Impacts of Climate Change Policies on Developing Country Export Markets

IISD REPORT

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1.0 Introduction

Climate change policies have taken on many forms, including net-zero commitments, green new deals, and circular economy plans. Each of these policies combines more abstract carbon reduction objectives with a more or less comprehensive set of policy and market interventions that are needed to reach those goals. This paper will focus particularly on net-zero commitments and circular economy plans and assess the impact of core components of such policies on developing country exports.

Net-zero commitments follow the guidance of the Intergovernmental Panel on Climate Change (IPCC) that highlights the need to be carbon-neutral by 2050 to reach the Paris Agreement goals and stay within a 1.5°C global warming range (IPCC, 2018). The Net-Zero tracker of the Energy & Climate Intelligence Unit takes stock of where countries are in discussing net-zero targets. As of March 1, 2021, Bhutan and Suriname are already carbon-negative, while six other countries have adopted net-zero commitments by 2050. These include Sweden, the United Kingdom, France, Denmark, New Zealand, and Hungary. Six more governments have proposed legislation that is awaiting formal adoption. These include Spain, Chile, Fiji, the European Union, Canada, and South Korea. Eleven more countries already have net-zero commitments in policy documents but have not yet formally proposed legislation. A net-zero target is under discussion in 100 more countries (Energy and Climate Intelligence Unit [ECIU], 2020a).

Together, the economies of countries that already have, or intend to have, net-zero targets account for 68% of global GDP and 56% of the global population. This indicates the scale at which a global low-carbon transition can affect global markets (ECIU, 2020b). These do not include subnational entities that have set net-zero goals, such as California, which, if it were counted as a country, would have the fifth largest economy worldwide. Similarly, it does not include independent private sector commitments that are becoming ever more numerous. A global net-zero economy will thus look substantially different, with some sectors growing and others declining. Given the scale of the challenge and the need for a rapid pace, such changes are likely to occur quickly. That means that countries will have to act swiftly to seize opportunities to enter growing value chains and reduce the negative impacts of value chains that will be worth much less in a net-zero world. Such export impacts can threaten the development prospects of developing countries, but they can also enhance them.

Circular economy plans tend to focus on the cradle-to-grave principle, in which products are manufactured more sustainably and reused and recycled rather than added to waste. They will also tend to reduce demand for primary materials. Circular economy initiatives rely on a combination of strategies and innovative business models that close material loops and focus on optimizing resource flows, ultimately decreasing the need for virgin resource use and reducing a range of environmental impacts including greenhouse gas emissions (International Institute for Sustainable Development [IISD] 2020). The ultimate goal is thus to gradually decouple economic activity from the consumption of finite resources and to move waste out of the system as permanently as possible (Ellen Macarthur Foundation, 2020).

Circular economy plans can come in different shapes and sizes. They can affect different sectors and include elements from reducing waste to increasing energy efficiency to boosting self-sufficiency. This diversity of approaches makes a comprehensive global tracking of circular economy initiatives somewhat challenging. In terms of trade impacts, it is sufficient to highlight how far and how broadly circular economy plans are reaching. Besides European countries and the European Union, China has had a circular economy promotion law in place since 2009, which was last updated in 2018. Also, large developing and emerging economies like Indonesia, India, Mexico, and South Africa all have certain circular economy plans in place, showing how far the notion of circularity has spread and hinting at the likely large trade impacts with regards to both global and regional value chains.

Generally, a lot of these net-zero and circular economy policies are fairly new and still need to move from being aspirational to having practically implementable components. Some regions, such as the European Union, do have specific implementation practices being developed and, as a result, trade impacts are likely to occur in the coming years.

2.0 Net-zero Commitments and Circular Economy Initiatives Worldwide

Aside from policies that affect multiple sectors at once, net-zero commitments[1] and circular economy policies[2] commonly focus on six broad sectors: energy supply, residential/buildings, industry, transport, waste, and agriculture & forestry.[3] Zooming in on what those policies in each of the sectors entail is a necessary first step to understanding what types of developing country exports might be impacted. Table 1 summarizes the most common net-zero and circular economy policy measures adopted by the reviewed economies. It should be noted that some key jurisdictions, such as the European Union, are working on the design of carbon border adjustment mechanisms (CBAMs), which could strongly impact developing country exports if no mitigation measures are built in or technical assistance provided to help compliance with new standards. However, details of such CBAMs are not yet available at the time of writing.

Table 1. Summary of common net-zero and circular economy policy elements

Sector	Common net-zero policies	Common circular economy policies
Cross-sectoral	• Emission trading schemes & carbon taxes (implicit and explicit) • Environmental reporting & certification regulations • Energy-efficiency action plans	• Reuse and recycling targets and fiscal policies (e.g., taxes, eco-design incentives) • Investments into collection systems; data and digitalization • Public purchases of recycled material and circular procurement
Energy supply	• Investment and production support for renewables/low-carbon energy • Cap, reduce, phase out coal-fired power • Reduce fossil fuel subsidies & production	• Reuse and recycling networks for renewable energy & electric vehicles (EV) infrastructure • Waste-to-energy incentives • Converting fossil fuel and petrochemical infrastructure to bio-infrastructure (e.g., refineries)

[1] To better understand net-zero commitments, we reviewed policies in Austria, Bhutan, California, Chile, China, Costa Rica, Denmark, the EU, Fiji, France, Germany, Hungary, Iceland, India, New York, New Zealand, Norway, Portugal, Spain, Surinam, Sweden, Switzerland, and the United Kingdom. These countries were chosen because they have either enacted net-zero commitments or are far advanced in their planning while having a large economy whose changes would have global ramifications.

[2] To better understand circular economy initiatives, we reviewed policies in Argentina, Australia, Belgium, Canada, China, Denmark, the EU, Finland, France, Germany, Greece, India, Indonesia, Italy, Japan, Mexico, Netherlands, Ontario, Portugal, Russia, Saudi Arabia, Slovenia, South Africa, South Korea, Spain, Sweden, Turkey, and the United Kingdom. These countries were chosen because they have either enacted circular economy policies or are far advanced in their planning while having a large economy whose changes would have global ramifications.

[3] Sources consulted are noted separately in the bibliography.

Sector	Common net-zero policies	Common circular economy policies
Residential	• Building construction and renovation/ retrofit standards • Incentivizing renewables heating systems • Incentivizing energy-efficient lighting	• Material recovery targets and renovation incentives • Residential waste targets and requirements • Residential and construction waste collection systems
Industry	• Green taxes • Energy audit and reporting requirements • Regulatory requirements & incentives regarding energy-efficiency standards and specific (greenhouse) gases	• Extended producer responsibility • Waste management regulations, labelling requirements • Incentives for waste and resource use reduction and incentivize secondary and recycled materials
Transport	• Incentives & targets for electric mobility and biofuels • Fuel taxes & vehicle emission/fuel quality regulations • Public transport programs	• Increase circularity (reuse and recycle) of EV batteries and fuel-from-waste investments • Car sharing, "last-mile" and public transport incentives • Regulations on end-of-life vehicles
Waste	• Extended producer responsibility regulation • Single-use plastic regulation and other waste-related taxes • Bans on landfilling of certain products and resources, and landfill methane reduction/capture targets	• Reusing and recycling incentives and targets • Extended producer responsibility; policies for collecting and separating waste • Regulating sales and labelling of products using certain difficult-to-recycle or wasteful materials (e.g., microplastics)
Agriculture and forestry	• Forest preservation and reforestation targets; land-use change regulations • Fertilizer and livestock management regulations - Incentives for carbon/methane capture and renewable energy in agricultural activity	• Food waste targets and incentives • Incentive organic recycled and waste-based nutrients and fertilizers • Wood waste reuse, repurpose and recycle incentives and targets

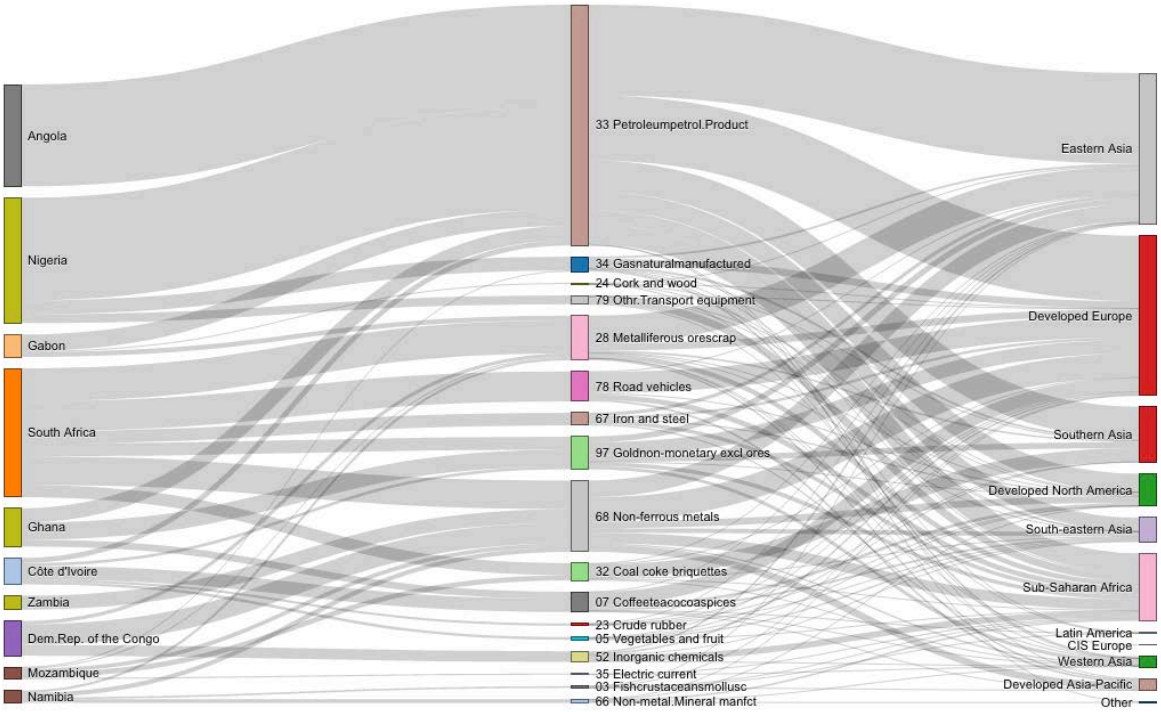
Source: Authors

In earlier work, IISD and Sitra (Tamminen et al., 2020) have highlighted that the most traded services related to the circular economy include IT services, other professional, technical, and business services, leasing and rental services, research & development (R&D) services, maintenance, repair and installation services, sewage and waste collection services, and professional services related to construction. That is good news for local jobs in areas that implement circular economy plans (IISD & Sitra, 2020) and, while services deserve more attention, a focus on exported goods is as important and more easily assessable given current trade data, so is the focus of this brief.

