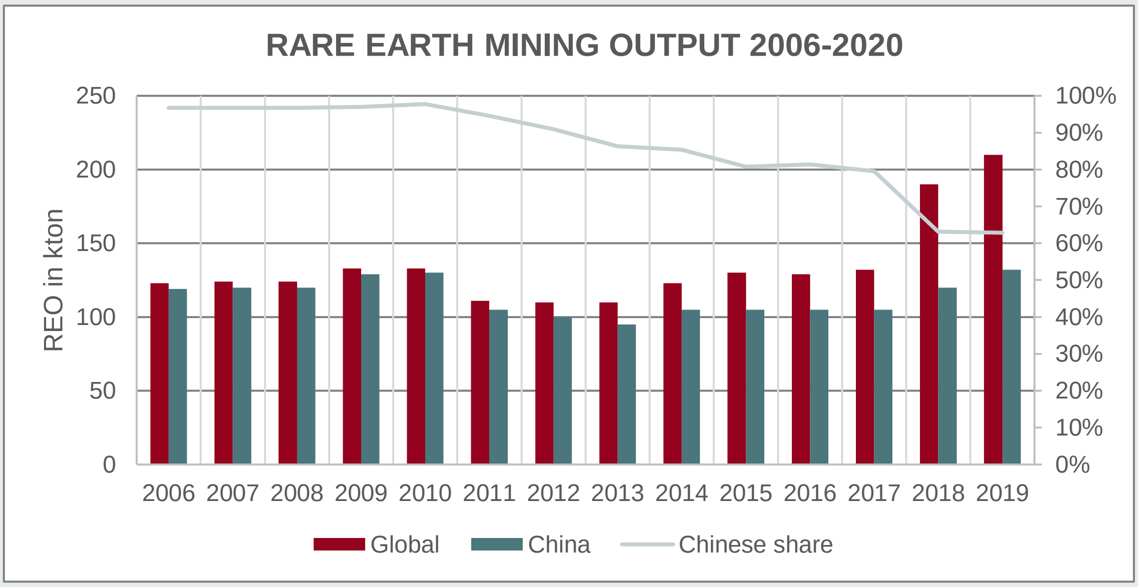


Figure 2: Global mining of rare earth oxides, mining in China (in thousand tones, left axis) and China's share of global mining (right axis). Source: Based on data from USGS Mineral commodity summaries editions from 2008-2020 (USGS 2020).

The export quota was reduced by 72% in 2010 (Hatakeyama 2015). Chinese officials argued that it was primarily to develop downstream industries and a response to environmental concerns related to local environmental pollution and rapid depletion of its reserves (Wübbeke 2013). China's share of REE permanent magnets production is lower when measured by value than weight because their products are of inferior quality (Hatakeyama 2015). China continues to depend on licensing foreign patents, particularly Japanese.

In 2010, a Chinese trawler collided with a ship of the Japanese coast guard in the East China Sea. The Chinese captain was arrested, igniting a diplomatic dispute between the two countries. As the diplomatic conflict escalated, China temporarily suspended all REE exports heading for Japan (Hatakeyama 2015). REE prices spiked in response and some reached peaks more than ten times the price seen a year before (Wall 2014). It should be noted that China has never officially recognised suspending REE export to Japan or the use of REE export as a diplomatic tool (Wübbeke 2013).

Responses by industries and states

Although REEs are more expensive than many other materials, they typically make up a small share of the total end use product. The price increase for most end use products was therefore muted. One exception was the energy-saving lights: the cost share of phosphorus increased from 10% to 70%, which resulted in cost inflation and contributed to sales growing at only one third compared to the rate of growth in previous years (Hatakeyama 2015).

Some researchers put forth that, based on previous experience, even near monopoly of a perceived critical natural resource is insufficient to make it a successful foreign policy tool.

Industries and governments responded by using REEs more efficiently or replacing them entirely when substitutes were available (Gholz and Hughes 2019). Such initiatives can be slow, as they require the development of new technologies and supply chains. However, Japan already had ongoing research and development projects underway, which sped up the process. Mining outside of China also increased, but this response was delayed by several years (see Figure 2).

Both Japan and the US stockpile REE and increased their stocks following the incident in 2010. The two countries stocks serve different purposes. The Japanese are motivated on economic grounds as they are used by the technology industry and managed by both state and industry (JOGMEC 2017). The purpose of the US stocks is to supply military needs (DOD 2015).

US, Japan and the EU together filed a complaint against Chinas export quotas in the WTO and China removed its export restrictions (but kept the production quota). Some researchers put forth that, based on previous experience, even a near monopoly of a perceived critical natural resource is insufficient to make it a successful foreign policy tool (Wilson 2018; Gholz and Hughes 2019). However, other researchers still caution importers about long-term dependence (Rabe et al. 2017). Countries depending on REE imported from China continue to perceive and describe this dependence as a security concern, see (EC 2020; US DoI 2018).

Hydrogen

Energy and chemical industries have been using fossil-fuel-based hydrogen for decades. Today it is mainly produced from coal or natural gas, complemented by carbon capture and storage (CCS) in a handful of projects worldwide. Produced with renewable electricity, green hydrogen can enable large-scale, efficient renewable energy integration, serve as a long-term storage medium and be used by heavy industry to produce low-emission steel, ammonia and synthetic hydrocarbons (Bataille et al. 2018; Ueckerdt et al. 2021). **Not all uses are equally competitive**, as sometimes direct electrification is a more effective mitigation option. But in the sectors with high mitigation barriers and no electrification possibilities, it represents a no-regret option. In countries of the Organisation for Economic Co-operation and Development (OECD), these sectors account for substantial energy consumption shares (Ueckerdt et al. 2021; Agora Energiewende and AFRY Management Consulting 2021). Many industrialised economies see green hydrogen as a necessary resource for a climate-compatible transition, and several countries explore hydrogen or its derivates as a future export commodity. A growing number of national and regional hydrogen strategies reflect this.

Types of hydrogen

Black or brown hydrogen, produced with coal, and **grey hydrogen**, produced with natural gas, dominate today's production (IEA 2019). **Blue hydrogen** is produced from natural gas through steam methane reforming or auto-thermal reforming and storing the resulting carbon dioxide in geological structures (CCS). While blue hydrogen is likely to play a role in the transition phase to wide use of hydrogen for decarbonisation (Dickel 2020; Van de Graaf et al. 2020), it still produces carbon dioxide and methane emissions (Howarth and Jacobson 2021). **Green hydrogen** is produced from water electrolysis using renewable electricity and currently accounts for less than 3% of global hydrogen production (IEA 2019).

Emerging hydrogen diplomacy

Green and blue hydrogen play a more important role in **national strategies** in the long-term than the medium-term, i.e. by 2030. In 2050, several countries envision exclusive use of green hydrogen (Albrecht et al. 2020). The EU and Germany declared the importance of international procurement. Japan intends to develop into a hydrogen-based society and to build a global supply chain that can deliver large amounts of renewable hydrogen in a cost-effective way (Pflugman and De Blasio 2020). Many countries, including Australia, Canada, Spain, Norway, Chile and Morocco plan to build up hydrogen exporting capacities (Albrecht et al. 2020; Van de Graaf et al. 2020).

Strategic goals	EU	DE	NL	FR	ES	IT	UK	NO	CH	UA	RU	JP	KR	CN	AU	CA	MO
Reduce emissions	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	(✓)	(✓)	✓	(✓)	✓	(✓)	✓	✓
Diversify energy supply	✓	✓	✗	(✓)	✓	(✓)	✗	(✓)	✗	✓	(✓)	✓	(✓)	✓	(✓)	(✓)	✗
Foster economic growth	✓	✓	✓	✓	(✓)	✗	(✓)	✓	(✓)	(✓)	(✓)	✓	✓	✓	✓	✓	✓
Support national technology develop.	✓	✓	✓	✓	(✓)	✗	✓	✓	(✓)	(✓)	✓	✓	✓	✓	✓	✓	✓
Integration of renewables	✓	✓	✓	✓	✓	(✓)	✓	(✓)	(✓)	✓	✓	✓	(✓)	✓	(✓)	✓	✓
Develop hydrogen for export	✗	✗	✗ 1)	✗	✓	✗	✗	✗ 2)	✗	✓	✓	✗	✗	✗	✓	✗	✓

main goal (✓) less relevant not addressed

Figure 3: Main goals of current hydrogen strategies per country. Source: Albrecht et al. 2020

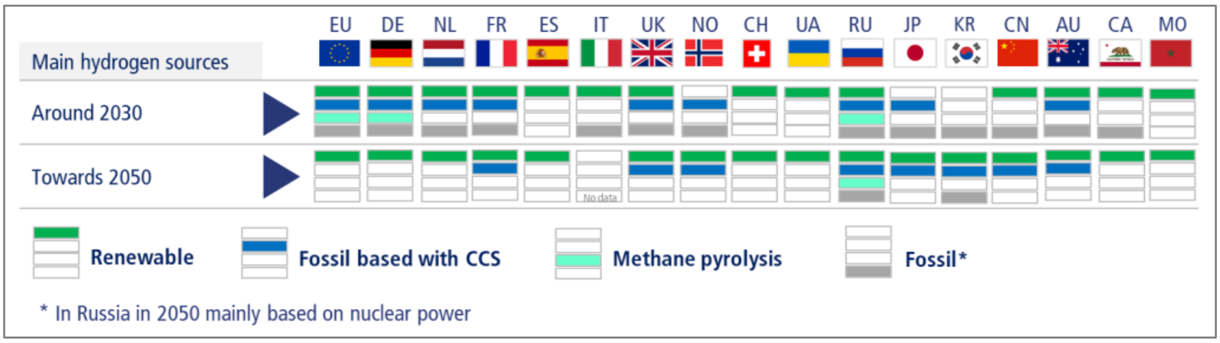


Figure 4: Medium- and long-term hydrogen production options by country. Source: Albrecht et al. 2020.

