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E3G

Heavy Industries

Trade, Climate, and Net Zero Pathways: Scenarios and Implications for Developing Countries and Climate-Resilient Development

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TESS Forum on Trade, Environment, & the SDGs

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About This Series of Sectoral Briefing Notes

This briefing note is part of a series of sectoral notes commissioned by TESS intended to inform a final report on *Trade and climate scenarios on the road to 2050: Implications for developing countries and climate-resilient development.*

The series and the report aim to provide an overview of current and anticipated transformations in trade on the road to 2050 in the context of the unfolding climate crisis and the international community's climate action agenda and to discuss potential scenarios and implications for developing countries.

A wider objective of the series is to contribute to a better understanding of emerging trade and trade policy trends and dynamics and their implications within the various sectors, with a focus on supporting developing countries in identifying and advancing their climate change trade-related interests and priorities in international discussions.

The sectors covered in the series include agriculture, border carbon adjustments, carbon markets, critical minerals, digital trade, fisheries, energy, heavy industries, renewable energy, textiles, tourism, and transport, each authored by experts in these respective fields.

Abbreviations

CBAM	Carbon Border Adjustment Mechanism
CCfD	Carbon Contracts for Difference
CCS	Carbon Capture and Storage
CO2	Carbon Dioxide
COP28	2023 UN Climate Change Conference
EAF	Electric Arc Furnaces
EMDEs	Emerging and Developing Economies
ETS	Emissions Trading System
EU	European Union
EV	Electric Vehicle
GHG	Greenhouse Gas
IDDI	Industrial Deep Decarbonisation Initiative
IEA	International Energy Agency
IRA	Inflation Reduction Act
NDC	Nationally Determined Contribution
NIM	Net-Zero Industries Mission
OECD	Organisation for Economic Co-operation and Development
UK	United Kingdom
US	United States
WTO	World Trade Organization

1. Heavy Industries and the Trade, Climate, and Sustainable Development Nexus

Energy-intensive industrial sectors, such as steel, aluminium, cement, and chemicals are major contributors to climate change. The chemical and thermal combustion processes involved in the production of these materials account for roughly 17–20% of global greenhouse gas (GHG) emissions and are responsible for 15% of global final energy demand (IRENA, 2024). As energy and water-intensive sectors, these are also vulnerable to climate-related disruptions. Industrial plants are often located close to rivers and are dependent on them for inputs and moving final products, making them vulnerable to flooding and droughts.

At the same time, these sectors are expected to play a vital role in the climate transition, especially in emerging economies. Steel, cement, aluminium, and chemicals are key inputs into infrastructure, buildings, wind turbines, electric vehicles (EVs), and appliances. The bulk of the growth expected in the demand for these commodities is set to happen in emerging markets as they urbanize and build out their clean energy infrastructure. Cement demand, for example, is projected to increase by three to fourfold in developing countries in Asia by 2050 (Imbabi et al., 2012).

Industrial sectors are facing a significant expansion in demand at a time when their emissions need to fall fast. With the Paris Agreement goal of limiting global warming to 1.5°C, heavy industry sectors are now expected to rapidly decarbonize, approaching net zero by mid-century.

Meeting this goal requires overcoming the "trade-trapped" nature of these sectors. Steel, cement, and chemicals are traded across borders and face fierce international price competition. This makes it harder for producers to pass through the additional costs of investing in more expensive, cleaner technologies without impacting competitiveness. Policymakers have been wary of introducing policies that could affect the competitiveness of their domestic industrial sectors and risk carbon leakage.

Trade policy and international coordination are, therefore, key to successfully decarbonizing these sectors. The global nature of industrial sectors and their supply chains limits the effectiveness of measures targeted just at the national level. Moreover, several of the key industrial decarbonization policies being explored by countries—such as public procurement targets, product requirements, green industrial subsidies, and carbon border measures—run into challenging trade law territory and risk provoking tensions if not designed carefully, coordinated, and justified adequately.

2. Climate Action and Impact Scenarios in Heavy Industry Sectors: The Road to 2050

International Commitments Related to Industrial Decarbonization

In recent years, there has been a proliferation of platforms and initiatives providing opportunities for cooperation on industrial decarbonization. These initiatives have focused on cooperation on roadmaps for industrial decarbonization (LeadIT and Mission Possible Partnership), procurement (SteelZero, ConcreteZero, First Movers Coalition, Industrial Deep

Decarbonisation Initiative [IDDI]), innovation (Mission Innovation), finance (Industrial Transition Accelerator), and trade policy (the Climate Club, the EU-US Global Arrangement on Sustainable Steel and Aluminium) among other things. Such initiatives cover a set of broad commitments to progress ambition in this space.

