HOW CAN AFRICA MAKE THE MOST OF ITS TRANSITION MINERALS?

A pledge for enhancing value addition for development and prosperity

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Main findings

1. Expanding existing value addition in Africa could bring $32 billion in annual exports for the entire continent. This could add up to $24 bn to Africa's GDP and could create 2.3 million jobs.

2. Cooperation amongst African mineral rich countries could significantly expand existing value chains on the continent, potentially generating $32 billion annually in processed and transformed exports. This growth could contribute up to $24 billion to Africa's GDP and create 2.3 million new jobs.

3. The vast majority of Africa's transition minerals are destined for manufacturing industries outside the continent. Only 2% of the continent's exports of energy transition minerals are destined for other African countries. Africa is currently stuck at the bottom of energy transition value chains while most of the profits are made elsewhere in the world.

4. Though some countries in Africa do process transition minerals to some extent, the continent remains almost completely excluded from downstream and often more lucrative segments of value chains for these minerals, such as design, manufacturing, marketing and sales. This represents a major problem for the continent but African governments have the power to change the game.

5. African countries can make the most of their transition minerals by adding value to them: transforming them into products that can then be exported at better prices, and/or using them to address Africa's own development needs, including building clean and affordable energy systems.

6. DRC, South Africa, Sudan, Zambia and Republic of Congo account for 90% of the continent's current opportunities to increase export of processed and transformed mineral products. Madagascar, Egypt, Namibia, Morocco and Mozambique also have opportunities for hundreds of millions of dollars in additional annual exports.

7. African countries should be strategic in deciding how to increase their participation in value chains. They should focus on specialising in the parts of the value chain in which they are most competitive, even if it means importing minerals from other countries, rather than seeing it as a necessity to retain the entire value chain of minerals within their own soil. Retaining value on the continent is possible through flexible and collaborative strategies among African countries.

8. Through this approach, there is also potential for Africa to produce renewable energy technologies for fostering an equitable access to energy on the continent, using its own transition minerals. Regional economic cooperation and preferential trade agreements are key to ensure African countries can trade minerals amongst each other and become competitive in the renewable energy market.

9. Mining has a huge human and environmental cost with devastating impacts, in particular for communities living in mining areas, Indigenous People, women, and rights defenders. No-go zones and safeguards must be put in place to protect ecosystems and the rights of affected populations, including a fair, ongoing process of Free, Prior and Informed Consent—the Indigenous People's right to give and withdraw consent to mining on their lands.

10. Value addition has to go hand in hand with strengthening accountability of the whole transition mineral value chain. We want to see resource-rich states adopt comprehensive national and regional laws for due diligence, public participation, and benefit-sharing. Investor-State Dispute Settlement (ISDS) mechanisms in Bilateral Investment Treaties undermine these efforts by allowing companies to challenge government actions aimed at protecting public interests, preventing these countries from implementing essential measures. Renegotiating such treaties are critical steps to empower states to implement regulations that ensure accountability in the transition mineral sector.

11. We need a globally just energy transition that is truly transformative for mineral rich, poorer countries. Consumer regions must play a role in supporting these countries' ambitions to become more involved in value chains. Key development partners have promised to do so through "partnership agreements" like the EU's Memoranda of Understanding with Namibia and Rwanda, and the MoUs the EU and US have with the DRC and Zambia. However, these promises are often contradicted by other policies undertaken by the same "development partners". Consumer regions should not pressure African countries to abandon industrial policies that support domestic mineral processing and transformation. Instead, they should focus on fulfilling their financial and technology transfer commitments, fostering industrial capacity in partner countries, and bringing economic benefits to African citizens.