Several agreements have already been signed or are under discussion, indicating the possible emergence of new trade routes. For example, with the project "Hydrogen Energy Supply Chain Pilot" Japan plans the world's first ocean-going liquid hydrogen carrier, sending liquefied hydrogen from Australia to Japan, which is supposed to be function on a large scale around 2030. Japan is also engaging with Brunei, Norway and Saudi Arabia (Albrecht et al. 2020). Germany has signed cooperative agreements with Morocco, entered into a strategic partnership with investment companies and developers to foster the expansion of the green hydrogen economy in the United Arab Emirates, and signed a bilateral Hydrogen Accord with Australia. South Korea is in conversation with Norway, the Netherlands with Portugal, Belgium with Oman and Chile (Van de Graaf et al. 2020; Whitlock 2021).

Some authors warn of a "green colonialism" that could emerge if richer importer countries use the natural endowments of less developed countries to secure hydrogen supply.

There might be a future field of cooperation between **Africa and the EU**, and several actors and initiatives already scope partnerships opportunities (RaviKumar Bhagwat and Olczak 2020; IEA 2019; IRENA 2019b; UNU-INRA 2021). There are many uncertainties with regard to the interaction of such plans with Africa's own energy needs. Some authors warn of a **"green colonialism"** that could emerge if richer importer countries use the natural resources of less developed countries to secure hydrogen supply (Van de Graaf et al. 2020; Scita et al. 2020), while the latter struggle to translate the revenues into welfare benefits or even to secure energy for their own industrialisation. In face of these uncertainties, it is important for Africa to be part of this conversation early on to achieve the best possible outcome and utilise potentials of future markets.

Reducing or reproducing risks?

Countries' potential to become important players on future hydrogen markets differs (Albrecht et al. 2020). Green hydrogen opportunities depend on the availability of **renewable energy and freshwater resource as well as infrastructure** for production, transportation and distribution (Jensterle et al. 2020). Blue hydrogen requires the use of CCS, which is contested in many countries (Pflugmann and De Blasio 2020). Countries might gain further advantages through specific hydrogen strategies, better governance and providing targeted financial support. Of course, the success of the different national strategies and investments will be determined by the way the future international hydrogen markets actually develop. This is still highly uncertain, as many combinations are possible of how exactly hydrogen will be produced, used and transported (Van de Graaf et al. 2020). To deal with this uncertainty, policy and investment decisions as well as coordination matter.

Hydrogen might present a **diversification option** for economies dependent on fossil fuel revenue (Van de Graaf et al. 2020). Fossil fuel players such as Australia or Norway can capitalise on hydrogen opportunities, therefore possibly maintaining their international positions as energy exporters (Jensterle et al. 2020; Pflugmann and De Blasio 2020). Fossil fuel exporters in the **Middle East and Northern Africa** might face higher barriers in shifting to hydrogen due to water constraints or, in case of blue hydrogen, low CCS readiness, and this could have geopolitical ripple effects (Pflugmann and De Blasio 2020; Jensterle et al. 2020). Using seawater in the process could help overcome water constrains for electrolysis. For instance, Saudi Arabia, a major conventional energy exporter, might lose influence if it does not increase desalinisation capacities (Pflugman and De Blasio 2020; Van de Graaf et al. 2020; RaviKumar Bhagwat and Olczak 2020). Overall, Middle Eastern countries are unlikely to maintain the same influence levels on green hydrogen as on the current oil markets. This could lessen conflict, but also destabilise the region further (Pflugman and De Blasio 2020).

> ***Since more countries could be able to produce hydrogen with renewables, trade could be less asymmetric.***

Hydrogen could be an **opportunity to restructure existing power relations**: since more countries could be able to produce hydrogen with renewables, trade could be less asymmetric. The potential for using hydrogen supply to exert political pressure could be smaller than that in geographically concentred fossil fuels (Van de Graaf et al. 2020). Furthermore, many potential export champions are democracies with stable market economies, as opposed to the authoritarian states dominating oil trade today. For instance, while Russia has been a main supplier of oil and natural gas for the EU, a transition to a low-emission economy is likely to reduce this energy dependency (Pflugmann and De Blasio 2020). Hydrogen transportation infrastructure could take the pressure off of geographies currently considered as strategic to fossil fuel supply (Van de Graaf et al. 2020).

The literature suggests that **some risks and dependencies that exist on current commodity markets could be perpetuated**. This includes interventions to influence the markets (for example, constraining production capacity, flooding markets) as well as defensive strategies to protect energy security (Pflugman and De Blasio 2020). In May 2021, Morocco was reported to put the hydrogen cooperation with Germany (initiated in 2020) on hold because the latter does not see Western Sahara as Moroccan state territory (Dumpis 2021). Furthermore, if new transportation routes lay in geopolitically disputed regions like the East China Sea, this could produce a new variance of old tensions (Pflugman and De Blasio 2020).

> ***Stronger international coordination is needed to use the full decarbonisation potential of hydrogen and reduce geopolitical risks.***

States may compete for **technology leadership** on specific parts of the hydrogen value chain. China already has a significant cost advantage on the production of electrolysers for green hydrogen, and could therefore dominate another important decarbonisation technology. Some countries with high hydrogen potential could develop energy-intensive industries like steel and chemicals. This could produce **tensions with established market players** that seek to ensure their competitiveness and secure the supply of decarbonised energy (Van de Graaf et al. 2020).

We only begin to explore the geopolitical implications of green hydrogen, and many scenarios are possible. But policy makers need to keep this dimension in mind as they begin to explore the partnerships of the future (Van de Graaf et al. 2020; Ueckerdt et al. 2021). **Stronger international coordination and governance** are needed to use the full decarbonisation potential of hydrogen and reduce geopolitical risks (Van de Graaf et al. 2020). Furthermore, the interactions between the private sector and the nation states with their respective economic and political interests, are yet to be determined.

2.1.2 High-emission commodities

High-emission commodities, especially fossil fuels, have been at the centre of the geopolitics of decarbonisation research. The argument goes that fossil fuels are extracted in few countries due to geographical reserve concentration, cause geopolitical dependencies and are often conflict-prone (IRENA 2019a; Månsson 2014). At the same time, the producing economies tend to depend on these exports substantially, and abrupt revenue decreases might cause tensions and instability, as national fossil assets and future resource rents are devalued ahead of time (Ivleva et al. 2017). Much has been written on the geopolitical implications of a decreased global demand for fossil fuels (Blondeel et al. 2021; Månberger 2021; Overland et al. 2019; Mehdi and Meidan 2021; IRENA 2019a; Tänzler et al. 2020; Goldthau et al. 2019; Hafner and Tagliapietra 2020). This paper will not concentrate on this comprehensive debate, but rather focus on commodity groups that are not discussed as often: bio-based and energy-intensive commodities.

Bio-based commodities

Agricultural commodities are often associated with high GHG emissions. In fact, the Intergovernmental Panel on Climate Change (IPCC) issued a special report on the interactions of climate change and land use in 2019, drawing international attention to a **potential sharp conflict of agricultural production and climate action** in the future. A number of land-related adaptation and mitigation options suggested increase the demand for land conversion, which can lead to adverse side effects for food production and hence food security (IPCC 2019). For example, negative emissions technologies such as bioenergy with carbon capture and storage (BECCS) could require up to 25% of agricultural land, which drastically impacts the amount of available land for food and ecosystem services (Smith et al. 2015).

In addition, the IPCC highlights the importance of **dietary shifts away from meat** in order to reduce greenhouse gases (GHG) emissions and cropland (2019). This would also increase the potential for other land-based climate measures and decrease the overall pressure on land, thereby reducing soil erosion and providing environmental co-benefits such as decreased use of fertilizer or deforestation. While diet transition largely depends on consumer behaviour, government incentives for unsustainable farming practices and lack a systemic perspective contribute to continued unsustainable food demand (Rust et al. 2020). Lower meat and dairy production can compromise profits and endanger livelihoods of farmers, calling for the political resolution of such trade-offs.

In some countries, reliance on agricultural and land-intensive exports makes for difficult political economy conditions for low-emission transitions, similar to fossil fuels. Agricultural elites can be expected to oppose climate action or define decarbonisation options such as Climate-Smart Agriculture in line with their own interests (Newell et al. 2018). Governments that rely on agricultural industries can struggle with change, contributing to political tensions (e.g. Casarões and Flemes 2019). Like fossil fuel assets, agricultural sector assets can end up stranded, both as a result of changing climatic conditions and of more restrictive land use policies (Hoare et al. 2016).

> ***A decrease of palm oil exports to the EU would likely increase sales to other large importers such as India and China and, therefore, their influence in southeast Asia vis-à-vis that of the EU.***

Climate regulations and policies – such as requirements for certified sustainably produced commodities, changes to land use management or the introduction of carbon taxes – may further increase the risk of stranded assets (Hoare et al. 2016). A case illustrating possible future dynamics in this regard could be the partnership Liberia and Norway entered into September 2014. In Liberia, development aid from the Norwegian government to support emissions reductions from deforestation required multinational companies to adhere to zero deforestation policies. Consequently, the Liberia Timber Association considered taking legal action to prevent the ratification of the agreement, arguing that investments may be stranded and forestry industry employees would be negatively affected (Hoare et al. 2016).