Under the Steel Breakthrough, for example, members have committed to ensuring that "near-zero emission steel is the preferred choice in global markets, with efficient use and production established and growing in every region by 2030" (IEA, 2023a).

Table 1. Landscape of Key International Initiatives on Industry Decarbonization

Function	Key International Initiatives				
Landscape Coordination	Steel Breakthrough				
Long-Term Vision & Action Plans	Leadership Group for Industry Transition	Mission Possible Partnership / Industry Transition Accelerator	World Steel Association	Climate Club	
Demand Creation & Management	IDDI	First Mover Coalition	SteelZero	Climate Club	
Finance & Investment	Industry Transition Accelerator	Leadership Group for Industry Transition	Climate Club		
Research & Innovation	Mission Innovation's Net-Zero Industries Mission	IEA's Industrial Energy-related Technology and Systems			
Standards & Certification	Responsible Steel	First Movers Coalition	G7 Industrial Decarbonisation Agenda	IDDI	Climate Club
Trade & Competitiveness	OECD Steel Committee	WTO Trade and Environmental Sustainability Structures Discussions	Steel Standards Principles	Climate Club	

Source: E3G elaboration on IEA et al. (2022).

While these are welcome developments, they require the backing of ambitious national policies and commitments to deliver on the stated objectives. On an individual basis, very few countries have set emissions reduction targets for these sectors in their nationally determined contributions (NDCs). France and South Korea have dedicated steel decarbonization strategies, but both fall short of setting specific emissions reduction targets for steel. France has set a 31% emissions reduction by 2030 target for its chemicals sector (IRENA, 2024). Canada is the only country to have projected a decarbonization trajectory for its cement and lime sectors in its mid-century strategy (a 93% reduction on 2015 levels by 2050).

Projected Decarbonization Trajectories and Policies for Industrial Sectors

Emissions from energy-intensive industries need to fall by roughly 30% by 2030 (on 2022 levels) and by over 90% by 2050 (IEA, 2023c). So far progress has been lacking: after steep annual increases in emissions up to 2010, industrial emissions have largely flatlined in the last decade as demand for industrial products has reached the saturation level in most advanced economies (IEA, 2023b).

There has been little robust policymaking to drive change to date, especially in comparison to the energy

sector. Characterized as "harder to abate" due to their trade-exposed nature and the lack of readily available alternatives, industry sectors had largely been on the back burner for policymakers. As products from these sectors are globally traded and face strong price competition, policymakers have been reluctant to introduce stringent climate policies that could affect their competitiveness and risk carbon leakage.[1] For example, under the EU Emissions Trading System (ETS), industrial sectors continue to receive most of their emission allowances for free (ERCST, 2024). This has dampened the carbon price signal and, therefore, the incentive to invest in cleaner production processes.

In recent years, however, two important factors have changed, ramping up momentum for industrial decarbonization. First, the political narrative has started to shift. "Carbon leakage" concerns have been replaced by "low carbon leakage" concerns. Previously policymakers worried that domestic industries would be undercut by carbon-intensive production abroad. The concern now, especially in the wake of the US Inflation Reduction Act (IRA) and with China ramping up investment in its clean tech sectors, is that domestic industries will be overtaken by cleaner production elsewhere. Decarbonizing production processes is now recognized as a prerequisite for continued competitiveness, the creation of decent jobs, and economic growth. Second, increasing technological maturity and the rapid decrease in the costs of renewable power mean that the technological solutions for industry decarbonization are now either already commercially available or in sight (IRENA, 2024).

Growing confidence in the feasibility of industry decarbonization has opened the political space for more concerted policy efforts internationally. More countries are introducing or adapting existing carbon pricing mechanisms, such as the emissions trading system in the EU, South Korea, China, and other emerging economies like India. The EU also recently introduced the Carbon Border Adjustment Mechanism (CBAM), which will also result in the phasing out of free emissions allowances for industry sectors in the EU ETS. The IRA in the US has unleashed huge amounts of green investment, including in hydrogen, carbon capture and storage (CCS) and conversion to electric arc furnaces (EAFs). Germany recently a €4 billion carbon contracts for difference (CCfD) scheme to support energy-intensive sectors to shift to cleaner production processes. Governments are also starting to introduce green public procurement schemes and develop ambitious standards to grow demand for lower carbon steel, cement, aluminium, and chemicals. The US Buy Clean Initiative will be expanded to include steel in the near future. Canada has set a target to reduce embodied carbon of structural materials used in major public construction projects by 30%, starting in 2050.