From the summary of common elements of net-zero plans and circular economy policies set out in the table above, we note that there are three large commonalities that may affect the export of goods from developing countries. First and foremost, climate mitigation is, of course, fundamentally reliant on a reduction in the use of fossil fuels. Cap and trade, carbon taxes, energy efficiency, the development of renewables, a reduction of fossil fuel subsidies, and so forth all fundamentally target emission reductions through the reduction of fossil fuel primary energy demand, whether that is through direct combustion or via the power sector. Second, a lot of new deployment of carbon mitigation measures will rely on technologies that will increase the demand for particular inputs of minerals and metals. Renewable energy technologies, the electrification of primary energy demand and transport, and batteries for grid electricity storage and EVs will all inflate such demand. And third, circular economy initiatives are used to reduce the amount of virgin materials needed, and such policies (as well as net-zero initiatives) also seek to elevate the producer's responsibility for waste, which ultimately can add requirements upstream.

These three commonalities will have a fundamental impact on the trade of goods between climate-ambitious economies and developing countries. This is because resource exports are by far the largest share of exports from developing countries. For example, in sub-Saharan Africa, total exports in 2018 were valued at around USD 344 billion (UN Comtrade Analytics, 2021). USD 286 billion (83%) of those exports were natural resource exports, and the top five export items from the region were oil, gold, diamonds, natural gas, and coal (World Integrated Trade Solution, 2021).

Figure 1. Main export flows from key sub-Saharan African countries by commodity and export destination



Source: UN Comtrade Analytics, 2021.

To uncover potential trade impacts on developing country exports of goods, we focused our analysis on three regions. First and foremost, we studied the export markets of sub-Saharan African countries.[4] Second, we identified potential impacts on goods exports from least developed countries (LDCs) as defined by the United Nations Statistics Division (2021).[5] Third, we verified impacts on low-income economies, as defined by the World Bank (2021).[6] The trade data for these groups were extracted from a data visualization tool developed by Chatham House (2020) that relies on International Merchandise Trade Statistics compiled by the United Nations Statistics Division in the United Nations Commodity Trade Statistics Database (UN Comtrade). The Comtrade database was also used to extract individual country data points.

Threats to existing exports are obvious from the export flows plot. First and foremost, developed Europe is the largest export destination of key individual sub-Saharan African countries, at USD 95 billion of total export flows (see Figure 1), so ambitious net-zero commitments and circular economy policies in Europe will possibly affect a large share of exports from the region. Eastern Asia is the second most important export region for sub-Saharan countries at USD 68 billion, of which USD 60 billion goes to China alone, indicating the importance of China as a trade partner and the relevance of its carbon mitigation policies. The third largest partner is India at USD 31 billion.

[4] Sub-Saharan African countries include Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, United Republic of Tanzania, Togo, Uganda, Zaire, Zambia, and Zimbabwe

[5] LDCs comprise Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Yemen, and Zambia.

[6] Low-income economies comprise Afghanistan, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of the Congo, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Haiti, Democratic People's Republic of Korea, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Syrian Arab Republic, Tajikistan, Togo, Uganda, and Yemen.

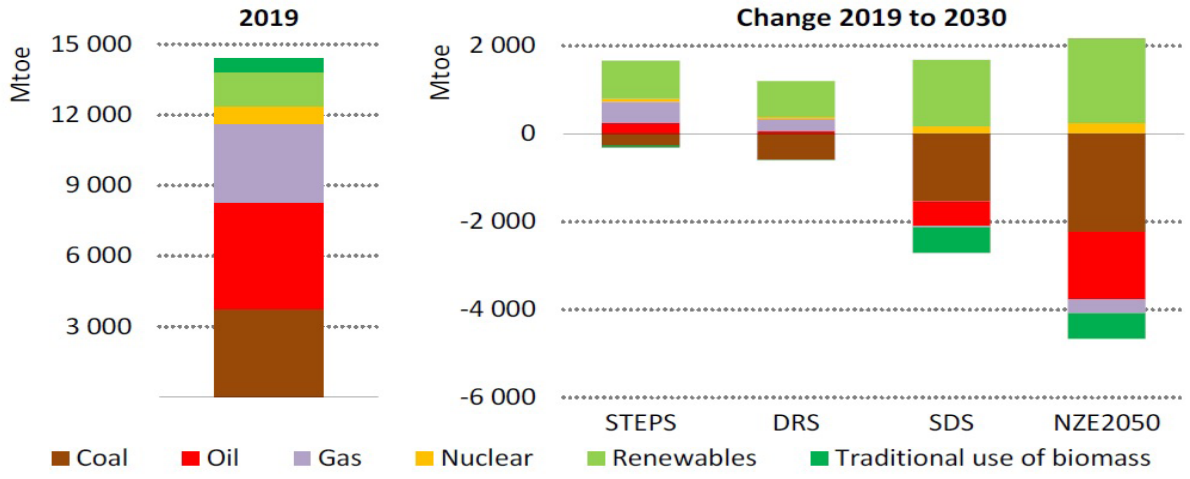
3.0 A Reduction in Fossil Fuel Consumption

3.1 Trends

Reducing the consumption and imports of fossil fuels stands front and centre in many net-zero commitments and circular economy objectives. For example, California's net-zero plans aim at 60% electricity from renewables by 2030 and 100% carbon-free by 2045 (Berkeley Law, 2020), China's Circular Economy Promotion Law mentions the use of efficient fuel-savings products directly (Standing Committee of the National People's Congress 2008, 2018), and various emission trading schemes and (proposed) carbon taxes around the world incentivize energy efficiency. These strategies and others would entail the reduction of oil, natural gas, and coal use, though in different stages and to different extents depending on the resource in question. To estimate how demand for fossil fuel resources might change as a result of net-zero and circular economy commitments, we can look at scenarios developed to model more or less ambitious policy shifts.

If policies were ambitious enough to meet the International Energy Agency (IEA)'s global net-zero by 2050 scenario (see "NZE2050" in Figure 2), a near-instant peak oil demand would need to be followed by a downward trend in oil consumption, and the reduction of coal-fired power would need to be both immediate and drastic (IEA, 2020a). This IEA's net-zero scenario is the one that would require the most substantial shifts in energy production and consumption, even beyond its sustainable development scenario.

Figure 2. Total primary energy demand by fuel and scenario



Note: STEPS = Stated Policies Scenario where countries meet announced targets; DRS = Delayed Recovery Scenario where COVID-19 health and economic recovery is slower; SDS = Sustainable Development Scenario that falls in line with objectives from the Paris Accord; NZE2050 = Net-Zero Emissions by 2050 for most advanced economies and globally by 2070.

Note: Mtoe = millions tonnes of oil equivalent

Source: IEA, 2020a.

Global oil demand—in a business-as-usual scenario that presumes the implementation of current climate commitments and which will lead to at least 3°C global warming—will increase this decade and start stagnating around 2030 (IEA, 2020a). This stagnation of oil demand may also be strongly affected by the rise of electric vehicles, which has seemed to accelerate in the wake of COVID-19 with large amounts of stimulus funding going into the EV market (energypolicytracker.org, 2021). In the short term, the reduction in oil demand due to the COVID-19 crisis has been severe but also temporary, even if demand growth rates for oil were already slowing down. The pandemic may have a lingering effect, however, as potential economic downturn effects can also influence further drops in oil demand. Many climate change plans do not set a specific hard target for oil phase-outs, but rather combine renewable energy targets, emission reduction targets, and coal phase-out objectives. For example, in the EU, the Commission's proposed Climate Target Plan foresees a 55% reduction of greenhouse gas emissions by 2030 and climate neutrality by 2050, but shies away from specific fossil fuel phase-out targets (European Commission, 2021)

While oil demand growth (especially in India and China) is still expected to continue to rise in the coming decade (IEA, 2020a), international supply competition will likely increase given the abundance of supply options available. Future supply growth will be stronger in low-cost producers with stronger financial buffers such as Saudi Arabia, Russia, Kuwait, and the United Arab Emirates. Other countries may be able to compete but may have to do so by relying on expensive subsidy schemes. As a result, producers in sub-Saharan African developing countries are unlikely to be able to compete at scale with either low-cost producers or heavy subsidizers when markets tighten (IEA, 2020a).