Another prominent example is the planned **palm oil ban for biofuels** under the Renewable Energy Directive (RED II) proposed by the EU in the current revision of the Directive. The ban affects countries dependent on palm oil exports to the EU such as Indonesia and Malaysia. While aiming to limit negative climate implications of the palm oil industry, the ban could have unintended consequences, as these trade flows are embedded in wider geopolitical dynamics.

> ***Markets for low-emission energy-intensive products will require policies to share investment risk and to prevent carbon leakage.***

A decrease of palm oil exports to the EU would likely drive sales to India and China and, therefore, their influence in Southeast Asia vis-à-vis that of the EU (Ellis-Petersen 2018). Retaliatory sanctions and countermeasures are not unlikely; plus, rising tensions could affect future trade agreements between the EU and the ASEAN (Pandey 2019). Indonesia and Malaysia have already filed a lawsuit to the WTO (Davies and Blenkinsop 2019; Raghu 2021). In addition, a ban on palm oil might drive up the demand for first-generation biofuels like soy and rapeseed. This could not only further drive deforestation but also increase global food prices due to the replacement of food crops (Robinson and Purnomo 2019). Therefore, not only should the ban be carefully crafted to guarantee WTO compatibility (Mayr et al. 2021) but it may also require accompanying initiatives to mitigate these risks. This shows that importer-exporter relations in the agricultural sphere can have geopolitical dimensions that can interact with both international politics and the success of the decarbonisation agenda.

Energy-intensive commodities

The industry sector is responsible for one-third of all emissions and a majority of these comes from three sectors: iron and steel, chemicals and plastics, and cement (Rissman et al. 2020). The emissions originate both from the use of fossil energy and from production processes, such as the use of coal as a reducing agent in production of iron. Increased efficiency of current technologies is not in themselves sufficient to comply with a stringent carbon budget. Generally, long-term demand for major metals (iron, aluminium, etc.) is assumed to increase as a result of economic and population growth (e.g Elshkaki et al. 2018; Watari et al. 2021). Radical emission reductions, or deep decarbonisation, is possible for each of the sectors using technologies that are at an advanced research and development stage (Bataille 2020).

Deep decarbonisation can profoundly relocate energy intensive industry supply chains. How they can be relocated remains unclear but local availability of low-cost renewable energy is likely to be one of the factors shaping this development (Samadi et al. 2021). Studies focusing on marginal abatement costs have concluded that China and developing countries strengthen their competitive advantage in comparison to Europe (e.g. Nabergnegg et al. 2017). On the other hand, studies that adopt a longer-term perspective, focusing on how the low-cost renewable energy potential is distributed geographically, instead conclude that iron production can be relocated from Southeast Asia to Australia, a country with vast solar and wind potential (Gielen et al. 2020). In addition to the decarbonisation of primary raw materials, a move towards a more **circular economy can reduce demand** for primary production (for example, mining) and shift trade flows to secondary products (Månberger and Johansson 2019).

Relocation of heavy industry, lower production volumes and increased recycling have local, national and global impacts. They provide job opportunities at the local level, tax revenues at the national level and are part of trade flows between countries. For iron ore, more than 60% of the global production is traded internationally and the export value was estimated to be more than 65.4 billion USD in 2015 (Lundmark 2018).

The production costs for these technologies are higher than for current technologies, and as a result, political action is required for the transition to occur. Establishing markets for low-emission energy-intensive products will require policies to share investment risk, prevent carbon leakage and due diligence requirements. We discuss the potential implications for trade regimes this can have in the section 2.2 on trade institutions.

2.1.3 In sum

The "trade game" will be played with different pieces in the decades to come. As the demand for some emission-intensive commodities goes down, that for commodities needed in low-emission economies can be expected to increase substantially. This creates **new opportunities while also reducing old commodity-related sources of income**. These changes interact with a myriad of geopolitical relations, which means that threats and opportunities change not only in the economic realm but also in international politics.

Changing trade flows may help to **overcome some risks and dependencies**, but can also **reproduce** them or **create new ones**. The nature of past and future "top commodities" is different, and changes will depend on non-linear decarbonisation patterns. The material flows can be expected to shift radically, as the EU strives for climate neutrality by 2050. In face of these uncertainties coupled with the scale of change, we are likely to underestimate trends and lag behind with governance responses.

Whether the growing demand for **new commodities will be a blessing or a curse for socioeconomic development** is not deterministic. The history of the use of fossil fuel resources provides examples of both. It also offers lessons for policy makers, among others, on how to create institutional environments that can help societies benefit from the use of natural resources and resolve conflicts around this. Yet, scholars sometimes draw diverging conclusions about how fossil resources have interacted with conflict and cooperation dynamics the past, adding to the uncertainty of how the future may unfold (Overland 2021). We cannot predict changes in trade dynamics, but we can **monitor them more closely**. This calls for forward-looking analyses and careful, multilateral governance of risks.

2.2 Institutions: governing future trade flows

Trade can be leveraged to **enhance climate-compatible economies**. This includes but is not limited to: increasing market opportunities for sustainable products, using trade-related rules to address uneven climate ambition levels across the globe, and capitalising on comparative advantages of economies for reducing emissions, among others, through market mechanisms under the Paris Agreement (Mehling et al. 2019). Furthermore, effective trade institutions could help cope with the risks of shifting commodity flows, described above, and with possible tensions over crucial decarbonisation technologies.

Trading rules and institutions are **interlinked with international politics**, facing pressures when geopolitical tensions rise. A deep shift in the global economy is likely to bring about new trade governance challenges. The following section zooms into several aspects of this nexus of trade related rules and geopolitics: the challenges of the WTO, role of trade agreements and Carbon Border Adjustments (CBA), a contested unilateral trade-related climate policy option.

2.2.1 Green and rules-based open trade regimes?

Trade opportunities and dependencies have a great influence on economic agendas. Therefore, international **trade governance needs to be better aligned with decarbonisation requirements**, providing a more conducive framework for the international supply and exchange of goods, services and technologies for a low-emission transformation in countries across the world. Policy analysis has produced rich results on aligning the global climate and trade regimes since the establishment of the Paris Agreement. Reform options tackle a range of decarbonisation aspects, aim at different institutional levels and, most importantly, are not all equally politically feasible (Das et al. 2018b).

The World Trade Organisation

National **climate action needs to be compatible with WTO rules** to avoid disputes. For this, support to decarbonisation-relevant branches such as renewable energy needs to constitute exceptions to the general principle to avoid trade distortion through governmental action (Droege et al. 2018. Similarly, CBA could be compatible with or challenged based on WTO rules, depending on their design (Droege and Fischer 2020). It needs to ensure the balance between enabling mitigation ambition and possible misuse for unfair economic advantages (Droege et al. 2018). While there are rules that can enable this by distinguishing justified support from veiled trade protectionism, there is no sufficient clarity under which conditions these apply to climate action (Droege et al. 2018).

> ***Open, rule-based, multilaterally governed trade and ambitious climate action are parallel challenges.***

There are also a number of **entry points in the WTO regime to advance climate action** proactively. The WTO's Agreement on Subsidies and Countervailing Measures (SCM) could allow for measures to increase transparency and reduce fossil fuel subsidies as trade-distortive. Furthermore, intellectual property rights with regard to climate technologies can be negotiated under the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) (Droege et al. 2018; Verkuijl et al. 2019). However, any changes to the legal set-up or key institutional process of the WTO are currently improbable. Policy makers could instead rely on changing the institutional practice, for example, expanding technical expertise on climate issues within the WTO or advocating for increased subsidy disclosure in WTO reporting procedures (Droege et al. 2018; Das et al. 2018b).

Environmental goods and services could furthermore enjoy beneficial tariffs to encourage trade. However, the Environmental Goods Agreement advanced by a group of WTO members for this purpose has been on hold since 2016. Recently, a group of WTO members have been picking up “structured discussions on trade and environmental sustainability” (TESSD) around “environmental goods and services, ‘greening’ Aid for Trade, fossil fuel subsidy reform, carbon border adjustments, and ‘green” trade’”, which could create new momentum for some of these topics (Baliño 2021).

Even disregarding decarbonisation challenges for a moment, **the global trade regime needs a profound update and faces geopolitical challenges**. The WTO has lost the ability to settle trade disputes, rendering its rules ineffective, while re-negotiating provisions and mechanisms to improve the system seems almost impossible (Dupont 2020; Narlikar 2020). Historically, WTO accession processes have been influenced by foreign policy and geopolitics (Davis and Wilf 2017). Not least, the geopolitical competition of China and the US has affected the WTO over the last two decades (Dupont 2020). Amrita Narlikar argues that the WTO was built “on the assumption that increasing trade liberalization and integration would automatically lead to peace” and lacks provisions to cope with “a weaponization of economic gains – the use of the benefits accruing from trade liberalization to acquire a strategic advantage in security matters” (Narlikar 2020: 35).