Importantly, policymakers only have a narrow window in which to act. Energy-intensive industrial sectors are characterized by "lumpy" investment cycles over long time periods. Industrial facilities typically operate between 20–50 years, with reinvestments and refurbishments only required every 15–25 years (Material Economics, 2029). Between 30% and 53% of the EU's cement, steel, and steam cracker plants, for example, will require major reinvestments this decade (Agora Energiewende, 2021). Asset owners will need to decide what to do with ageing fleets and how to minimize employment and other social impacts from those decisions. The key question for this reinvestment wave is how to give asset owners the confidence and support to invest in low-carbon processes instead of locking in three more decades of carbon-intensive production. Given this fleeting window, it is paramount that the right policy signals are sent in the coming years. Early action is also critically important in China and India. China faces the challenge of a large and comparatively young existing emissions-intensive industrial base and will need to explore options for retrofitting and early retirement. India is on the precipice of a major growth in industrial capacity where the crux will be to ensure that new plants are "net-zero-ready," in other words able to accommodate clean technology retrofits once these are available.

1. Carbon leakage can occur when economic activities are displaced, or investment or consumption patterns change, for reasons of costs related to climate policies. This could directly or indirectly cause GHG emissions to be displaced to other countries with no or laxer emissions constraints in place.

Table 2. Technological Decarbonization Pathways for Industry Sectors and Potential Implications for Trade Flows

Lever	Description	IMPACT	Description of Trade Impact	Example
Energy Efficiency	Upgrading equipment, processes and plants to ensure less energy is used in production.	Low	1) Shifts in production and processing hubs: Efficiency largely reflects the age of equipment and investment cycles, which vary by geography, e.g. generally older fleets in Europe and the US vs. emerging and developing economies but are unlikely to cause large shifts in production locations or nature of industrial products traded. 2) Shifts in commodities traded: Emphasis on lower CO2 intensity in border measures or product standards could shift trade flows, but as energy efficiency measures generally only allow for incremental emissions reductions this effect is unlikely to be very large.	The Indian cement industry is one of the most energy-efficient in the world, with average thermal energy consumption of approx. 3.0 GJ/tonne of clinker (WBCSD, 2016).
Alternative Fuel Use & Direct Electrification	Shifting from fossil fuels to lower carbon fuels and/or direct electrification.	High	1) Shifts in production and processing hubs: The production costs of lower carbon fuels (e.g. renewable-based hydrogen) and renewable electricity will vary considerably by geography, incentivizing shifts in production to locations with abundant low-cost renewable capacity. 2) Shifts in commodities traded: Increased import demand for renewable-based fuels (e.g. green hydrogen and its derivatives, green iron), reduced import demand for fossil fuels.	Near-zero emission chemicals production has the potential to reorganize global supply chains. Currently mainly reliant on highly transportable fossil fuels like oil and gas as feedstocks and a source of energy, the production of green chemicals will likely happen where clean energy is both abundant and cheap. Saudi Arabia's "Vison2030" envisages significant investments in green chemicals to leverage its abundant solar potential and diversify its economy from fossil fuels (Industrial Info, 2024).
Material Efficiency & Demand	Reducing demand for industrial materials by taking new approaches to design, using higher-quality materials, using alternative materials, improving the efficiency with which the materials are used and increasing the share that is reused and recycled.	High	1) Impact on raw material flows: Reduced import demand for raw and processed materials. 2) Impact on manufactured goods: Emphasis on durability, modularity, and recyclability in product design standards may impact trade flows. 3) Impact on secondary material flows: Increased import demand for secondary materials, reduced exports of secondary materials.	As countries scale up secondary steel production via EAFs, there will be increasing demand for scrap. Countries are likely to act to try to secure their own supply and restrict exports with knock-on impacts for the steel transition in trade partners.
Carbon Capture and Storage	Capturing the emissions at the production site/plant and then securing and storing these.	Medium	1) Shifts in production and processing hubs: Access to CO2 storage and transport infrastructure will vary by location, and dispersed sites may be disadvantaged. 2) Shifts in commodities traded: Increase in CO2 transport to storage locations.	Norway has been positioning itself as a future hub for storing CO2 captured from its own and other European industrial installations. The Longship Project, Europe's first complete CCS value chain, is currently under construction and set to start storing CO2 from cement, waste incineration, and ammonia plants starting from 2025 onwards.

Source: Author's elaboration.

Potential Shifts in Industrial Supply Chains and Production by 2050

The shift to near-zero emission industrial production has the potential to reorganize global supply chains, with new production, processing, and trading hubs emerging for low-carbon steel, aluminium, cement, and chemicals production. Countries with abundant, low-cost renewable electricity and access to critical materials, such as Australia, Brazil, and Chile and South Africa and Middle Eastern countries, are looking to position themselves as potential major winners from this transition.