1. Introduction

Key messages

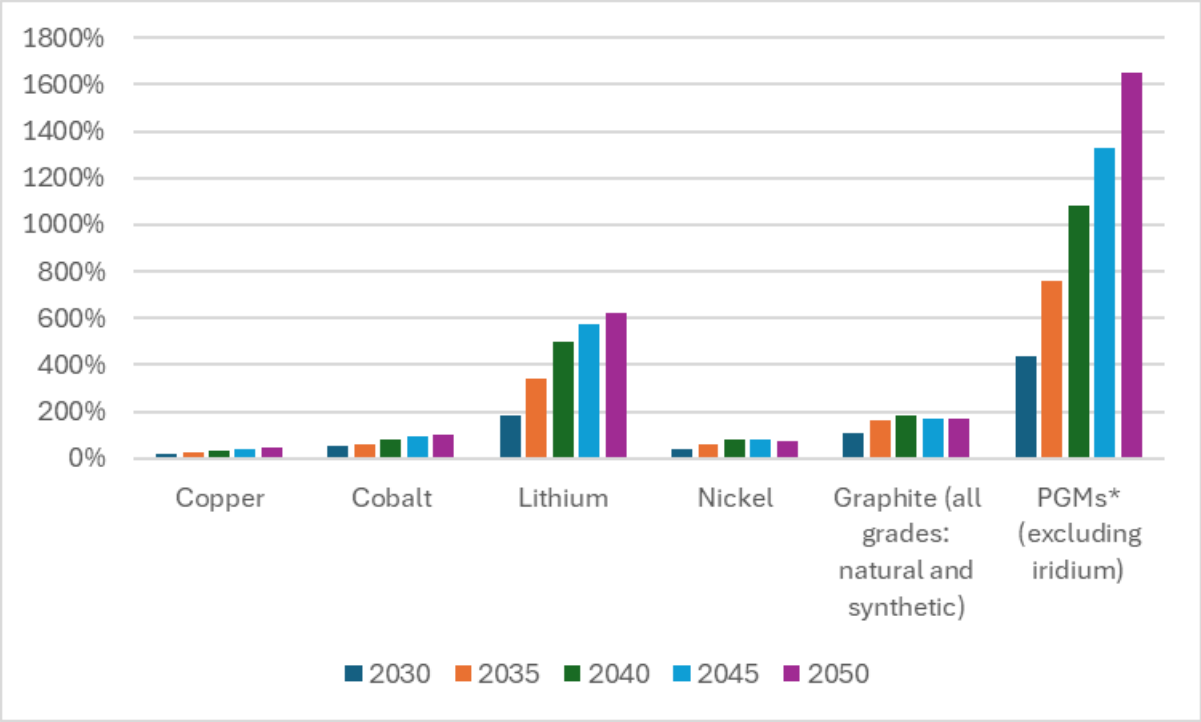
- A boom in Africa's transition minerals is coming.
- Some resource-rich African countries experienced only limited benefits from the continent's last commodity boom. For things to be different this time, they need to change their approach to natural resource management.
- Poor governance has led many countries to be worse off as a result of possessing natural resources in the past. Transparency and accountability around revenue management, anti-corruption and environmental protection are paramount.
- The impacts of transition mineral mining on the environment, society and human rights can be severe in some cases.

1.1 A boom in demand for transition minerals is coming

"Transition minerals" are those minerals that are used in technologies linked to the transition to renewable energy. This includes minerals used to make renewable energy technologies, as well as those needed to help existing technologies (such as motor vehicles) to run on electricity. For the purposes of this project, we use the International Energy Agency (IEA)'s list of "critical minerals" linked to the energy transition (which in this case is equivalent to transition minerals).[1]

Demand for many of these minerals is already strong and a source of exports for Africa. In 2022, Africa exported around $29 billion in transition mineral products. From 1995 to 2018, transition minerals and associated products accounted for 23% of Sub-Saharan Africa's total exports. [2] In 2022, countries around the world reported sourcing $55 billion in transition minerals (and metals derived from them) from Africa.[3] And global demand is expected to increase further as the energy transition accelerates. Even based only on governments' current stated policies, demand for key transition minerals that Africa produces is expected to rise rapidly to 2050, as shown in Figure 1 below. If governments go further in climate mitigation than current policies and, for example, meet their announced emissions reduction targets, demand for transition minerals would be significantly greater.

Figure 1: Projected growth in demand for selected transition minerals, as% of 2023 levels, under the International Energy Agency's Stated Policies Scenario[4]



** PGMs refers to platinum-group metals. Growth in demand for platinum-group metals is expressed as a percentage of the 2022 level.*[5]

But many African resource-rich countries did not benefit much from the last commodity boom.

Will Africa's resource-rich countries benefit from such an increase in demand from these minerals? Unfortunately, history suggests otherwise, unless something changes. The last major boom in demand for (and prices of) the commodities that the continent produces took place from 2004 to 2014, linked to the rise of China and that country's rapidly increasing demand for raw materials. Although this boom generated additional government revenues (around $1 billion per year on average compared to the pre-boom period of 1998-2003) in resource-rich African countries and spurred economic growth, much of this growth was confined to the resource sector. Indeed, "[O]nce the expanding resource sector's contribution to GDP growth is subtracted, overall economic performance was not significantly higher than in the rest of Africa [i.e., in non-resource rich countries)".[6]