In terms of natural gas demand, the largest part of demand growth to 2040 is concentrated in South and East Asia (IEA, 2020a). This is far from markets that sub-Saharan African countries could sell to and would thus only really open up the potential for liquefied natural gas (LNG), whose market faces stark competition from Australia, the United States, and Qatar. Some African countries, such as Mozambique, Nigeria, Mauritania, and Senegal, have already invested in LNG projects (IEA, 2020f), but space for future growth is very uncertain. While LNG demand is indeed set to increase strongly in a baseline business-as-usual scenario where countries meet their current climate targets, it would be much lower, though positive, in the IEA's sustainable development scenario (IEA, 2020a).

This sustainable development scenario would thus tighten competition between existing LNG capacity and capacity currently under construction. That would also question the fundamentals of additional investment in liquefaction plants, which are immensely capital intensive. Additionally, natural gas markets have been confronted with a prolonged period of oversupply and low prices, which again does not help the competitiveness of developing countries and rather favours supply growth in top producing countries (IEA, 2020a). Last but not least, natural gas consumers may also start targeting methane emissions from across the supply chain, as the scientific consensus is growing that they pose more of a greenhouse gas emission problem than previously recognized, and therefore calls for more effective methane control regulations are rapidly increasing (Hmiel et al., 2020; IEA, 2020a).

In terms of coal, demand is set to only grow in India and Southeast Asia to 2030; China will see a small demand growth until 2025 and will then start lowering demand (IEA, 2020a).

Net-zero commitments often have coal reduction targets. For example, Chile envisions a complete coal phase-out by 2040 (Climate Action Tracker, 2020b), 11 EU member states have formally adopted plans to phase coal entirely in electricity generation (Climate Action Tracker, 2020e), 36 national governments and 36 subnational governments are now members of the Powering Past Coal Alliance (PPCA, 2021), and, while China has not formally committed to a hard coal phase-out plan, its carbon emission reduction targets suggest the lowering of coal-fired power generation.

Coal is still, of course, a key input for iron and steel production as well as electricity generation in many parts of the world, so there is some market potential, but in the grand scheme of energy supply options, coal is likely to be outcompeted in electricity markets and therefore see its use drastically reduced. As for oil and gas, the space for coal supply will likely be captured by the lowest-cost producers, and sub-Saharan African countries will not see production increase by 2030 in the event of an accelerated energy transition, and even in the absence thereof, production is set to decrease (IEA, 2020a).

3.2 Impacts

According to resourcetrade.earth and ComTrade data, trade in fossil fuels in sub-Saharan Africa was worth about USD 146 billion in 2018, which was a year with an average oil price of around USD 65/barrel. Of this, USD 146 billion, USD 123 billion was from oil exports. More than 90% of these oil exports were in the form of crude oil. This might suggest that developing countries may be able to offset lower demand by improving domestic refining, which adds significant value. However, given the time- and capital-intensive nature of setting up domestic refining businesses, as well as the high comparative advantage of several refiners around the world, this seems like a high-cost and high-risk option given the anticipated peak in oil demand. At the same time, large-scale investment in fossil fuel infrastructure would run the risk of resulting in stranded assets. This should be added to an assessment of the opportunity costs of new and future fossil fuel infrastructure investments in developing countries.

In Africa, refinery output already shrank by more than 10% between 2009 and 2018 (IEA, 2020e), while refinery output in large consumers such as China has grown by close to 70% to reach nearly a 100% refinery output to domestic oil product demand ratio, which means China barely imports refined oil products anymore (IEA, 2020e). Refineries in African countries cover only about half of global petroleum product demand, but, given that other countries with refineries will start slowing down demand, those existing refineries can still add product to international markets, aggravating potential competitiveness concerns.

The biggest oil exporters in sub-Saharan Africa in 2018 were Nigeria (USD 48 billion), Angola (USD 40 billion) and the Republic of Congo (USD 8 billion). The main importers of sub-Saharan oil were China (USD 39 billion), India (USD 15 billion), the US (USD 10 billion) and Spain (USD 8 billion), but the export destination matters less given the international nature of the oil market.

Big oil producers like Angola and Nigeria have limited financial resources, partly due to a prolonged period of low international oil prices and the economic fallout of the COVID-19 crisis. This will likely stifle domestic investment in production compared to other countries

and also make them struggle more to attract foreign direct investment. As a result, the IEA has now modelled their oil production lower in 2030 than it is today (IEA, 2020a).

Oil trade is also essential for LDCs. While export values are less large in comparison to larger countries, oil trade is still essential in terms of export revenue. Besides Angola, LDCs like South Sudan (USD 1.6 billion), Chad (USD 1.5 billion), Sudan (USD 1 billion), and Yemen (USD 900 million) have a big stake in oil exports since it is the commodity with the highest export value of all resource exports.

Besides oil, coal exports from sub-Saharan Africa represented around USD 10 billion in 2018. The most important exporters included South Africa (USD 7 billion) and Mozambique (USD 3 billion). As mentioned, phasing out coal use is a key plank of net-zero commitments in several countries. In this case, however, net-zero commitments and circular economy initiatives may have only a small impact on this trade, given that the key export destinations are India (USD 4.1 billion) and Pakistan (USD 1.1 billion), two countries that have not yet firmly committed to a coal phase-out.

The third coal export destination for sub-Saharan Africa, however, is South Korea (USD 900 million). While the export of hard and coking coal to South Korea grew strongly between 2013 and 2018, the Korean Green New Deal is eyeing a reduction of coal-fired power generation, with 10 coal power plants closing in 2022 and another 20 by 2034 (Ko, 2020). Hard and coking coal are important inputs in steel manufacturing, but alternatives that rely on recycled steel and energy inputs from renewables can change that market significantly in the coming years, ultimately lowering its use of coal in the production process.

Relatively speaking, coal exports are more important for low-income countries (LICs) in general than they are for sub-Saharan African countries. While sub-Saharan African countries exported USD 10 billion worth of coal in 2018 and LICs "only" USD 3 billion, the share of coal exports in total fossil fuel exports in LICs was 25%, versus 7% in sub-Saharan Africa.

In summary, then, net-zero and circular economy commitments—along with general market trends—appear likely to have a larger potential impact on sub-Saharan African exports of crude and refined oil, and smaller potential short-term impacts on export markets for LNG and coal, although all three fossil fuels are likely to face a tightening market in the medium term, in which sub-Saharan African, LDC, and low-income country exports are likely to struggle.

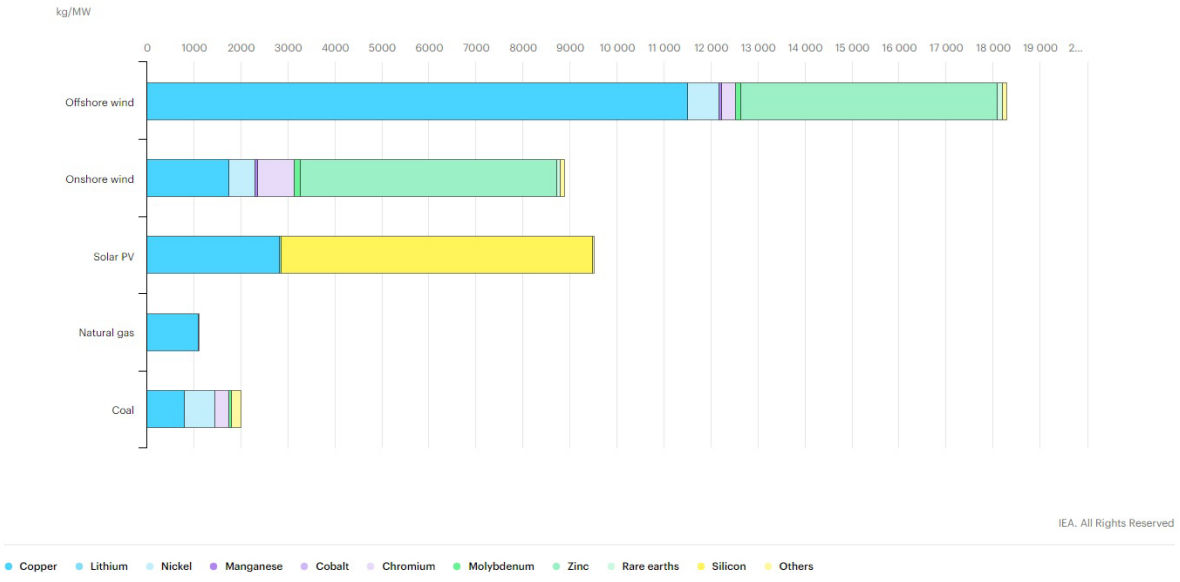
4.0 An Increased Need for Metals and Minerals for the Energy Transition

4.1 Trends

The energy transition will require increased quantities of several critical metals such as aluminum, chromium, cobalt, copper, iron ore and steel, indium, lithium, manganese, molybdenum, nickel, platinum, rare earth metals, silver, titanium, and zinc (World Bank, 2017). The need for these metals arises from the transition to renewables for electricity generation, the electrification of primary energy demand, and the increased use of batteries in either grid electricity storage or electric vehicle, which are many of the policy objectives set out in net-zero and circular economy commitments (see Section 2).