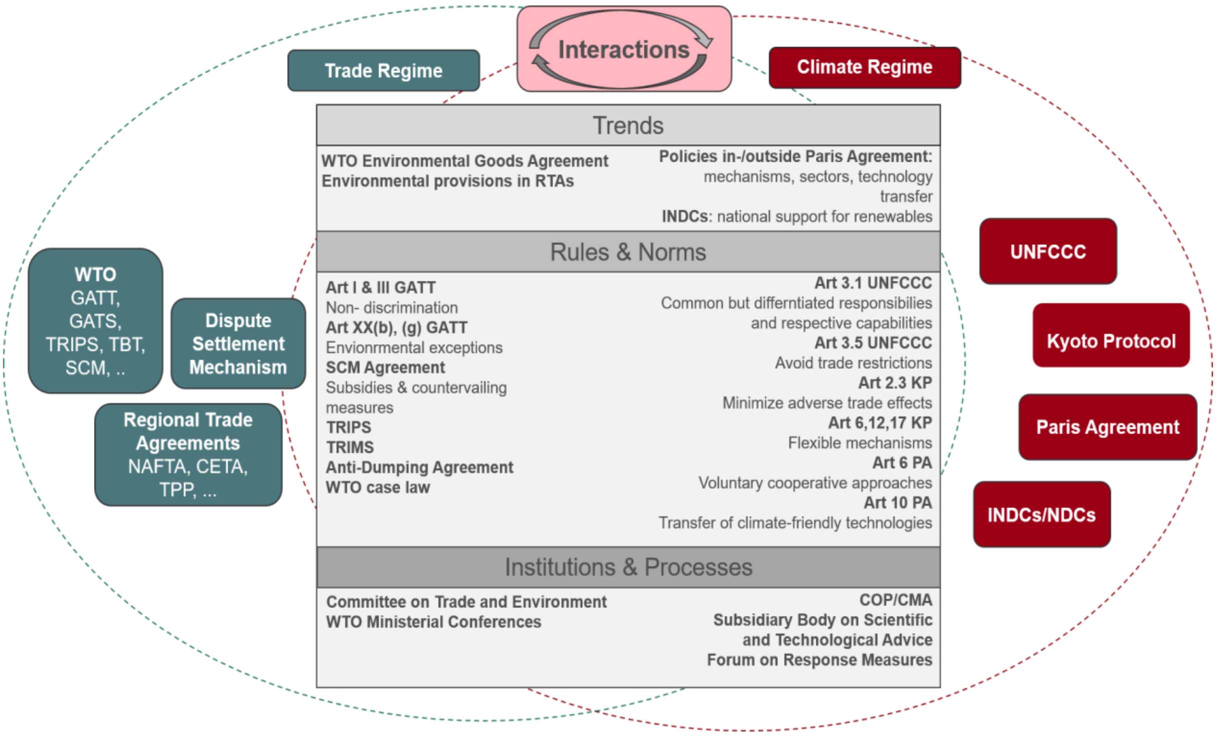


Figure 5: Overview of the interactions between the trade and the climate regimes. Source: Droege et al. 2016.

The EU highlights its **WTO reform aspirations** “across all of its functions” and “based on its membership sharing a common sense of purpose”, with an emphasis on the transatlantic partnership (EC 2021: 11f.). The EU underlines its commitment to open, rules-based, multilateral trade structures, including with regard to the Green Deal and in its regional strategies (EC 2021; EC 2019; Council 2020; Council 2021; Council 2019). As shown in the previous chapter, reconfigured resource flows might add to geopolitical risks. Decarbonisation is in itself a process of deep cross-sectoral transformation accompanied by socio-economic and geopolitical risks (Ivleva and Tänzler 2019). If deliberate use of new trade dependencies for political purposes materialises, it will only increase barriers for transformation.

It seems that **open, rule-based, multilaterally governed trade and ambitious climate action** are parallel challenges. That is, we need multilateral trade governance that supports climate-compatible economies and risk-resilient supply chains. The technical complexity of forging such trade rules can be compounded by (geo)political challenges, including the apprehension of purposeful undermining of international institutions for national advantage. WTO reforms have been on the international agenda for some time and are connected to deeper challenges to multilateralism in the current geopolitical landscape. Such a profound reform would be a unique, not-to-miss opportunity to improve compatibility of climate and trade regimes and help manage the risks of geopolitics of decarbonisation. The EU in fact intends to prioritise the reforms for sustainability (EC 2021).

Trade agreements

The past decades saw an **increasing fragmentation** of trade regimes under various preferential and free trade agreements (FTAs) (Jaimovich and Baldwin 2012; Baccini 2018; Droege et al. 2018). Academics often use the "spaghetti bowl" analogy to describe this development (Droege et al. 2018: 13). Regional trade agreements have been spreading rapidly, with "mega-regional" agreements[5] identified as a trend, albeit with many uncertainties (Mehling et al. 2019; Droege et al. 2018; EIU 2019).

Trade and investment agreements can be a **platform to introduce and diffuse sustainable trade rules**, including provisions to foster climate action and enhanced social standards (Das et al. 2018a; Lechner 2020; EC 2021). Such agreements can promote low-emission economic activities, helping "pave the way for more global cooperation in a time when interest in global talks is low" (Droege et al. 2018: 29). They can also be designed to ensure that business actors do not undermine national sustainability action through the investor-state dispute settlement mechanism or expropriation clauses (Martini 2017; UNCTAD 2018; Droege et al. 2018). The recent agreements – between the EU and Singapore, the EU and Canada, between Korea and Australia and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) – largely fall behind their potential to support climate action[6] (EIU

[5] Examples are the Comprehensive Economic and Trade Agreement (CETA), Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) or Regional Comprehensive Economic Partnership (RCEP).
[6] The Economist Intelligence Unit (EIU) identifies seven "opportunities for boosting climate-friendly trade flows": removal of tariff barriers on environmental goods and services; removal of non-tariff barriers on environmental goods and services, explicit limits on fossil fuel subsidies, green procurement, border adjustment carbon taxes, international cooperation on climate change goals,

2018). The EU has increasingly been using trade relations with its partners to promote sustainability and considering a stronger alignment of its trade deals with the Paris Agreement (Lechner 2020; EC 2021). Its regional strategies underline the role of trade cooperation, including of trade and investment agreements, in strengthening sustainable and low-emissions transformations in EU's partner regions (e.g. EC and HR 2020a; Council 2021; EC and HR 2020b; Council 2019). Among the more environmentally progressive FTAs, the EU-Singapore agreement "explicitly seeks to facilitate trade in climate-friendly goods and services" while reducing non-trade barriers for renewable energy and trade distortions from fossil fuel subsidies (Droege et al. 2018: 26). However, the ambition level of these provisions is considered low (EIU 2019).

A specific instrument has been introducing **trade and sustainable development (TSD) chapters** in its FTAs. These also promote dialogues on sensitive issues and the establishment of institutional and civil society structures. The experience has shown that TSD chapters have key limitations in promoting higher labour or environmental standards such as weak civil society, insufficient targeting, a 'one size fits it all' approach and uncertain purposes decrease their ability (Harrison et al. 2016).[7]

Some studies see sustainability provisions in trade agreements as a function of **EU domestic economic interests** to a certain extent (McNeill 2020; Poletti et al. 2020). For example, the Mercosur FTA, a planned agreement between the EU and Brazil, Argentina, Uruguay and Paraguay, incorporates additional requirements for tropical timber which could compete with the comparably expensive EU forestry sector. Similarly, it has been pointed out that Austria's veto on the Mercosur FTA, reportedly because of the uncontrolled burning of Brazilian tropical forest, delayed the entering of South American beef in the EU markets. This favoured Austrian farmers' more cost-intensive organic meat (McNeill 2020).

The EU can do much to foster sustainable food systems through trade-related measures. But it requires a differentiated understanding of current barriers.

Fair and sustainable trade rules are an important piece of the jigsaw, and yet the **fairness and sustainability challenges are rooted deeper**. Trade incentives in and of themselves can hardly overcome broader governance and institutional capacity challenges or economic imbalances. Appropriate trade incentives and national and international support to low-emission economic activities could rather create a virtuous cycle to boost climate-compatible economies.

For instance, the **trade in agricultural goods between Africa and EU** is often subject of heated debate from development, economic and environmental perspectives.[8] African exports of agricultural goods have "largely been duty-free under various agreements" with the EU (Kornher and von Braun 2020), but still face many barriers to accessing and succeeding on the European market, including bureaucratic challenges. At the same time, the impact of European agricultural policies on the competitiveness of African agricultural products tends to be overestimated, even though some negative effects remain with specific measures (Rudloff and Brüntrup 2018; Foote 2020).

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and approval of non-discriminatory renewable energy subsidies (2019: 19). While these options are often included in the agreements analysed, many provisions are non-binding or show low level of ambition (EIU 2019).

[7] Studies on the TSD chapters' achievements in relation to addressing labour standard issues show unsatisfactory results and an overall failure to improve the labour standards governance (Harrison et al. 2018). Similarly, the effectiveness of transnational and domestic civil society mechanisms as well as cooperation across actors has proven to be limited (Orbie et al. 2016). While better monitoring and dialogue mechanisms could increase the success of labour standards, such measures require financial resources and qualified personnel (Schmieg 2018).

[8] Africa-EU trade relations also reflect the heterogeneous nature of present trade regimes: EU has a long-term vision of a "comprehensive continent-to-continent free-trade area" based on the recently achieved agreement on the African Continental Free Trade Area, but expanding and deepening Economic Partnership Agreements with individual countries and Regional Economic Communities in Africa is the cooperation focus. These structures are said to be able to contribute to a green transformation (Council 2020; EC and HR 2020a; Hogan 2020). The EU is looking to secure Africa's support for a "rules-based multilateral trading system" and a WTO reform (Council 2020: 6; EC and HR 2020a: 7). These efforts and fostering mutually beneficial green transformations on both continents can create synergies for a more balanced and less risky transition.

EU can do much to **foster sustainable food systems through trade-related measures**. But it requires a differentiated understanding of current barriers, shared on both sides, and a comprehensive policy mix to tackle them at different entry points. In this, sustainable trade agreement clauses can be supported by appropriate measures to improve market opportunities for African producers, including Aid for Trade measures, support in complying with respective standards (while also making these more attainable), and policies to invigorate investment and private sector activity (Rampa et al. 2020; Kornher and von Braun 2020).