While the technological transition pathways for energy-intensive industries differ by sector, they each broadly combine four main levers: i) energy efficiency; ii) alternative fuel use and direct electrification; iii) material efficiency and demand reduction; and iv) carbon capture and storage. Each of these levers has different potential implications for industrial supply chains and the future of trade flows in these sectors (Table 2).

3. Trade-Related Trends and Dynamics in Heavy Industry Sectors

The global nature of energy-intensive industrial sectors and their supply chains means that domestic decarbonization policies set in any one country or jurisdiction have spillover effects in other geographies. Building on the analysis in Table 2, policies geared towards accelerating the technological shifts captured by the four decarbonization levers will also reinforce the trade trends set out above. As noted in section 1, moreover, several of the key industrial decarbonization policies being explored by countries—such as public procurement targets, product requirements, green industrial subsidies, and carbon border measures—run into challenging trade law territory and risk provoking tensions if not designed carefully, coordinated, and justified adequately.

This section maps and reviews current and future trends in industrial decarbonization policies and the implications for trade trends in the current geopolitical context.

Carbon Border Measures

Although carbon border measures have a long history in globalization and trade discourse, there have historically been very few examples of practical application. This is now changing. In 2022, the EU passed legislation to introduce a CBAM, which will eventually impose a charge on goods imported into the EU from foreign producers who operate without a carbon price. The measure aims to protect the EU's domestic producers, who face a carbon price, from being undercut. The sectoral scope is narrowly focused, with an emphasis on energy-intensive sectors: iron and steel, aluminium, cement, fertilizers, electricity, and hydrogen. The EU CBAM pilot phase started last year with importers required to start reporting and flagging issues with accompanying administrative costs. Importers will start being charged in 2026.

International Implications

The introduction of the EU CBAM has given a regulatory push internationally to carbon pricing for the sectors covered. It also signals that a major market will for the first time give preferential treatment to lower carbon industrial commodities, with the aim of incentivizing industrial decarbonization efforts more broadly. The UK, US, and Canada are exploring introducing their own CBAMs. In response to the EU CBAM, China is also progressing with inclusion of cement and steel in its ETS, with reporting requirements starting in 2023.

The EU has also faced considerable push-back from trade partners on the design, fairness, feasibility, and legality of the measure. Countries like China, India, South Africa, Australia, and Russia, but also the US pushed back openly against the idea. Countries worry that this measure will negatively impact their industrial producers and not adequately recognize domestic climate efforts.

These tensions came to a head at the 2023 UN Climate Change Conference (COP28), when the BASIC group of large emerging countries—Brazil, China, India, and South Africa—launched a campaign to denounce unilateral measures in the text of the global stocktake (Kerstens, 2023). This campaign was particularly focused on the EU CBAM, criticizing the EU for its failure to provide any kind of flexibility or financial support to developing countries or consider the perceived discriminatory burden on their economies. For example, analysts have questioned why the EU is not committing CBAM revenues to support decarbonization efforts in emerging and developing economies (EMDEs), tying into broader discussions on the lack of climate financing for EMDEs.

International Coordination

There is a broad recognition that common approaches need to be developed on how to deal with carbon in traded goods, including exploring common principles and coordination on carbon border measures. A recent example of such an initiative is the Climate Club. In June 2022, under the German presidency, G7 leaders committed to establishing an "open, cooperative international Climate Club" by the end of that year. This initiative was formally launched at COP28 with a programme spanning 3 pillars: converging on ambition, sectoral cooperation, and engagement with developing countries. One of the main workstreams of the Climate Club has been on coordination on carbon leakage measures.

Product Standards and Procurement Measures

Building demand for low-carbon steel, cement, and chemicals is crucial to creating a more attractive business case for investment in lower carbon production processes. Without a clear incentive, it is likely that new investments will otherwise be stifled. Governments have a critical role to play in building that demand through green public procurement and by helping to define what qualifies as "low-carbon," "near-zero," and "net-zero" steel, cement, or aluminium in partnership with industrial stakeholders and civil society actors. Ambitious definitions and product requirements tied to transparent and trusted processes for certifying adherence to those definitions and standards are key tools in driving industrial decarbonization.

Canada, Germany, and the UK have all demonstrated clear ambition on this front.[2] Canada, as noted, is setting out to reduce the embodied carbon of structural materials used in major public construction projects by 30%, starting in 2025 (Treasury Board of Canada Secretariat, n.d.). The German government has launched a voluntary green steel labelling system known as LESS (WV Stahl, 2024). The German steel association WV Stahl plans to start certifying steel producers with the LESS label by the end of 2024. In its 2023 public consultation on a UK CBAM, the government held a consultation on the adoption of mandatory product standards for industrial sectors and IDDI green steel procurement pledges (Industrial Deep Decarbonisation, 2023).