First, renewable energy technologies are more heavily reliant on minerals than conventional sources of power generation (i.e., natural gas and coal). Figure 3 shows that wind energy is especially reliant on copper, zinc, and nickel in terms of weight of material needed per installed megawatt (MW) of capacity. In addition, wind technologies also rely on manganese and chromium. Offshore wind is especially resource intensive (Hund et al., 2020). Between 2010 and 2018, the offshore wind market already grew by almost 30% annually, and the IEA expects that installed capacity can grow fourfold in the next decade (IEA, 2019). Solar energy is also resource intensive, relying especially on copper and silicon (IEA, 2020c).

Figure 3. Minerals used in selected power generation technologies



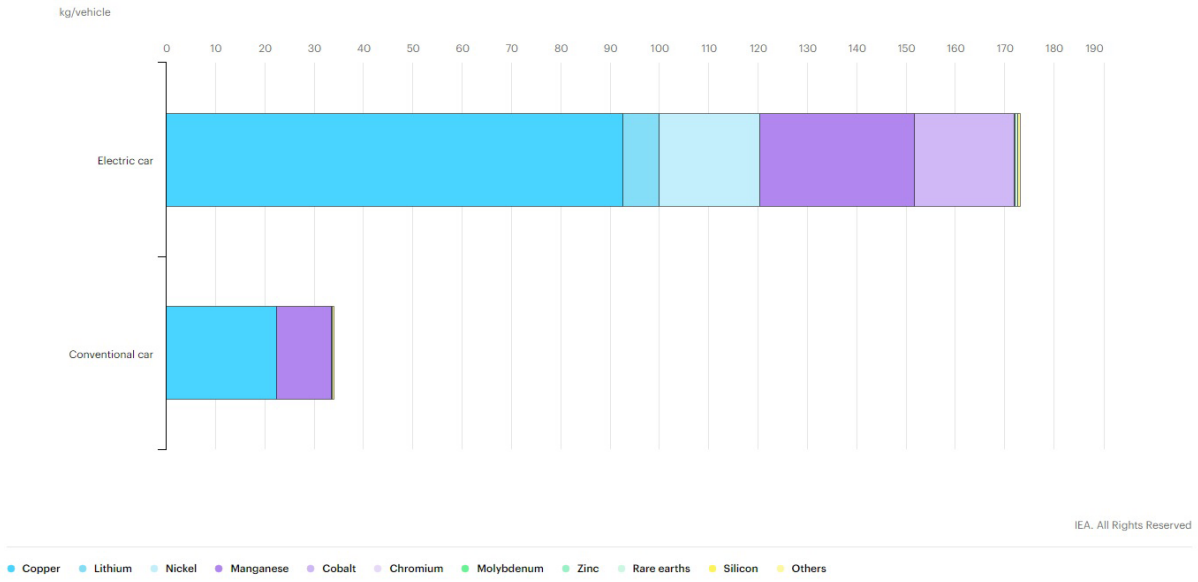
Source: IEA, 2020a.

Second, the growing electrification of primary energy demand will facilitate opportunities, for reasons including growing material needs to further expand and optimize the grid (IEA, 2020d). High-voltage cables are very resource intensive, particularly with regards to steel and

aluminum and, when deployed underground, copper (Deetman et al., 2021). In the case of accelerated carbon mitigation, the global electricity sector could consume 34% of current global aluminum production and 28% of current copper production by 2050 (Deetman et al., 2021).

Third, batteries for electricity storage and EVs are very resource intensive. While EV batteries are still under development, and their chemical compositions continue to change (Bridle et al. forthcoming), they generally use significant amounts of copper, lithium, cobalt, manganese, and nickel (see Figure 4). Recently, there has been a trend to reduce the amount of cobalt in batteries, but experts still expect the mineral to remain critically important for the next decade. At the same time, virgin materials are expected to remain important, as battery and mineral recycling is still in its infancy and continues to struggle with basic profit generation (Hill et al., 2019).

Figure 4. Minerals used in selected transport technologies



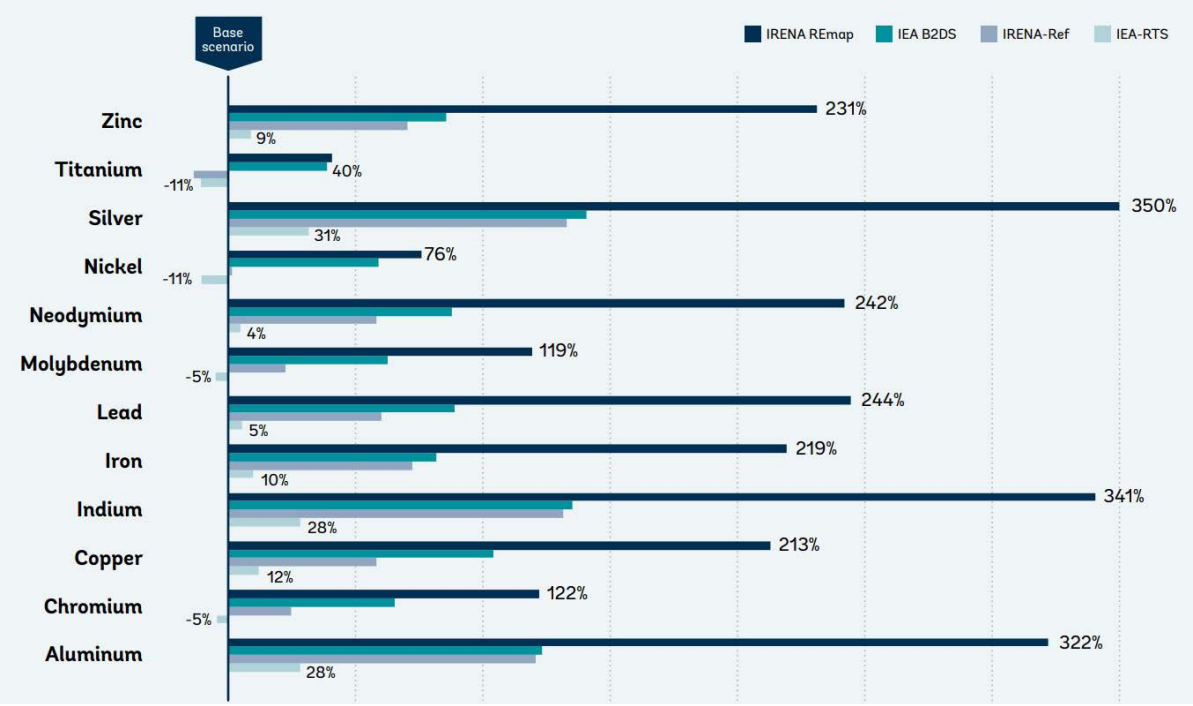
Source: IEA, 2020a.

To assess what net-zero and circular economy commitments related to renewable energy might mean in terms of mineral use, and therefore exports of minerals from sub-Saharan Africa, we look estimates of global mineral use under different energy transition scenarios.

Hund et al. (2020) have modelled what this energy transition can mean under different scenarios up to 2050. Figure 5 below shows results for four scenarios in comparison to the base scenario of 4°C global warming. The difference between reference scenarios (i.e., International Renewable Energy Agency reference scenario [IRENA-Ref] and IEA-reference technology scenario [RTS]) and scenarios that target a more rapid energy transition (i.e., IRENA renewable energy roadmap scenario [Remap] and IEA beyond 2-degree scenario [B2DS]) is clear, with the latter scenarios having a much higher demand for key minerals. In the strongest scenario, demand growth for various minerals is between double and four times the base scenario.

The more ambitious net-zero and circular economy commitments are with respect to the transition to renewable energy, the more demand for minerals, including those produced in sub-Saharan Africa, can be expected to grow. Current targets show considerable ambition. The EU has a renewables target of 32% of total final energy and 57% of electricity generation by 2030; China has a renewables target of 20% of total final energy and 35% of electricity generation by 2030; India has a renewables target of 40% of total final energy by 2030; the United States has targets according to states, with California having a 60% target renewable electricity target by 2030 and New York a 70% target (REN21, 2020).

Figure 5. Relative change in demand for minerals from energy technologies (without storage) through 2050 under RTS, Ref, B2DS, and Remap, compared to base scenario



Note: Base scenario = 4°C global warming scenario.
Source: Hund et al., 2020.

4.2 Impacts

After fossil fuel exports, metals and minerals exports are those of most value to developing countries. According to resourcetrade.earth and ComTrade data, sub-Saharan African countries exported USD 110 billion worth of metals and minerals in 2018. This market was also important for LDCs, where it totalled USD 50 billion. LICs had USD 32 billion in exports of metals and minerals.

The most important and valuable market is the one for non-ferrous metals such as copper, aluminum, nickel, and zinc. Some of these materials are important for both renewables and batteries. Nickel, for example, is important for lithium-ion batteries but also to produce stainless steel, which is critical in the construction of wind turbines. Copper is a conductor

for wind power but equally essential for general wiring and in EVs. It represents the biggest metal export from sub-Saharan Africa, at USD 21 billion annually. In LDCs, it represents a total export value of USD 19 billion. Following copper, aluminum is the most important non-ferrous metal export, with 2018 exports valued at USD 8 billion in sub-Saharan Africa and USD 6 billion in LDCs.