At the same time, trade and investment agreements[9] have a **geopolitical dimension**, as they pursue both economic gains and expansion of political influence and can reflect geopolitical rivalry (Eichengreen et al. 2019; Hinz 2017; Ledermann and Özden 2007; Janusch 2016; Vicard 2012). China's expansion in global trade in light of its geopolitical ambition is frequently a subject of analysis, often together with possible US and EU response strategies and in the context of the geopolitics of the Asia-Pacific region (Perthes 2020; Bendiek and Lippert 2020; Rajah and Leng n.d.; Hilpert 2021; Solís 2021; Wang 2004). For instance, the planned Trans-Pacific Partnership (TPP) was discussed as part of the US "pivot to Asia", while China's economic activities in the region were seen as a response to this. The TPP efforts were discontinued by the Trump administration, leading to CPTPP without the US. However, the country might turn to expanding economic ties in the Asia-Pacific again under the Biden administration (Cai 2017; Ghiasy and Zhou 2017; Solís 2021).

Trade relations and dependencies, including the existence of preferential trade areas, can be an **indicator of political ties or influence** (e.g. Wrobel 2019, Hilpert 2014). For example, the Russia-led Eurasian Union is a regional economic integration project that supports the country's political influence, creates a counterweight to China and even provides Russia with leverage over the members' economic relationships with third parties (Pieper 2020). Establishing trade agreements can be a "defensive" move in order not to lose advantages in comparison to powers who deepen their economic integration with other countries, a possible reason for the rapid spread of FTAs (Jaimovich and Baldwin 2012). Finally, trade agreements often emerge in conditions of entrenched (economic) **power asymmetry**, and this can be reflected in different motives to enter such an agreement. Bigger trading partners might be more likely to choose smaller partners for political reasons rather than for purely economic benefit (Hinz 2017).

[9] Investment provisions have increasingly found their way into trade agreements (Droege 2018 et al).

While a complex task in itself, supporting low-emission economic transformations through regional economic cooperation also interacts with **specific geopolitical conditions** in each region. Visions of greener trade could be at odds with geopolitical goals partners pursue with FTAs and face additional difficulties on this account. Fostering green trade might mean worse conditions for “conventional” goods and services, cause fairness concerns, be perceived as an imposed trade restriction or lead to a loss of influence vis-à-vis other parties. However, geopolitical motives can also foster certain “green” trade flows, if actors use decarbonisation-related economic demands for resources or technology to gain international influence. Regional and bilateral cooperation arrangements are likely to be an important building block of greening trade while managing risks, especially while WTO reforms are stalled.

2.2.2 Carbon border adjustments

CBA are an option to **account for the fact that climate ambition is uneven** across different economies that interact on a globalised market. A “tariff or other fiscal measure for imports” to the jurisdiction with stricter climate measures is the most commonly discussed form of CBA, but exports can also receive rebates of “domestic carbon constraint through tax or regulatory relief” (Mehling et al. 2019: 442). This reduces economic disadvantages for actors that need to comply with stricter emissions regulation such as a higher carbon price.

CBA primarily aim at **avoiding carbon leakage** – i.e. transfer of carbon-intense economic activities to jurisdictions where climate policies put less economic pressure on them, which could increase global emissions. At the same time, CBA help “level the playing field” for those actors exposed to international economic competition that face higher decarbonisation pressures. Finally, CBA might give countries with lower levels of climate ambition an incentive to enhance their efforts. The literature sees CBA as the only unilateral policy option that, in theory, is able to perform these functions simultaneously (Mehling et al. 2019).

There are various design options for CBA discussed in an extensive body of literature. Experts highlight several points a **CBA design should provide for**: compliance with international trade rules, fairness considerations, multilateral approach, and the credibility of the mechanism as climate mitigation measure (Droege and Fischer 2020; Mehling et al 2019).

The EU has presented its first specific proposal of a Carbon Border Adjustment Mechanism (CBAM)[10] as a part of implementing the European Green Deal, which foresees the introduction of a carbon adjustment through purchasing certificates linked to the EU Emission Trading System (ETS) allowance prices ("notional ETS") for imported cement, steel, electricity, aluminium, and fertilizers based on the emissions embedded in these products, starting 2026. This cautious approach of the Commission might be "owed to concerns over diplomatic and legal pushback from trade partners, a desire to minimize resource shuffling, as well as power wrangling and industry concerns" (Marcu et al. 2021).

Critics maintain this might hinder emerging country exporters' access to markets of the advanced economies, could be protectionist and unfair, potentially creating two trade blocs (Tsafos 2020; Sapir and Horn 2020). First scenarios show that some countries are more vulnerable to CBAM than others (see Figure 6) and developing countries might be affected more than developed ones, while overall the expected reduction of exports to the EU is limited[11] (UNCTAD 2021). Specifically, the requirement to calculate all embedded emissions and disclose value chain information discriminates against countries with lower capacity to handle such processes (Zachmann and McWilliams 2020). CBA-related trade deviations and resulting economic and political disadvantages might motivate countries to pursue countermeasures or litigation at the WTO (Sapir and Horn 2020; Hillmann 2013). The EU had, however, prioritised WTO compatibility in the CBAM design.

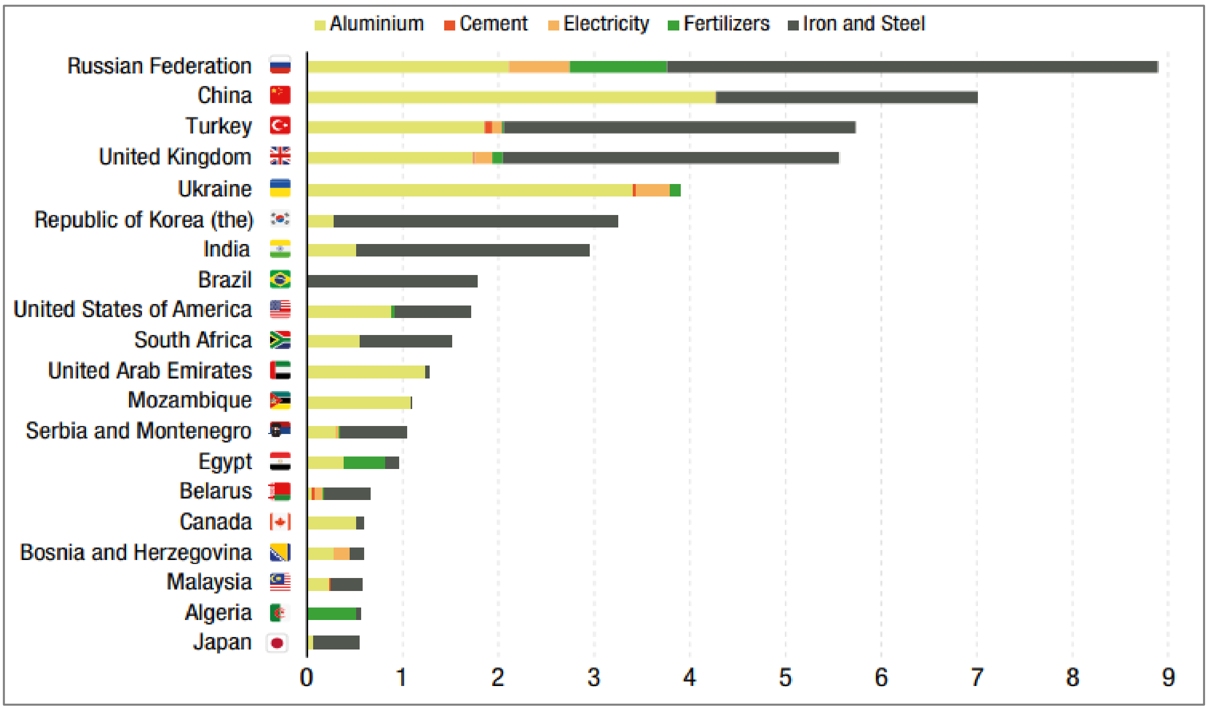


Figure 6: 20 most exposed countries to the European Union 2019 in selected sectors likely to be considered in the CBAM, in terms of aggregated value of exports (billion USD). Source: UNCTAD based on UN COMTRADE.

[10] This paper uses CBAM to refer to the specific proposal by the EU and CBA to refer to the political instrument overall, that could have different designs and be introduced by different jurisdictions.

[11] "The simple average reduction in exports by developing countries across the targeted carbon intensive sectors is only 1.4 per cent when the CBAM is implemented with a $44 per tonne tax, and just under 2.4 per cent when implemented by an $88 per tonne tax. It must be pointed out that in these two scenarios, however, developed countries do not suffer export declines. This is expected since developed country producers, as a whole, employ less carbon intensive production methods in the targeted sectors than their developing country counterparts." (UNCTAD 2021)

Introducing such regulations is a “**political minefield**” (Droege et al. 2018: 31). The controversies around the CBA had been widely discuss even before the EU presented a specific draft, and at the same time, a more challenging geopolitical environment might have improved conditions for introducing such a measure. Research observes that “deterioration of trade relations could expand the political opportunity space” for such measures, as “earlier sensitivity” against them decreases in the wake of trade conflicts and growing mistrust towards liberalised international trade (Mehling et al. 2019: 440, 436). In its Trade Policy Review, the Commission states with regard to CBAM that “autonomous measures are supporting the objective to ensure that trade is sustainable, responsible and coherent with our overall objectives and measures” (EC 2021).