International Implications

Standards for near-zero emissions industrial products set at the national level, such as those that have been presented for public consultation in the UK and have been developed in Germany, could contribute to setting international benchmarks for the supply chains of these industrial products globally. Mandatory product requirements could also be applied at the border, requiring adherence from both domestic and foreign producers. Changes in green public procurement

2. Canada, Germany, the UK, and the US issued public announcements about their current procurement initiatives and how they align with different IDDI pledge levels at COP28 in December 2023. At the point of publication, we are still waiting for public information on which pledge levels they are officially committing to. See Industrial Deep Decarbonisation (2023).

requirements would also affect what products from foreign producers are eligible for procurement in the country adopting more stringent standards, creating a demand pull internationally for cleaner industrial materials.

A potential flashpoint in this space could be the increasing use of local content requirements attached to green public procurement (and broader industrial policy measures). The US included several local content requirements in the IRA. Other examples of local content requirements, mainly related to the deployment of renewables like wind and solar, can be found in countries like South Africa, Canada, Brazil, and China (Peterson Institute for International Economics, 2021). Tendencies towards protectionism in green public procurement frameworks may end up being counterproductive. While green protectionism can be useful for initially enticing national public spending to support clean technologies, it could end up delaying the transition and increasing costs. Guaranteeing a minimum level of openness of new green product markets to all countries and non-discrimination between domestic and foreign producers of green products is essential for global-scale decarbonization.

International Coordination

Interoperability of standards for near-zero emissions industrial products and harmonized procedures and methodologies for reporting on the emissions intensity of production processes improves transparency and data collection, ensures a level playing field, and, ultimately, facilitates the greening of industrial supply chains globally. Multiple international initiatives and organizations are focused on trying to provide a space of greater alignment: including the International Energy Agency (IEA), the Industrial Deep Decarbonisation Initiative, and the World Trade Organization (WTO) Secretariat. At COP28, standard-setting bodies, international organizations, and steel associations came together to launch the Steel Standards Principles, setting out principles aimed at aligning how GHG emissions are measured in the steel sector (WTO, 2023).

Subsidies and Technology Deployment

Many of the technology options for decarbonizing steel, cement, and chemicals are more expensive than conventional production processes and investments in innovative production sites carry higher levels of risk. Even in jurisdictions with higher carbon prices, like the EU with its ETS, break-even carbon prices for these technologies are considerably higher than those for carbon-intensive production. Some form of direct support will be required to cover higher operating and capital costs, although the costs of these technologies will decrease as they scale up. The exact means of how such support is given varies in different national contexts, reflecting different levels of fiscal resources and different production costs (Devlin et al., 2023). Table 3 provides some examples of public support for steel decarbonization projects in different jurisdictions, showing the scale of financial support on offer.

Table 3. Examples of Green Steel Projects From Across the World

Company, country	Capacity	Public Investment	Private Investment
ArcelorMittal, Spain	2.3Mt DRI, 1.1Mt steel**	$0.5bn**	$0.6bn**
H2GS, Sweden	2.1Mt DRI, 5.0Mt steel*	$0.3bn**	$6.7bn**
Techint Group, Mexico	2.1Mt DRI, 2.6Mt steel*	Not stated	$2.2bn*
Saltzgitter, Germany	2.0Mt DRI, 1.9Mt steel**	$1.1bn**	$0.8bn**
Vulcan Green Steel, Oman	2.5Mt DRI, 5.0Mt steel*	Not stated	$3bn*

Note: Mt stands for megatonne (one million tonnes) and DRI for direct reduced iron.

Sources: *Global Energy Monitor (n.d.); **Public Citizen (2024). Table originally published in Whitwham (2024).

International Implications

Direct support for technology deployment could bring down learning costs on these technologies for other countries. However, a more assertive industrial policy in wealthier countries like the US and in the EU may also impact on the diffusion of technology abroad and/or impact on the ability of other countries and regions to build up their competitiveness in these areas. Given these considerations and the challenges that developing countries already face in accessing and deploying industrial decarbonization technologies, assertive industrial policies in wealthier countries could be considered in conjunction with technology transfer initiatives to accelerate the uptake of these technologies in developing countries.