As mentioned, the potential growth for these markets is immense and is even more pronounced when understanding supply-related challenges. In terms of nickel, for example, new investments are not sufficient to cover expected demand growth, and export restrictions in Indonesia (a key producer country) also cast questions on supply reliability (IEA, 2020c). Copper, on the other hand, is difficult to substitute in electrical appliances (IEA, 2020c), and production in countries like Chile and Peru (which represent 40% of global production) has recently suffered in light of social tensions and rising production costs. Additionally, mines in both Latin America and Australia are considered vulnerable to climate and water stress (IEA, 2020c). The only substitute for some copper applications is aluminum, which can also be found in developing countries (Månberger &Stenqvist, 2018). These supply-side challenges show that, in addition to improving the circularity of key metals, investment will need to be scaled up in mineral-rich countries to keep accelerating the pace of the global energy transition.

The second largest metals and minerals markets—those of precious metals—are unlikely to be strongly affected by net-zero commitments as they are articulated today. This market includes especially gold, whose exports from sub-Saharan Africa were worth USD 31 billion in 2018. In LDCs and LICs respectively, that market was worth USD 14 billion and USD 12 billion. Gold is likely to be unaffected by the energy transition and can even gain in importance in the coming years as a hedge against inflation. With both an influx of stimulus money and fears over the impact of COVID-19 on the global economy, the price of gold hit USD 2,000 for the first time in August 2020 (Sanderson, 2020).

The third largest metals and minerals market today is that for specialty minerals and metals. This is a market with huge growth potential as it includes two key minerals that are needed for the energy transition generally and electric vehicle batteries specifically: cobalt and manganese. Within specialty minerals and metals, those are the most valuable export commodities for sub-Saharan countries, worth USD 6 billion and USD 5 billion in export revenues respectively in 2018. Importantly, cobalt is also important for LDCs and LICs, where the export value was USD 5 billion. While cobalt demand growth is expected to increase, there are also clear signs that producers are trying to limit the amount of cobalt needed in batteries, and therefore this may be a sunset market quicker than developing country producers would like. Finally, the market for iron and steel generally—and iron ores & concentrates specifically—was worth around USD 8 billion in 2018 in export values for sub-Saharan African countries.

These four key existing markets of developing country exports of primary resources may be ripe with growth potential, but more investment is needed to fully unleash it. Wood Mackenzie modelled that a global investment of more than USD 1 trillion would be needed in aluminum, cobalt, copper, nickel, and lithium alone, which is double what was invested over the last 15 years (Mining.com, 2020).

Investments in resource-extraction projects in developing countries are capital intensive and need to rely on assumptions about the longevity of resource use (World Bank, 2017). While African countries are expected to be particularly important producers given their reserves, especially in platinum, manganese, bauxite, and chromium (World Bank, 2017), there are also a number of concerning indicators that cast doubt on developing countries' ability to fully exploit demand growth. There is still a strong discrepancy between reserves and production, with several developing countries holding larger reserve-to-production ratios than developed economies. For example, 26% of bauxite reserves—a key metal for aluminum production—are located in Africa, but the region accounts for only 6.5% of global production (World Bank, 2017). There is also no reserve or production data available for rare earth metals in developing countries (World Bank, 2017). Some of these investment hurdles will need to be overcome if developing countries generally—and those in the sub-Saharan region specifically—seek to accelerate production and exports.

In summary, the shift to electrification and renewable energy use prompted by net-zero and circular economy commitments in large export markets is likely to generate considerable demand in those markets for specific metals and minerals that sub-Saharan African countries, LDCs and LICs have reserves of, particularly for non-ferrous metals. However, these countries will need to overcome a number of challenges to develop the production capability to take advantage of this potential surge in demand, and further measures to avoid a new resource curse and make sure export gains reflect positive developmental outcomes.

5.0 Waste and Waste Markets

As mentioned above, waste regulations are important in that they can reduce the need for virgin materials. For example, battery repurposing and recycling targets may reduce the need for virgin metals. However, in the coming decade, it is not expected that e-waste regulations will be strong enough to improve circularity to the extent that we would see demand reductions for virgin materials. As a matter of fact, there are barely any net-zero policies that set lithium-ion battery recycling targets. This may change in the 2020s and 2030s as e-waste from batteries piles up, but lithium-ion battery recycling will remain a fairly niche market that struggles with economic and regulatory fundamentals in the next years. This fact, in combination with growing markets for such batteries, seems to suggest a large market for virgin materials.

Waste regulations can, of course, have an impact on existing trade between large economies and developing countries, but this would mainly result in a reduction of waste exports from those economies to developing countries, rather than from developing countries to large economies. This is because waste exports from sub-Saharan countries to the global North are relatively uncommon (Van Der Ven, 2020). If circular economy policies and investments scale up, it is conceivable that higher-income economies keep the circularity within their borders and as such add value, while developing economies would only gain income once at the export of virgin materials. This could however also favour existing waste exports from developing countries. Today, LDCs export wastes, scraps, and residues for about USD 6.6 billion annually (circulareconomy.earth 2021), most of which to China (USD 2.4 billion), Singapore (USD 1.9 billion), and Thailand (USD 600 million). The main exporters are Cambodia (USD 2.5 billion) and the Democratic Republic of the Congo (USD 2 billion).

Waste regulations can also open up new markets, particularly for labour-intensive repairs. In recent years, the export and reimport of used goods and scrap materials from the global North to developing countries and back has indeed increased (Gregson et al., 2015). There are, however, still challenges with such models as several researchers have pointed to the social and environmental burdens on developing countries populations associated with this model (Cotta, 2020; Gregson et al., 2015; Gutberlet et al., 2017; Kettunen et al., 2019; Schroeder et al., 2019).

Extended producer responsibility policies can change some of the problems associated with waste in general, and electrical and electronic appliances waste specifically. A lot of this waste ends up broken and unrepairable and finds its final destination in developing country landfills or burners to recover some of the materials (Cotta, 2020). It has been suggested that extending producer responsibility in free trade agreements could lead to a more virtuous cycle of trading, reusing, and recycling than currently exists (Torrente-Velasquez et al., 2020). Today, this appears more aspirational than real, with more and more developing countries returning toxic waste to its place of origin (O'Neill, 2019).

A key measure that precedes potential positive waste trade in the future will thus consist of capacity building and technical assistance to support the repair industry in developing countries, including investments in infrastructure and training (Kettunen et al., 2019;

Organisation for Economic Co-operation and Development [OECD], 2020b). This also includes investments in better reverse logistics infrastructure. Eventually, this could lead to a transformation of the endpoint of global waste trade, with developing countries becoming the suppliers of secondary raw materials to global markets (Van Der Ven, 2020).

6.0 Impacts on Other Key Resource Exports

There are two other key resource exports for sub-Saharan African countries of which the impacts of net-zero and circular economy policies are either small or uncertain. One is the agricultural sector. Export markets for agricultural products are essential for sub-Saharan African countries. According to resourcetrade.earth and ComTrade data, the largest sub-component of this market is in stimulants, tobacco, and spices. Cocoa alone was worth USD 10 billion in exports in 2018 and was the single largest agricultural export good for sub-Saharan Africa, LDCs, and LICs. That was followed by tobacco, coffee, tea, and spices, whose exports were valued at about USD 2 billion each in 2018. Horticulture was an important secondary export market, worth USD 12 billion in 2018 in sub-Saharan Africa. This was mainly in the form of exports of fruit and berries (USD 6 billion) and nuts (USD 4 billion). Fish and other agricultural products were worth USD 4 billion each, with frozen fish and cotton respectively the most important exported goods (each USD 2 billion).

An increase in agricultural production can, in certain places, pose problems for the environment in terms of tropical deforestation, groundwater exhaustion and loss of species as a result of land-use change (Balogh & Jàmbor, 2020). These impacts, however, are largely linked to the place of production, and therefore agricultural trade might not be immediately severely threatened by net-zero and circular economy policies in major economies that try to limit such indirect emissions. Some of these policies already target indirect land-use change caused by increasing demand for resources (especially palm) from the food and biofuel industries. Even if such regulations have to date focused mainly on biofuels, indirect land-use change effects also exist in other sectors (including the food sector), and agricultural exports that originate in such carbon sinks may be affected by a shift to a net-zero world. This effect could be similar to other standards and consumer preferences that target supply chain responsibility and seek a reduction of the greenhouse gas intensity of imports. Eventually, net-zero strategies will have to catch up with such standards.

Even more important is the fact that South–South trade of agricultural products has surpassed both North–South trade and South–North Trade (United States Department of Agriculture 2015), and as a result, policies in the North that target agricultural trade may be less impactful on developing country exports.

On the other hand, two resource sectors that will not be affected much include forestry products and pearls and gemstones. Forestry products represent, comparatively, only a small export market for developing countries. In sub-Saharan Africa, the export market of this sector was worth about USD 5 billion in 2018, of which USD 4 billion was in lumber and sawn wood. Wood waste and timber regulations may increase the circularity of existing wood resources, but it is unclear whether this would have a big impact on wood exports. Pearls and gemstones are important export markets for sub-Saharan Africa. Like precious metals, pearls and gemstones—whose exports were worth USD 19 billion in 2018 from sub-Saharan African countries—represent a market that is unlikely to be affected by net-zero and circular economy commitments.

7.0 Discussion and Conclusion

This paper identified potentially large international export impacts between developing countries and OECD economies and other economies with more elaborate climate change policies. The magnitude of these impacts depends however on several factors and variables. First, the analysis assumes that net-zero emissions and circular economy targets will effectively be implemented by countries elaborating them, which may not always be a safe assumption. Second, the impacts will depend on the extent to which imports from developing countries can effectively be substituted by cleaner alternatives, for example, by replacing primary raw material with secondary raw materials or by replacing carbon-intensive goods with cleaner alternatives associated with lower greenhouse gas emissions. Finally, the magnitude of the impact on developing country exports will depend on the extent to which these countries succeed in diversifying their economies and rely on a wider set of exported goods in the decades to come. A more dynamic analysis estimating those variables is, unfortunately, beyond the scope of this policy brief. However, these elements should be clearly taken into account in a more in-depth analysis.