As CBA **redistribute benefits and disadvantages** among countries, it is not surprising that they are contested (Mehling et al. 2019). For example, current steel import from China is highly carbon intensive as opposed to the US and South Korean steel industry. A CBA could therefore result in trade flow deviations: Ukrainian steel exports might be redirected from the EU to the US, increasing the sale of lower-carbon steel from the US to the EU (Zachmann and McWilliams 2020). In the short to medium term, this would weaken the position of China in the EU while strengthening that of the US (Aylor et al. 2020). Consequently, depending on the concrete design of the CBA, reactions from China and the US may be unfavourable for exports in the EU, increasing the risk of a minor trade war between the economic powers (Chemnick 2020).

Possibilities for the deep decarbonisation of energy intensive industry open up for new co-operations, as well as tensions. In the long term, strategies to reach net zero emissions from heavy industry can reconfigure supply chains profoundly, as it may become more competitive to locate energy intensive production in other places than before or some of the processes within the supply chain. Reliable access to low-carbon energy can become important for businesses choosing their localisation in addition to proximity to other resources, such as natural and human capital, and demand centres (Gielen et al. 2020; Samadi et al. 2021). To what extent such reconfiguration will take place depends on the co-evolution of several factors including the technologies that will be used in heavy industry, transport costs, circular economy policies put in place, development of internationally traded green energy carriers and policies designed to prevent carbon leakage.

Such tensions should be managed proactively: **communication and transparency** towards partners are central as well as the credibility of CBA as a measure to lower emissions, not to secure economic advantages which need to be ensured through the policy design in the first place (Mehling et al. 2019; Droege and Fischer 2020). For instance, there is merit in exploring coordination on CBAs between the EU, China and the US, as all three players are aiming for climate neutrality by mid-century and could all face leakage issues (Tänzler et al. 2021b). The new German government has suggested a climate club of which CBAM could be part (Schäfer et al. 2021). The negative reactions of third countries to the EU plans alert to cooperation challenges (Lo 2021; Kardish et al. 2021; UNU-INRA 2021; Sapir 2021), but many entry points for political and technical dialogue remain (Kardish et al. 2021; UNU-INRA 2021).

2.2.3 In sum

The “trade game” will need new rules in a decarbonising world. Economic interconnectedness calls for an **alignment of trade institutions and trade-related national policies with decarbonisation efforts**. Trade regimes are essential in structuring trade flows and can play an important role in promoting reliable supply chains and greening trade. National policies need to account for international factors to avoid carbon leakage and ensure unencumbered exchange in goods and services necessary for low-emission transformations. Finally, greening trade requires **complementary dynamics with non-trade economic and development policies**.

The **geopolitical dimension** of the multilevel, overlapping trade regimes should not be underestimated. WTO reforms might be leveraged to benefit the sustainability agenda and multilateral trade governance, but remain very challenging in the current geopolitical landscape. Negotiating economic cooperation agreements is part of larger diplomatic agendas to gain international power and is contingent on the state of international relations. Furthermore, unilateral policies to advance the implementation of the Paris Agreement in a trade-connected world, such as EU’s CBAM, may lead to geopolitical tensions. At the same time, their success hinges on their compatibility with the multilateral trade regime and acceptance by trade partners. Therefore, establishing CBA needs to be accompanied by sophisticated international cooperation strategies. **Building coalitions** for a fairer and more efficient trade regime might be synergetic with searching for mutually beneficial green trade arrangements. However, this is an extraordinary complex puzzle to solve.

2.3 Transportation: setting trade in motion

International trade is itself a **source of emissions as it relies on transporting goods internationally** as supply chains are highly globalised. Around the word, decarbonisation of transportation poses paramount challenges. While green urban transportation can count on vast co-benefits and a progressing cultural change for success, freight, shipping and aviation sectors are difficult to decarbonise (IRENA 2020; Davis et al. 2018). Furthermore, shifts in commodity trade discussed in section 2.1. partly require new and reconfigure existing transportation infrastructure (Ueckerdt et al. 2021; Van de Graaf et al. 2020). Transformations in the transportation sector related to decarbonisation will interact with geopolitics.

2.3.1 Trade-related transportation emissions

Transportation emissions are estimated at **one-third of all trade-related emissions**. However, given the lack of data and inadequate measures that attribute international transport emission to origin and destination countries, these emissions are often overlooked (Cristea et al. 2011). The International Transportation Forum (ITF) estimated that “international trade-related freight transport currently accounts for around 30% of all transport-related carbon dioxide emissions from fuel combustion, and more than 7% of global emissions" (ITF 2015: 3). Road transport is the most common mode and carries the largest share of international trade-related emissions (53%), followed by maritime (37%) and air (7%) transport. Rail only accounts for 3% of global trade-related transport emissions (ibid.).

The 10% of international trade that happen within domestic borders[12] has a major carbon footprint, due to the high percentage of road transport to move goods from international hubs to consumers. Emissions from international trade-related freight transport are expected to almost quadruple by 2050 in a baseline scenario (ibid.). It is among the most difficult to decarbonise (IRENA 2020) and "tends to react less and later to mitigation policies than other sectors" (Pietzcker et al. 2013: 2). It is estimated that decarbonisation of the cross-border goods transport sector lags 10-30 years behind other sectors in the first half of this century (ibid.).

Whether increased **trade and trade liberalisation** lead to higher or lower emissions is contested.[13] While some argue that trade openness fosters efficiency in resource allocation and access to green production technology, others highlight the high levels of pollution and emissions that come with expanded production and consumption. Empirical findings are mixed. Cristea et al. (2011) find **that importing goods from low emission producers can reduce emissions**, if a country itself has high output emissions and finds ways to transport goods efficiently. An ITF calculation suggests that liberalised multilateral trade might **increase carbon dioxide emissions from trade-related freight transport** by 15% by 2050, compared to a business-as-usual scenario (ITF 2015: 9).[14]

2.3.2 Mitigation options

A mix of mitigation approaches is required, including the switch to low-carbon fuels, improved vehicle and engine performance technologies and modal shifts (IPCC 2014; IRENA 2020). However, freight transportation poses specific challenges. Switching to low-carbon or carbon-neutral fuels is problematic for aviation, long-distance transport and shipping (Davis et al. 2018: 1). Currently, diesel heavy-duty trucks can carry up to 40 % more goods than e-trucks with lithium-ion batteries (Davis et al. 2018). Coming generations of solid-state lithium batteries have much higher energy densities, but they are still

[12] In tonne-kilometres

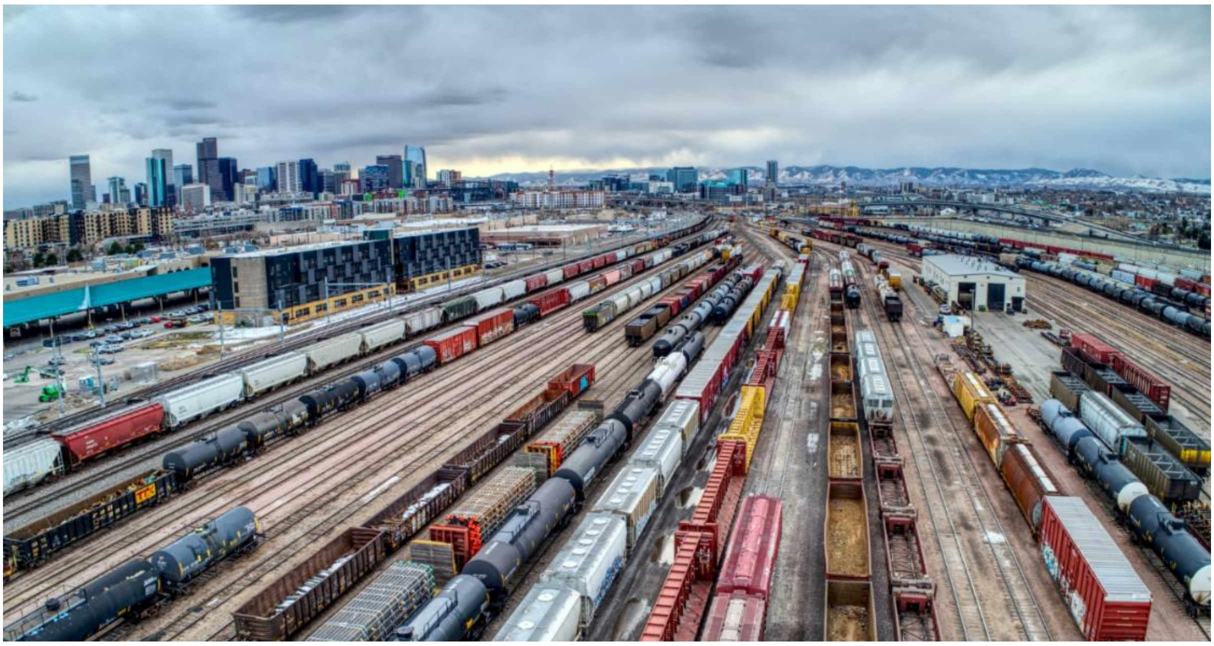
[13] Scenario exercises also face data challenges. For instance, Kim et al. (2019) investigate the relationship of trade and carbon emissions within and between developing and developed countries. However, the study only considers trade as a whole and does not look specifically at trade-related transport emissions, due to a lack of precise data.

[14] Overall, calculations that account for the effects of the shifts in consumption and production patterns of the magnitude and complexity that can be expected in wake of decarbonisation and digitalisation of economies on global trade-related transportation seem to be lacking in existing literature.

in the research and development phase (Zheng et al. 2018). E-fuels could contribute to decarbonisation of heavy-duty vehicles, shipping and long-distance aviation, but likely after 2030, when electricity used to produce e-fuels is largely decarbonised (Ueckerdt et al. 2021).