International Coordination

There have been several proposals developed for putting forward a shared set of principles for green industrial subsidies and agreeing permissible forms of direct state support in order to avoid future trade tensions and give political cover for pursuing ambitious green innovation and industrial policies. For example, subsidies could be assessed based on whether they are sustainability enhancing and trade distorting—subsidies that produce positive sustainability outcomes and have limited trade distorting effect would be categorized under a "green box" and as a result would be permissible and would not be countervailable (Cima & Esty, 2024). However, these proposals have not extended beyond the academic space to date and are yet to receive political buy-in, particularly as many of them require consensus of all 166 WTO members and a new workstream on industrial policy can easily be blocked by one member (Kerstens, 2024). Instead, progress on a bilateral or plurilateral level, focusing on the largest subsidizing countries like the US, EU, China, and India and key emerging country members such as Brazil and South Africa may be more likely. If not a set of principles, enhancing transparency on green industrial subsidies with a view to building trust and analysis of their effectiveness is increasingly being prioritized (IMF, 2023).

Transition finance is another area that will be key for addressing inequities and tensions over green industrial subsidies. Capital costs and access to skills and finance vary massively between geographies. OECD countries have a key role in scaling up investment, mobilizing targeted support and technical assistance for industrial decarbonisation, and bolstering international climate finance to facilitate the industrial transition internationally.

Scaled up technology cooperation and transfer to developing countries could also help to mitigate some of these tensions. However, most of the technology cooperation efforts to date have focused on early-stage research and development for breakthrough technologies rather than on deployment of existing pre-commercial technologies, and they largely focus on cooperation between industrialized economies. The Net-Zero Industries Mission (NIM), for example, includes Australia, Austria, Canada, China, European Commission, Finland, Germany, Republic of Korea, UK, and US. The aim of the NIM is to accelerate the development of new and radical breakthrough low-emissions industrial technologies (Net Zero Industries Mission, 2022).

While advancing the technology frontier, as the NIM seeks to do, continues to be crucially important for industrial decarbonization, we also have a suite of technologies like hydrogen electrolyzers, thermal heat batteries, and industrial scale heat pumps that are at a higher stage of technology readiness and becoming ready for widespread commercialization. There is a gap in our understanding of the barriers to adoption of these technologies in developing countries, whether this stems primarily from a lack of finance or instead barriers around intellectual property and licensing, skills and capacity, or how suitable these technologies are to different contexts. In recognition of this gap, the NIM is now also looking to recognize innovation projects in EMDEs as part of its Net-Zero Industries Award. In May 2023, the United Nations Industrial Development Organization (UNIDO) also launched the Accelerate-to-Demonstrate Facility to accelerate the

commercialization of innovative technologies, including for industrial decarbonization, through demonstration projects in EMDEs. These represent promising but early-stage efforts to try to close the gap on technology cooperation with EMDEs.

Trade Policies Supportive of Circularity and Waste Management

Material efficiency, circularity, and waste management policies are critical to industrial decarbonization, as they help lower how much steel, cement, and basic chemicals we use. The IEA Net Zero by 2050 report estimates that material efficiency alone can reduce demand for cement and steel by 20% in 2050 (IEA, 2021). Beyond mitigation potential, circular economy levers also have the potential to address wider environmental challenges, including biodiversity loss and pollution (Forslund, 2021).

For EU member states, the EU Circular Economy Action Plan released in March 2020 is critical in this regard. It includes a revised Ecodesign for Sustainable Products Regulation, which highlights steel as a priority product for future regulation. China has also explicitly connected steel with its circular economy initiatives, setting steel scrap use targets as part of its fourteenth Five-Year Plan for the Development of the Circular Economy (China Briefing, 2021).

International Implications

As countries scale up material efficiency and recycling of industrial materials, there will be increasing demand for secondary materials and recycling feedstock. Countries are likely to act to try to secure their own supply and restrict exports with knock-on impacts for transition in trade partners. The last few years have seen a growing number of trade restrictions on steel scrap in Africa, the Middle East and North Africa region, and Asia (Manthey, 2023). The EU will introduce restrictions of scrap exports to non-OECD countries from 2027 unless they can demonstrate sustainable practices.

International Coordination

There has been a notable gap in efforts to improve international coordination of circular economy and waste management policies. Under its G20 presidency in 2023, India launched the Resource Efficiency Circular Economy Industry Coalition and released a technical paper entitled "Knowledge Exchange on Circular Economy in Steel Industry." Deeper dialogues with trade partners on potential impacts of regulatory changes alongside support in-country will be key.

Tariffs

Toxicities around trade, including concerns about excess capacity and dumping, continue to result in trade restrictions targeting industrial products, in particular steel and aluminium. In 2018, the Trump administration invoked "risks to national security" to justify imposing tariffs on steel and aluminium under section 232 of the Trade Expansion Act to all trade partners including the EU (CRS, 2022). In retaliation, the EU introduced rebalancing measures while also initiating a legal proceeding at the WTO (European Commission, 2018).