Keeping those caveats in mind, the paper reviews four broad sectors: fossil fuels, metals and minerals, waste and waste products, and other resource exports including agricultural products. We find that exports of fossil fuel products could be threatened in the short and medium terms, with tightening markets and supply-side competition across the world. Metals and minerals, however, have growth potential, even though more investment is needed to reap the full potential. While circular economy policies may ultimately depress trade in primary materials including metals and minerals, in the case of non-ferrous metals such as copper, aluminum, nickel, or zinc, this trend will likely be offset at least in the short to medium terms by increased demand for primary resources to produce renewable energy and batteries. In the longer term, and with a lot more investment, however, we can expect more practices to increase remanufacturing, repurposing, recycling, and recovering of materials (de Jong et al., 2016). This could eventually reduce demand for primary resources but also create opportunities for trade in waste and secondary materials.

Agricultural products may be less directly affected by energy transition components of net-zero and circular economy packages but may be influenced by (public or consumer) standards related to the greenhouse gas intensity of imports. The impact on agricultural products could come particularly from campaigns in importing countries to privilege locally produced goods over imported ones, or calls to apply carbon border adjustments, the latter of which could have a disproportionate welfare impact on developing countries and far-reaching consequences on non-resource exports as well (OECD, 2020). Finally, pearls, gemstones, and forestry products are less vulnerable and may be only marginally affected by net-zero and circular economy packages. Table 2 summarizes these findings for the different categories highlighted above.

Table 2. Findings summary – Impact of net-zero and circular economy commitments on natural resource exports

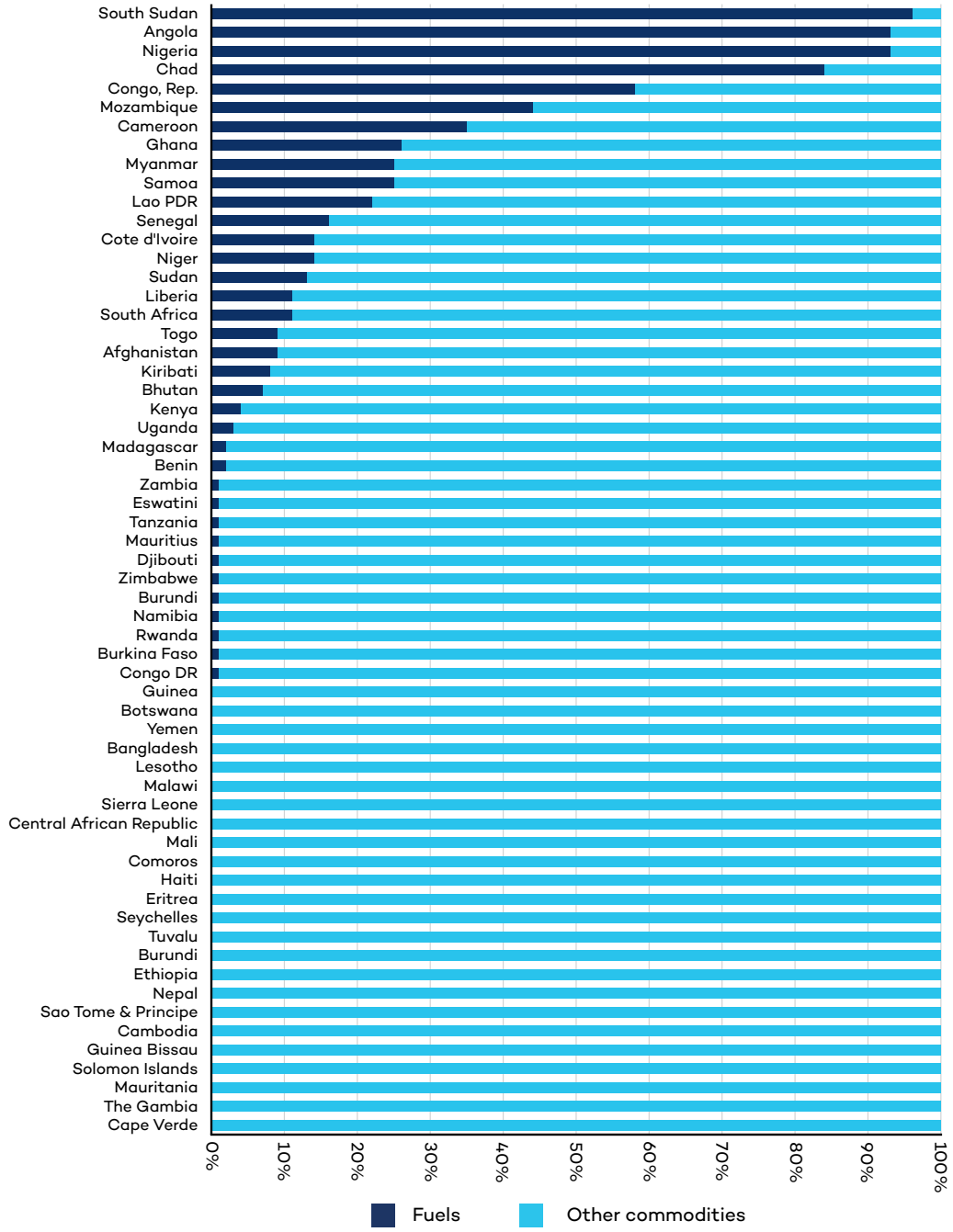
Resource type	Export value sub-Saharan Africa (USD billion)	Export value LDCs (USD billion)	Key export markets	Projected trends
Fossil fuels	146	60		
Oil	123	49	Crude; refined	Tightening market for crude and refined oil in the short term
Natural gas	12.7	8	Natural gas; LNG	Tightening market for natural gas & LNG in the medium term
Coal	10	3	Hard and coking coal; brown coal	Tightening market for coal in the medium term
Metals & minerals	110	50		
Non-ferrous	41	27	Copper; aluminum	Growth potential due to an increase in RE, EVs, and electrification; more investment needed
Precious	39	14	Gold; platinum	Low impact due to lack of alternatives or circularity
Specialty	16	6	Manganese; cobalt	Growth potential due to an increase in battery use; more investment needed; time-bound for cobalt
Iron & steel	14	2	Iron ores & concentrates	Unclear: large energy transition iron demand but possible steel recyclability
Agricultural	48	27		
Stimulants, tobacco, spices	18	6	Cocoa	May be affected by circular economy and net-zero standards; Consumer preferences and supply chain responsibility standards can demand a reduction of greenhouse gas intensity of imports.
Horticulture	12	4	Fruit and berries; nuts	
Fish and aquatic resources	4	4	Frozen fish and seafood	
Other agricultural products	4	3	Cotton and yarn	
Oilseeds	3	3	Sesame	

Resource type	Export value sub-Saharan Africa (USD billion)	Export value LDCs (USD billion)	Key export markets	Projected trends
Pearls and gemstones	20	3		
Diamonds	19	3	Non-industrial diamonds	Low impact due to lack of alternatives or circularity
Forestry products	5	2		
Lumber, sawn wood	4	2	Logs and sawn wood	Wood waste and timber regulations may affect imports
Wood pulp, chips	1.2	<1	Wood pulp	

Source: Author's elaboration based on resourcetrade.earth and ComTrade data.

While the policy packages described in this paper may directly affect some of the largest export items of developing countries, their impact will vary considerably between countries depending on their export structure or destination. To illustrate this point, Figures 6 to 8 rank sub-Saharan African countries and LDCs according to their export dependence on fuel, minerals and metals, and agricultural products. It shows a very high dependence on fuel exports for a small set of countries. South Sudan, Angola, Nigeria, Chad, and Congo in particular rely on fossil fuel for more than 50% of their exports, a share which can go up to 96% in the case of South Sudan. These countries will urgently need to diversify their revenues and exports or risk being significantly affected by net-zero commitments and circular economy packages. By contrast, nearly half of the countries analyzed did not export fuel at all or only up to 1% of their trade.