Kaack et al. (2018) see huge potential from **modal shifts** to reduce GHG emissions. They propose two types of policy approaches: infrastructure investments that focus on the construction of efficient rail and intermodal terminals, and discouraging road freight through pricing mechanisms or tighter regulation. The ITF (2019) considers modal shifts (for example, from road to rail) difficult because of the flexibility and accessibility that road freight transport offers are hard to replace.

Structural **supply chain changes** due to localising production and shifting origin-destination patterns represent another option (McKinnon 2016). However, this needs a differentiated assessment. For food trade, for instance, “savings generated by replacing ship-freighted international goods with locally produced and trucked goods will be modest”, but locally produced goods can reduce emissions when they replace those distributed by long-distance trucks (MacRae et al. 2013: 954).[15] If food systems are reconfigured in tandem with consumption and waste management systems, local supply chains can increase nutrient recovery and reduce imports (such as phosphorous and potassium) with low GHG-emissions (Harder et al. 2019). Supply chain localisation would require an extensive institutional process and fundamental changes in business practices (Wu and Jia 2018).



From a **governance perspective**, decarbonisation of the transport sector is a complex matter (Cristea et al. 2011). Even universal accounting of transport related emissions is contested due to the conflicting interests of importers and exporters. This attempt of the EU to integrate aviation emissions in the EU ETS has become a cautionary tale in the context of CBAM, as non-EU countries claimed trade rules violations (Sapir 2021). Mitigation leverages are complex and located on different governance levels: it concerns local and sub-regional decisions on supply chains, national transportation planning and international maritime or air transport regimes. The sector’s optimal decarbonisation strategies are difficult to devise in face of this complexity and uncertainties, and the implementation challenges are likely much greater. In light of this, it is even more important to recognise decarbonisation as a priority for transportation infrastructure policies and cooperation.

[15] When designing mitigation strategies, transportation emission impacts need to be considered in relation to other emission sources in a given sector. For food systems, transportation accounts for 1-9% of the total supply chain emissions (including packaging and retail) (Poore and Nemecek 2018), which is still significant in absolute terms.

2.3.3 Geopolitical aspects

Moreover, these policies and strategies are embedded in **geopolitical dynamics**. Developing trade, competing for markets and technological leadership is an important part of international politics, and transportation infrastructure is a key element. This is demonstrated by the proliferation of connectivity initiatives – by Australia, the EU, Japan, India, the US and, of course, China with its Belt and Road Initiative (BRI) (Plagemann et al. 2021; Godehardt and Postel-Vinay 2020; Pepe 2020; Islam et al. 2019). Prominently, the G7 have launched the G7's Build Back Better World initiative, partly as a response to the BRI (Holland and Faulconbridge 2021). The state of multilateral structures, the ability to use international governance structures and the willingness to negotiate joint solutions for connectivity could determine where synergies can be harnessed through cooperation and where a competitive mind frame will dominate.

> ***In view of the pandemic experiences, supply chain resilience has become a priority for globalised markets such as the EU.***

While **sustainability** is increasingly discussed as a **criterion for connectivity initiatives** (e.g. EC and HR 2018; Pepe 2020), this is clearly a relatively new and not a priority concern. At the same time, large infrastructure cooperation initiatives, albeit created with (geo-)economic and (geo-)political motives, could be leveraged to bring decarbonisation efforts to international scale, using cooperation structures (for instance, on technical standards enabling cross boarder high speed rail networks and electrified road transport) in place (e.g. Pepe 2020). Furthermore, due to the pressing need for decarbonisation of the sector, it is also possible that providers of viable solutions gain significant competitive advantages and possibly political influence in the future. Especially, in view of the pandemic experiences, supply chain resilience has become a priority for globalised markets such as the EU. Excessive dependence on other powers – notably, China – is seen as a risk, while opportunities for "reshoring" are discussed (Raza et al. 2021; Pepe 2020).

2.3.4 In sum

Moving the pieces in the "trade game" will pose new challenges as decarbonisation progresses. Trade in both high- and low-emissions economies is impossible without transportation. Though technical options and extensive research exist, defining and implementing **tangible solutions to decarbonise the long-distance transportation of goods remains a challenge** in the short term, even within countries or integrated regions. International transportation needs for low-emission economies bring about much uncertainty. Resilience concerns with regard to supply routes for emerging commodities, strategic use of green infrastructure solutions, and geopolitics getting in the way of integrated green connectivity are some of the possible issues around international trade-related transportation.

If multilateral coordination is insufficient, **geopolitics is likely to pose additional challenges to decarbonisation, in parallel to synergies in specific cases**. The EU advocates for sustainable and rules-based connectivity, but concrete steps to make it compatible with the Paris Agreement have been highly challenging. With its Global Gateway initiative, the EU might be better positioned to accomplish this[16]. Decarbonised connectivity cooperation could become EU's "trademark offer" to its partners, possibly supporting some of its goals in international relations.

[16] The recently initiated Global Gateway has not been systematically analysed for the paper.

3. Areas of interest for European policy makers

3.1 Trade – at the confluence of EU's strategic challenges

Understanding the nexus of geopolitics and decarbonisation should ultimately help policy makers raise global climate ambition and reduce (geopolitical) transition risks. For the EU, the world's largest single market area and a highly interconnected economy, the pursuit of these goals will inevitably pose trade-related questions. This section briefly highlights three recent policy developments that, setting the context for European external action in the future, already reflect geopolitics, decarbonisation and trade topics prominently:

- → the European Green Deal that now marks the framework for the EU's external action,
- → the evolution of the EU's external cooperation structure,
- → and the Trade Policy Review that offers a new strategic direction for trade.

The **Green Deal** brings the low-emission transformation to the core of the EU's international affairs. The Green Deal document reflects upon its international context and the importance of trade as a platform for engagement on decarbonisation with other actors. It underlines the increasing "green" elements of trade agreements as a transformation incentive outside and the need to secure the raw material supply for low-emission transformation inside the EU (EC 2019: 21). Both the Green Deal itself and the accompanying Council Conclusions "Delivering on the external dimension of the Green Deal" highlight the geopolitical dimension of decarbonisation (EC 2019: 21; Council 2021).

Trade policy is a powerful instrument for the EU, and many hopes lie with it to support global transformations – in the economic domain as well as with regard to geopolitical, social and environmental goals.

The EU has been **revising its partnerships**. Many of the new strategies towards other regions bear the mark of the Green Deal, the "geopolitical Commission" (EC 2019; Teevan 2019) and mention trade-related goals, for example, the WTO reforms (see chapter 2.2.1). This demonstrates how the EU seeks to globalise low-emission transformations, building on its own experiences. It also shows that the EU is seeking to strengthen its influence as a cooperation partner that is able to support green solutions for the socio-economic challenges of its partners. The opportunities for international green leadership are furthermore shaped by the major overhaul of its development cooperation structure – including the establishment of Neighbourhood, Development and International Cooperation Instrument (NDICI) under the new Multiannual Financial Framework 2021-2027, a new agreement with African, Latin American and Caribbean states and the Team Europe approach (EC 2020; Medinilla 2021; Tänzler et al. 2021a). Trade-related topics will be at the centre of this, as the appetite for trade cooperation with the EU will likely persist.

Importantly, the issues this paper discussed resonate with strategic challenges of European trade policy overall. The recent **Trade Policy Review** presented by the Commission is a case of external policies increasingly integrating climate change and sustainability. It also evidences the efforts to adapt the EU's trade policy paradigm to current international trends, balancing different objectives. The document highlights sustainability, openness and multilateral governance of trade as well as EU's resilience as a market. It aims to promote a more assertive position for the EU as a trading power, not least vis-à-vis its competitor China (EC 2021).

The confluence of multiple requirements towards EU's trade strategies with regard to sustainability and international affairs is evident in the response of the European Parliament to the Commission's suggestion. It "stresses that trade policy finds itself at a crossroads" as "the geopolitical reality has changed and […] the EU still has to position itself in this new environment" (EP 2021: 6). It highlighted that trade policy should promote sustainability, climate action and equality as well as help the EU strengthen its international standing (EP 2021). Furthermore, the EP "is convinced that **COVID-19** has reinforced the need for a thorough review of the EU's trade policy". Thus, the pandemic underlined various vulnerabilities of societies and markets, giving new momentum to the concept of a green and just economic recovery, also affecting the tasks of trade policy.

As international politics and climate action become ever more interwoven, the EU needs to **prioritise a global low-emission, low-risk transition** in all its external action (see also Tänzler et al. 2021a). Because decarbonisation is embedded in geopolitical dynamics, the success of climate action hinges on taking geopolitics seriously *and* reducing its interference with low-emission transformations. This includes coping with geopolitical difficulties linked with decarbonisation as well as exercising caution with regard to the instrumentalisation of climate policy for geopolitical objectives. While the Green Deal offers an important compass to align the EU's external agenda, in many cases we can expect conflicting objectives that need to be resolved, rather than a complete fit. This will require a comprehensive, context-specific assessment of the distribution of disadvantages and benefits.

Shaping the EU trade is one of the top policy areas where decision-makers will need to search for this difficult balance. Trade policy is a powerful instrument for the EU, and many hopes lie with it to support and to weather global transformations – in the economic domain as well as with regard to geopolitical, social and environmental goals. But achieving progress towards these multiple goals in different regional contexts would require sophisticated policy design, sustained political and economic investment, and substantial institutional capacities.