The background for these tariffs was the lack of progress emerging from multilateral efforts, including in the G20 Global Forum on Steel Excess Capacity, to resolve the challenge of global overcapacity in steel markets. This problem is largely seen as having been driven by the unprecedented non-market driven build-up of steelmaking capacity in China (OECD, 2023).

International Implications

The US recently ramped up its tariff rate on steel and aluminium products from China once again under Section 301 (White House, 2024). With rising steel excess capacity and increasing Chinese exports, more trade defence actions are expected, with likely negative spillovers for international coordination on industrial decarbonization.

International Coordination

Given the long history of tensions over steel excess capacity and ensuing trade measures, there have been several attempts at international coordination in this space with mixed success. The OECD Steel Committee brings together members accounting for 40% of global steel production to address evolving challenges and opportunities in the global steel industry. The Global Forum on Steel Excess Capacity was launched in 2016, with membership from all G20 countries and interested OECD countries with the aim of allowing countries to share information and track the underlying causes of overcapacity. China, India, and Saudi Arabia all disengaged from the forum's work in 2019.

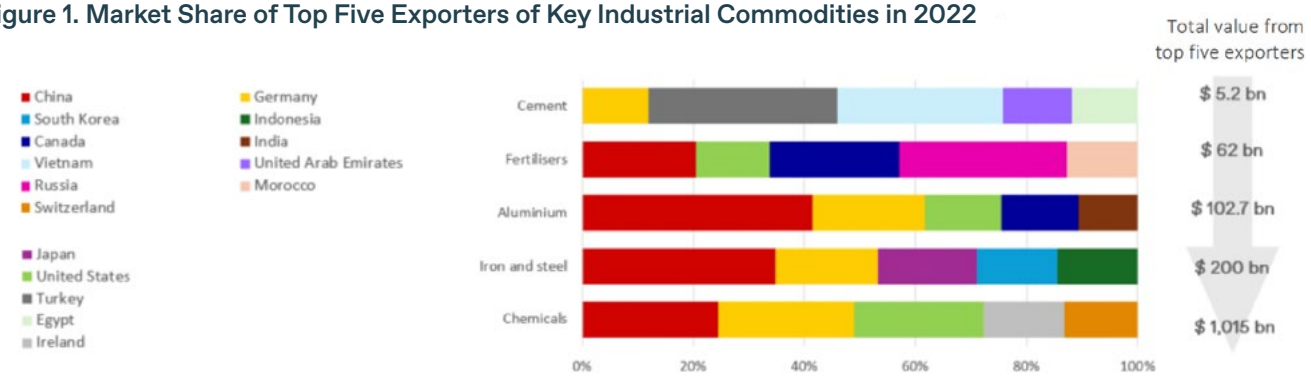
The most recent example of bilateral coordination on steel tariffs is the Global Arrangement on Sustainable Steel and Aluminium, launched in 2021 by the EU and US to resolve their ongoing tariff dispute over steel and aluminium, address challenges related to global overcapacity, and accelerate decarbonization of the steel and aluminium sectors. These negotiations proved challenging and stalled in early 2024 with both sides remaining far apart. One of the key sticking points was around how to structure a potential sectoral arrangement on steel and aluminium: what sanction or incentive to apply to membership of such an arrangement. The US, which is unlikely in the current political climate to adopt a domestic carbon price, favoured a tiered tariff system aimed at shielding domestic markets from global overcapacity. The EU preferred a price-based system more in line with its existing emissions trading system to avoid undermining its CBAM. These positions were informed by the different starting points both jurisdictions have in terms of their domestic policy frameworks.

4. Opportunities and Challenges for Developing Countries

Today, close to 90% of steel, aluminium, and cement production occurs in non-OECD countries (37% excluding China), which will also see the highest future growth (Rimini et al., 2023).[3] The vast majority of planned capacity expansions in industrial sectors in the coming decade are set to occur in developing economies. These can either lock in carbon-intensive pathways for decades or kick-start a green industrial revolution. As set out in the previous two sections, regulatory ambition and trade policy set by OECD countries will have spillover effects and will play a huge role in determining which of these pathways EMDEs end up on.

This section assesses the opportunities and challenges faced by developing countries as industry sectors transition on the road to 2050 and what policies and initiatives they can use to navigate this transition. Figure 1 gives an overview of the top five exporters across the key industrial commodities considered, with Vietnam, Indonesia, India, Morocco, and Egypt standing out as key developing country exporters.

Figure 1. Market Share of Top Five Exporters of Key Industrial Commodities in 2022



Source: E3G based on Observatory of Economic Complexity (n.d.) 2022 data.