Figure 6. Share of fuel in exports of LDCs and sub-Saharan African countries (Avg. 2016–2019)

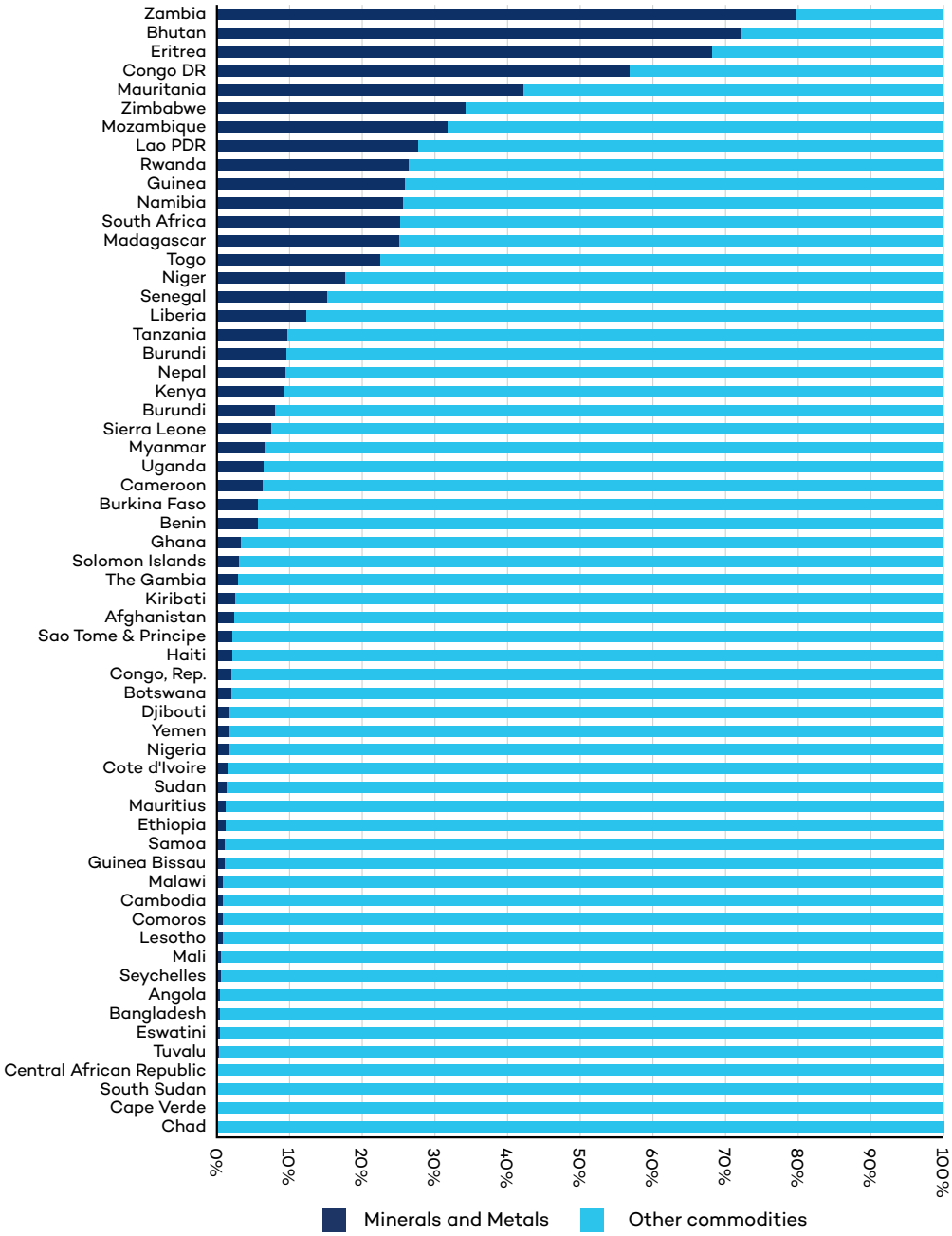


Source: Author's elaboration based on ComTrade.

When looking at metals and minerals, the data for 2016 to 2019 shows a relatively lower level of dependence even if a larger number of sub-Saharan African countries and LDCs export these items in non-negligible volumes. The country relying most on metals and minerals is Zambia, where such exports accounted for nearly 80% of total trade; however, half of the countries analyzed depended on those items for at least 3% of their exports. Given the growth potential in these markets, at least in the short to medium terms, the urgency to diversify is less pressing in those countries. A significant challenge nonetheless remains to ensure that

a larger share of the benefits from mining occurs at the domestic level and contributes to generating decent jobs and opportunities for value addition and industrialization. Increased demand for some of these primary materials may also be accompanied by strengthened scrutiny to avoid illegal or unethical labour practices or significant environmental impacts in the extraction process.

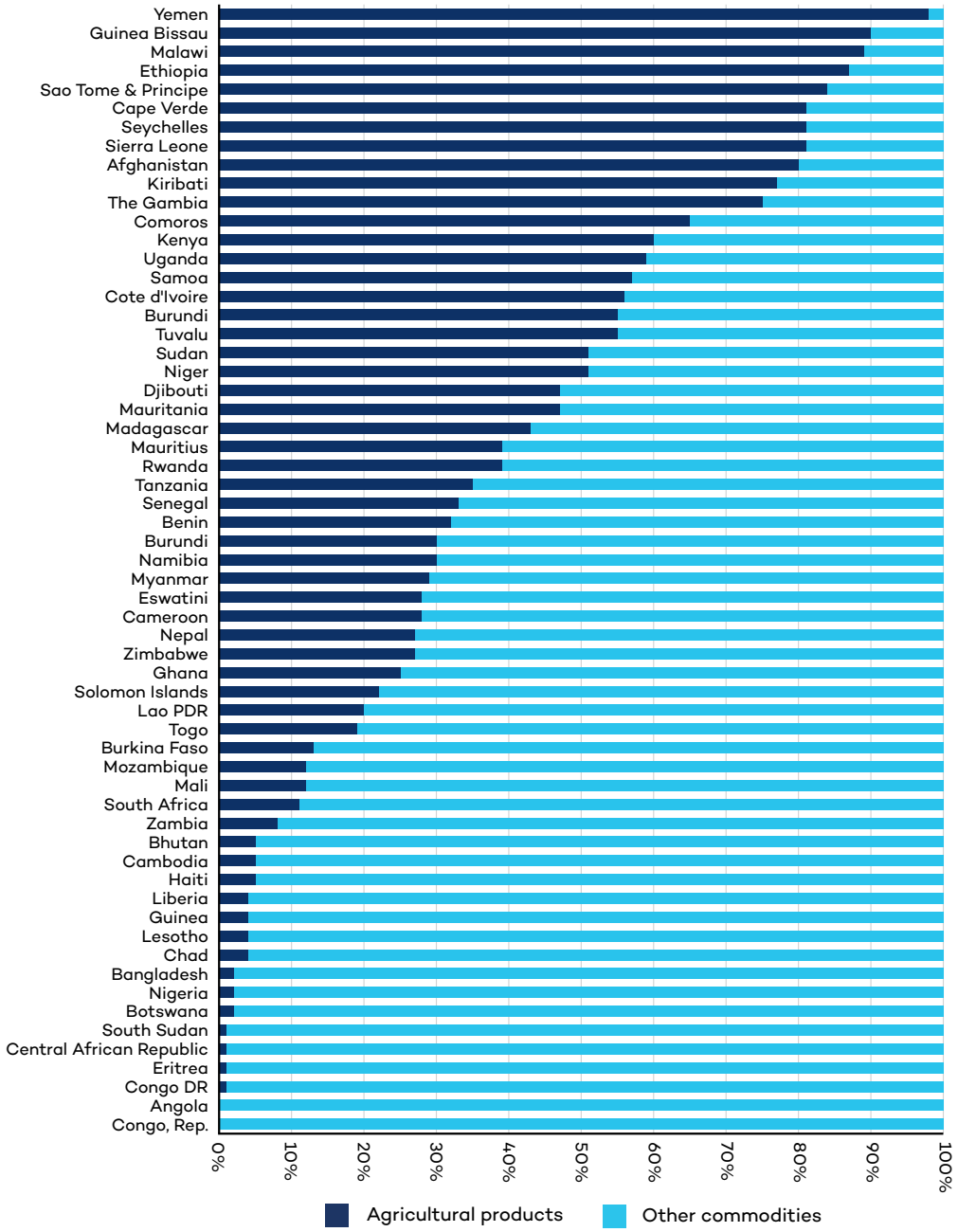
Figure 7. Share of minerals and metals in exports of LDCs and sub-Saharan African countries (avg. 2016–2019)



Source: Author's elaboration based on ComTrade.

Finally, while the agricultural sector is expected to be less directly affected by net-zero and circular economy packages, possible trade effects linked to consumer preferences, standards, or border carbon adjustments are likely to affect a much larger range of countries. With a third of all countries analyzed here depending on agricultural products for 50% or more of their exports, this is the sector where sub-Saharan African countries and LDCs show the largest export dependence. It affects virtually all countries except those relying on fuel as described above or those specialized in light manufacturing such as Bangladesh, Cambodia, Lesotho, or Haiti, where textiles and clothing play a more prominent role.

Figure 8. Share of agricultural products in exports of LDCs and sub-Saharan African countries (avg. 2016–2019)

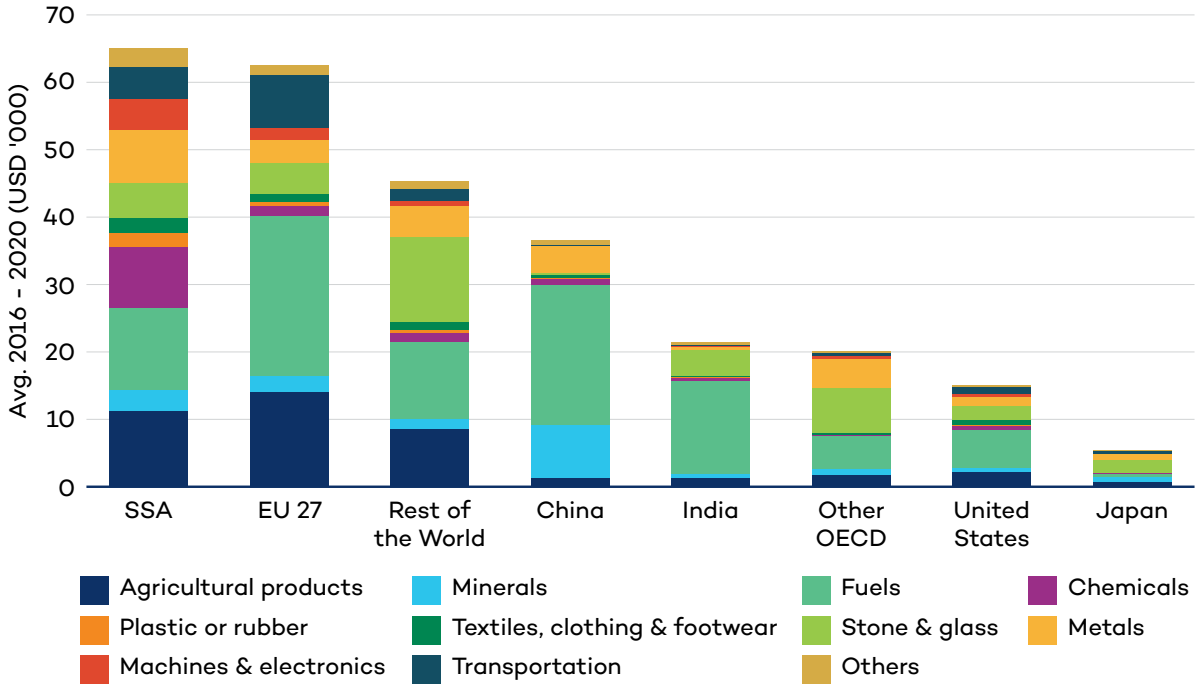


Source: Author's elaboration based on ComTrade.