3.2 Entry points to improve analysis and policy responses

All three dimensions of trade – **substance, institutions and transportation** – have a geopolitical component and will likely experience shifts in the course of decarbonisation. Following the chess analogy, the pieces, the rules and even the mode of moving the pieces around are likely to change. Given the expected scale and multidimensionality of this change, trade might become an entirely different "game" in the coming decades. Among the challenges this has in store for decision-makers are: planning for an uncertain future, finding the right balance of priorities and achieving policy coherence.

In the following, we highlight entry points for EU policy makers to improve the analysis and to advance policy responses in order to prepare for a changing "trade game".[17] This can build on more in-depth research that is available on the different topics, cited throughout the paper. Along all three dimensions identified, region-specific insights and actors mapping might help unravel the complexity. Transparent dialogue with partners, whenever politically feasible, could enrich the results of these exercises.

3.2.1 Substance

Managing shifting commodity flows is a central task for economies as decarbonisation progresses. Providing for stable supply of the raw materials of the future and harnessing new opportunities is already on the agenda of state institutions and private actors. Hydrogen strategies of different countries as well as coping strategies for metal procurement demonstrate how actors prepare for the future and explore partnerships under economic and political angles. Avoiding new vulnerabilities that may entrench global inequalities and present international stability risks is a significant part of this. In a joint quest for more stable supply and competitiveness, political institutions need to safeguard matters of public interest, while the private sector can provide innovation and investment capacities. Geopolitics of decarbonisation might therefore call for new modes of coordination between governmental institutions and the private sector.

Possible entry points for analysis:

- → **Create mechanisms to forecast the shifting material needs of the EU** in the wake of decarbonisation compatible with the goals of the Paris Agreement, in order to better grasp the scale of change and the challenges. This should enable comprehensive analysis across different commodities and economic sectors as well as processing data dynamically as it is emerging and being refined, for example, in face of progress of the circular economy and technology evolution. For this highly complex exercise, the EU could draw on experiences with the European Union Raw Materials Knowledge Base (EURMKB) and Raw Materials Information System (RMIS), while setting a clear sustainability focus and assessing all commodity needs.[18]
- → **Produce granular insights into potential trade flow shifts**, including their interactions with EU's external partnerships, within the respective regional contexts. Such analyses could explore actors' strategies in response to the EU's transformation policies in a given partner region: for instance, of countries who currently profit from trade in high-emission commodities and of those with high prospects for emerging low-emission markets. A combination of qualitative and quantitative methods, participative foresight approaches and including a wide spectrum of stakeholders can improve the results.

[17] It is therefore understood that this section is guided by EU's perspectives on trade, decarbonisation and international politics, and views of other jurisdictions on these topics can differ substantially.
[18] The EU could furthermore harness the expertise of international institutions such as the International Energy Agency, and national-level experiences with research units such as the Federal Institute for Geosciences (BGR) and Natural Resources in Germany or the United States Geological Survey (USGS).

- → **Establish policy-oriented monitoring of geopolitical risks** related to decarbonisation. This could follow the structure of the newly established NDICI, so the monitoring outcomes can help shape the portfolio of its regional pillars. The process could be supported by information from the wide diplomatic and development cooperation networks of the EU and its Member States across the world.
- → **Map strategic interests and positions within the EU** with regard to changing trade flows dynamics. The mapping scope should reach across different Member States, policy areas, governance levels, and private and public sectors. This exercise could also identify suitable formats and forums for policy coordination in the future, both existing and suggested in the literature.

Possible entry points to advance policy responses:

- → **Continue to align all areas of external action with the overall goal of reducing transition risks both in the EU itself and for its partner countries.** Coordination is also required within governance networks of the EU, i.e. where it engages with Member States and non-government actors, including searching for public-private interactions that maximise synergies and manage conflicts of interest with regard to more sustainable and resilient supply chains.
- → **Continue to align EU's partnerships with today's fossil fuel producers with imperatives of economic diversification and just transition**. This should build on existing instruments of cooperation in trade and investment, energy, environmental, climate and other areas, and take the (post)pandemic challenges in different regions and counties into account.
- → **Work towards establishing international markets for low-emission, energy-intensive commodities and cooperative approaches to green commodities**. This could be complemented by an action plan that aligns development and science and technology cooperation with different countries and regions with these goals, depending on their interests and strengths.

3.2.2 Institutions

Trade institutions and governance mechanisms on different levels need to evolve in a decarbonising global economy. They can promote non-trade objectives, including low-emission development and reliable transition governance, especially if they are in sync with domestic economic policies. Yet, the multilateral trading regime is facing important challenges, and strengthening trade ties with economic agreements is connected to the search of political partnership and alliances. Reforms that help secure open, rules-based trade for the future could help advance decarbonisation goals as well as reduce geopolitical risks emerging from shifting trade flows. But the many functions of the EU's trade policy can also be a burden to it, creating complexity that is difficult to manage and straining policy making capacities. Therefore, involved stakeholders need a detailed understanding of these interactions that is supported by international perspectives exchange and a clear strategic compass.

Possible entry points for analysis:

- → **Systematically include decarbonisation aspects in EU's analyses of how international governance could deal with rivalling perspectives on trade**. Building on the role sustainability already has in the Trade Policy Review, the EU could analyse possible institutional responses on different levels to the risks of decarbonisation-related trade shifts, including commodities, technology and infrastructure. This encompasses identifying specific steps to bring the WTO reform efforts together with greening the organisation's rules and proceedings. It also includes spelling out how trade agreements could achieve their full potential in fostering green trade while strengthening the parties' front-runner advantage on green markets.

- **Scrutinise the positions of other actors towards open rules-based trade in relation to climate topics**. Identifying specific points of contention in bilateral and regional partnerships could help the EU devise negotiating strategies to build alliances for green rule-based trade and attenuate tensions, also in wake of the first CBAM draft. This would also include analysing potential tensions with other policy areas. For instance, while technology sharing can boost green trade, it could also raise competitiveness or geopolitical concerns in some contexts.
- **Elaborate holistic policy schemes to boost green trade with EU's partner countries and regions**. This would help achieve an effective combination of incentives through trade regimes and development cooperation for key branches of a decarbonised future. This analysis should render options suitable for the economic structures of the partner countries and respond to pressing socio-economic needs, creating welfare benefits across societies.

Possible entry points to advance policy responses:

- **Set up an action plan** to further integrate the trade agenda with the Green Deal. It could devise a specific roadmap to bring EU's existing and upcoming trade and investment agreements in line with the Paris Agreement and the 2030 milestones of the Green Deal. This should be coordinated with the envisioned efforts to improve TSD chapters.
- **Establish green trade governance dialogue with partner regions** (e.g. Africa, Latin America and the Caribbean as well as the EU neighbourhood). This should include the needs and concerns on both sides, analysing shortcomings of existing measures for green trade, and discussing mutually beneficial solutions and effective multilateral trade governance. The planned CBAM and its possible advantages for establishing green trade flows could be part of this dialogue.
- **Pilot selected green trade partnerships**. Such partnerships would combine trade agreements with a comprehensive policy package to diversify economies based on strengthening low-emission sectors and investing in skill development and innovation. These initiatives could include private sector and civil society actors.
- **Build capacity of the EU's external relations staff on how trade institutions interact with geopolitics of decarbonisation**. This could include foresight, joint scenario and policy design exercises, both in internal settings and involving academia and international partners.

3.2.3 Transportation

Trade is currently made possible mostly through fossil-fuel-based transportation. Decarbonisation would modify transportation routes and the accompanying geopolitical calculi. At the same time, it is unclear how states' connectivity efforts in search for new markets and spheres of influence would align with the goals of the Paris Agreement. The lack of coordination in a competitive geopolitical setting further increases the risk of locking in high-emission development of the sector.

Possible entry points for analysis:

- **Analyse what new major trade routes and hubs could emerge due to decarbonisation**, in interaction with other global trends such as digital trade. (Participative) foresight exercises can be a useful tool for this.
- **Systematise knowledge on how connectivity agendas pursue the geopolitical goals of different countries in their respective regions**. The EU could analyse whether this can cause significant carbon lock-in and, vice versa, whether increased green trade could be a geopolitical instrument.

- → **Assess emission scenarios for transportation related to the EU trade**, including scenarios compatible with the Paris Agreement. These scenarios can help map actors that are involved in shaping EU's trade corridors – including EU institutions, private sector, Member States ministries, international organisations.
- → **Identify the coordination needs, possible alliances and appropriate forums for the EU to promote low-emission transportation of goods on key trading routes around the world**.

Possible entry points to advance policy responses:

- → **Set up formats for international dialogue to discuss how connectivity strategies can be coordinated to include decarbonisation and enable resilient supply chains**. This should promote transparency of the climate impacts of connectivity strategies and explore comparable sustainable standards. Such dialogues should happen on high-level and technical levels, could be open to the public and in exclusive political rounds, and should seek complementarity to existing formats such as within the ITF.
- → **Identify specific steps to further strengthen green and resilient connectivity through EU development partnerships**. This can help manage transition risks in its own connectivity networks through which needed goods and resources are delivered and promote green transportation worldwide by facilitating international coordination and sharing best practices.
- → **Set up a roadmap of how to mainstream decarbonisation across the EU's connectivity portfolio**. This should include using the full potential of all key areas of the Global Gateway strategy for promoting low-carbon and resilient infrastructure as well as compatible operationalisation of the EU-Asia Connectivity Strategy and the Member States contributions to the G7's Build Back Better World initiative.

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T: + 49 30 89 000 68-0
F: + 49 30 89 000 68-10
E: office@adelphi.de
I: www.adelphi.de

Authors Daria Ivleva, adelphi
André Månberger, Lund University
With contributions by Julia Kirr, adelphi

Design: adelphi

Text editing: Jonathan Randell Smith, Claudia Zwar

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