3. Author's analysis based on USGS (n.d.) 2023 data for cement, aluminium, and raw steel production.

Trade Opportunities

The main opportunity for developing countries is around the emergence of new export markets and increased demand for certain green commodities. Developing countries with abundant renewable energy, access to critical raw materials and/or skills, and assets to position themselves as remanufacturing or reprocessing hubs will be in a strong position to capitalize on the shift to lower carbon industrial manufacturing. Brazil and South Africa, for example, with their low-cost renewable electricity and access to iron ore resources, are looking to become major green iron hubs in the shift to decarbonized steelmaking. Developing green hydrogen and green iron and steelmaking capacities for export would bring jobs and further growth opportunities as these foundational sectors could support the development of additional manufacturing sectors further downstream. As industrial processes increasingly electrify and rely on lower carbon fuels, those developing countries that can provide low-cost renewable electricity will find themselves at a major competitive advantage for green industrialisation.

The second key opportunity for developing countries lies in improved energy and material security. The shift to lower carbon and more circular industrial production processes will also allow countries to reduce their import dependence on certain commodities. India, for example, is currently very dependent on imports for its metallurgical coal use: 85% of demand is met through imports (Arora, 2024). A shift to non-coal-based steelmaking would greatly improve the resilience and economic security of the domestic steel sector as it would allow the sector to rely on domestic abundant renewable energy sources, making it less vulnerable to international commodity price spikes.

Trade-Related Challenges

As indicated in section 3, developing countries already face a wide set of trade-related challenges because of the measures and policies being pursued in industrialized economies and it is likely that these trends will be reinforced. These challenges include:

- *Lower demand for fossil-based exports:* Reduced import demand in developed countries for fossil-based products from developing countries. As production processes for industrial products shift towards lower carbon fuels/inputs, electrification, and more circular processes, developed countries with strong export markets based on fossil fuels will likely see a reduction in demand for these products. As noted, there are new industrialization opportunities for certain countries, but this will require alternative development pathways and the capacity support and finance to pursue these.

- *Impact on imports:* Reduced exports of secondary materials from developed to developing countries. As developed countries scale up material efficiency and recycling of industrial materials, there will be increasing demand for secondary materials and recycling feedstock and, as a result, a likely decrease in exports of these commodities to developing countries. This can be a substantial challenge for certain countries that have whole industries predicated on waste sorting and scrap recycling. Turkey, for example, is a major importer of scrap steel that could face challenges due to trade restrictions on scrap exports.

- *Reduced market access:* Changing regulations, norms, and standards favouring lower carbon industrial production processes may impact the ability to export from certain developing countries. The most concrete example of this is the EU's CBAM, which reduces market access for high-carbon intensive goods but also requires monitoring, reporting, and verification processes to allow exporters to access the single market. Similarly, product standards applied at the border or green procurement measures (even those not stipulating local content requirements) will affect export markets from developing countries. Without access to lower carbon technologies or the skills and financial assets to convert processes, these types of measures will be a disproportionate burden for developing countries (Ravikumar, 2020).

5. Priorities for Policy Engagement and Future Analysis

Industrial sectors face particular challenges (e.g. high capital expenditure, long investment cycles, competitiveness and trade issues, and lack of markets for green products) which act as strong barriers for countries to move ahead without international coordination. Luckily, momentum on coordinated policies for industrial decarbonization is growing, as is evident by the steady stream of initiatives launched over the last few years.

Among these initiatives, there is a strong recognition that engagement with and support for developing countries will be a critical lever for accelerating industrial decarbonization internationally. The Climate Club launched at COP28, for example, has a dedicated pillar on boosting international support for industrial decarbonization in EMDEs (Climate Club, 2024). However, this is still an area where there has been less concrete action to date.

In this context, key priorities for these initiatives and for bilateral cooperation to support climate-resilient industrial development could include:

- *Open policy dialogues about the potential impact and pathways:* Deeper dialogues with developing countries about the potential impacts of regulatory changes alongside support in-country. Open and inclusive dialogue could be pursued at a bilateral and plurilateral level in parallel to the multilateral.

- *Accelerating actions on widely accepted trade policy challenges:* This could include a more concerted focus on lowering non-tariff barriers, ensuring interoperability of low-carbon industrial product standards, and addressing the lack of clarity on rules that apply to different waste and secondary materials.

- *Strengthening the empirical base:* Many of the trends identified in the analysis above are still largely uncertain. A stronger understanding of the trends and opportunities deriving from industrial decarbonization and the range of policy options as well as scenario analysis to identify appropriate responses for developing countries would be key.

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