These countries will largely benefit from enhanced technical assistance and capacity building under general official development assistance programs or the Aid for Trade initiative to adapt to new circular economy requirements or reduce the carbon content of their exports. This could include, among others, support for the establishment of regulatory bodies for conformity assessment, methods to meet new technical regulations and standards, and steps that would need to be taken by producers (Kettunen et al., 2019; Yamaguchi, 2021). Assisting developing countries in achieving product standards that fit the circular economy objectives and other carbon content requirements of importing countries would help achieve the potential of international trade.

Besides the dependence of individual countries on certain commodities, export destinations also matter. While sub-Saharan African countries and LDCs show significant patterns of export concentration, this dependency varies considerably according to the export destination. Overall, the largest growth in international trade is expected to happen between developing countries (estimated to grow 7-fold between 2011 and 2060) rather than between OECD economies and developing countries (Dellink, 2020). In turn, South–South trade has its own dynamic in terms of trade content. To illustrate this point, Figure 9 shows exports of sub-Saharan African countries by product category and destination between 2016 and 2019. While exports remain heavily concentrated around metals, minerals and fuel in China (and to a lesser extent, the EU or the United States) intra-African trade (represented in the left bar in Figure 9) clearly exhibits a much more diversified and balanced pattern of trade.

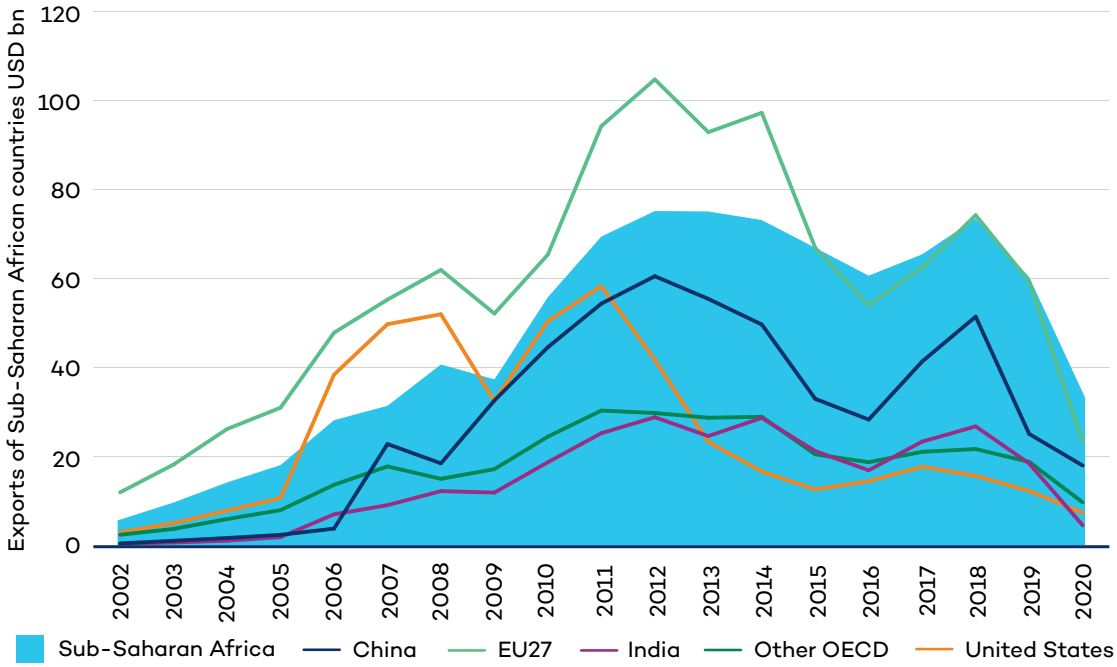
Figure 9. Exports of sub-Saharan African countries by category and destination (avg. 2016–2019)



Source: Author's elaboration based on ComTrade.

Intra-African trade also happens to be particularly dynamic. As seen in Figure 10, it has grown significantly and fairly consistently since 2002 to become the largest destination of sub-Saharan African countries' exports. While South Africa alone accounts for more than a third of these trade flows, this reality points to the fact that efforts at diversifying exports in sub-Saharan African countries should put particular emphasis on promoting regional integration, for example in the context of regional economic communities or as part of the African Continental Free Trade Area (AfCFTA). This type of trade not only offers new opportunities for economic diversification—it is also less likely to attract restrictions related to net-zero commitments or circular economy packages that are more prevalent in OECD countries or large emerging economies.

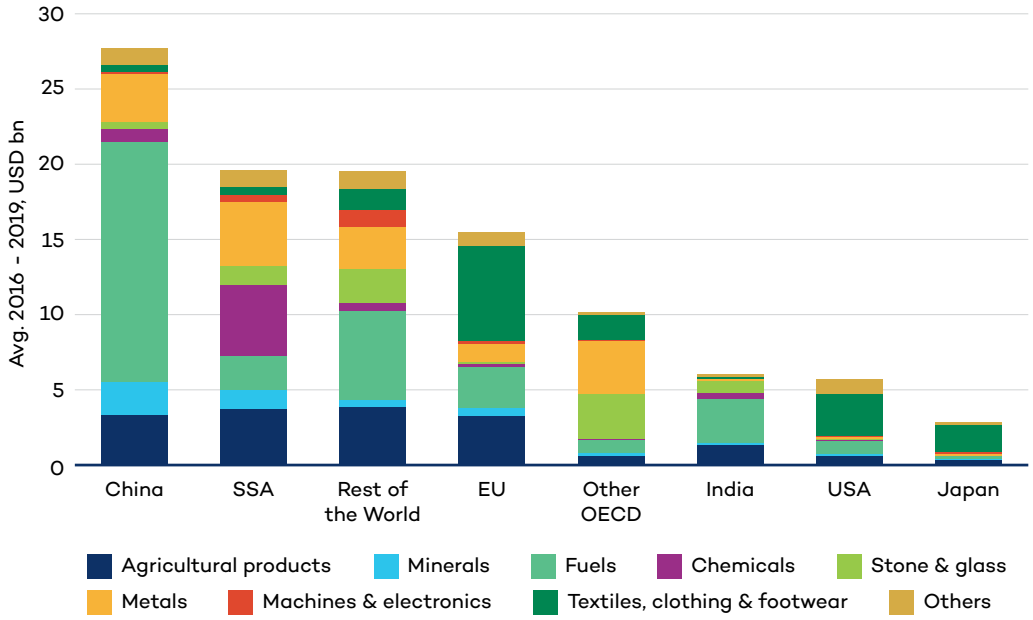
Figure 10. Evolution of sub-Saharan African countries exports by destination (2002–2019)



Source: Author's elaboration based on ComTrade.

As seen in Figure 11, this more diversified pattern of trade is also present in exports from LDCs going to Africa. This confirms that the more diversified nature of intra-African trade is not solely due to South Africa. In terms of destination, China, however, remains the largest market for LDCs in absolute terms, and largely surpasses intra-LDC trade. As with sub-Saharan Africa, exports to China remain highly concentrated on raw materials. Exports going to the EU, United States, and Japan are, by contrast, more concentrated on textiles and clothing, with Bangladesh and Cambodia playing a leading role.

Figure 11. Exports of LDCs by category and destination (avg. 2016–2019)



Source: Author's elaboration based on ComTrade.

In summary, net-zero commitments and circular economy packages are likely to have significant impacts on exports of developing countries, assuming that those commitments are effectively implemented, that imports are easily substituted, and that exporting developing countries still rely on these exports in the short to medium terms. The most immediate impact potential is on exports of fossil fuel products. This is likely to affect selected African countries such as Angola, Chad, or Nigeria who rely almost exclusively on fuels for export revenues. The risks for agricultural products may not be as pronounced but will affect a much higher number of LDCs and African countries. Finally, countries relying on metals and minerals may benefit from increased demand associated with renewables and battery production, at least in the short to medium terms, but in the long term, demand for secondary raw materials and recycling requirements may affect export prospects. These trends will force developing countries to accelerate their efforts to diversify their export basket and comply with new requirements in OECD countries and emerging economies. Besides technical assistance and capacity building (for example, under the Aid for Trade initiative), the promotion of intra-African trade in the context of regional integration including the AfCFTA offers significant prospects to support industrialization and economic diversification in support of sustainable development.

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