Moreover, in spite of higher government revenues, some of sub-Saharan Africa's resource-rich countries did not effectively invest in diversifying their economies or laying the groundwork for sustained economic growth. As a result, after the commodity boom ended, these countries experienced slower growth than the rest of sub-Saharan Africa. This is not an artefact of commodity prices declining and reducing the value of commodity production - growth in these countries continued to be lower than in the rest of the region, even after commodity prices stabilised in 2016.[7] And some countries, such as the Democratic Republic of Congo (DRC) and Zimbabwe, have failed to invest their mineral wealth to the benefit of future generations, meaning that they could

be worse off unless more minerals are found. This is particularly important for the energy transition because the period of peak demand for transition minerals linked to the energy transition is likely to be temporary - there will be high levels of demand linked to the replacement of the fossil-fuel based energy system, but once that is done, demand will be lower, driven by economic growth replacement of decaying equipment. Indeed, the period of peak demand could finish in 2050, when countries accounting for two thirds of world GDP aim to reach net zero emissions.[8] Once this period is over, unless their governments invest mineral wealth for the long term, Africans could be left worse off.[9]

1.2 Different approaches needed to make the most of the boom

As a result, many voices are saying that, with the coming energy transition boom, "this time must be different" and African countries must benefit from the sale of their minerals. One way to do this is for African countries to revisit their mining tax and regulatory systems to make sure that they are getting the best deal possible from mining companies. In addition, African countries should strengthen public institutions, to ensure transparency and accountability in natural resource management,[10,11] including the management of natural resource revenues.[12] Another way for Africa to benefit more from their transition minerals is for African countries to increase their participation in value chains linked to mining and mineral-based products, at the same time stimulating other sectors of the economy.[13] These strategies could, in theory, be pursued concurrently, so long as governments have the bandwidth to do so.

Increasing participation in mineral value chains could be particularly beneficial if it allows African countries to diversify their economies and move into exporting products that they did not produce before. In addition to general research showing the benefits of producing a wider range of products and diversifying the economy,[14] there is research underlining how moving into new products can enhance the contribution of natural resources to Africa's development.[15]

Moreover, encouraging the development of mineral processing can contribute to job creation and improved living standards, which are key priorities for people across 34 African countries.[16] (However, recent research also suggests that, while industrialisation can create jobs, it will no longer be sufficient to transform developing economies. More comprehensive strategies encompassing other opportunities are also needed).[17] This report therefore focuses on opportunities for African countries to add value to their energy transition minerals, with some discussion of possibilities for increased "local content" (i.e., supplying mining companies) linked to the production of these minerals. , and how the continent can seize those opportunities.

Beyond participating more in transition mineral value chains, African countries also need to better control the effects of transition mineral mining on the environment, society, human rights and Indigenous people's rights. According to the IEA,

"[I]f poorly managed, mineral development can lead to a myriad of negative consequences, including:

- Significant greenhouse gas (GHG) emissions arising from energy-intensive mining and processing activities.
- Environmental impacts, including biodiversity loss and social disruption due to land use change, water depletion and pollution, waste related contamination, and air pollution.
- …Fatalities and injuries to workers and members of the public, human rights abuses including child labour and unequal impacts on women and girls."[18]

As the IEA mentions in the quote above, the mining of transition minerals can have negative effects on the environment and communities around mining projects, as with the mining of other minerals. The extent of these effects can depend on how and where the mineral is mined; and the picture is not always the same for different transition minerals. For example, the negative environmental impacts of cobalt mining are sometimes similar to those from most mining. But, many of the most valuable sources of cobalt are located in environmentally sensitive areas such as forests where the degree of environmental damage from mining would be much greater.[19] For lithium, local environmental impacts can be significantly larger than other types of mining, depending on the technique used.[20] Reducing available water is one of the key impacts,[21] and is particularly severe for copper and lithium mining.[22] The water demand "[C]reates competition for water between mining and other industries, especially agriculture, and thus affects food security."[23] Impacts of transition mineral mining on the toxicity of the soil, which can harm agriculture and undermine food security.[24,25]

Other key environmental impacts include, "Waste generation – [m]ineral development results in massive amounts of residues, both during extraction and after utilisation, some of which are hazardous to human health…air pollution from particulate matter (e.g. mine dust) and gaseous emissions, and noise pollution due to blasting and transporting activities."[26]

Mining is also plagued with corruption. The extractive sector accounts for one in five cases of transnational bribery, according to the OECD.[27] Corrupt networks increase the poverty gap and the power asymmetry between government, companies and communities. It is impeding any chance of equitable redistribution of revenues.

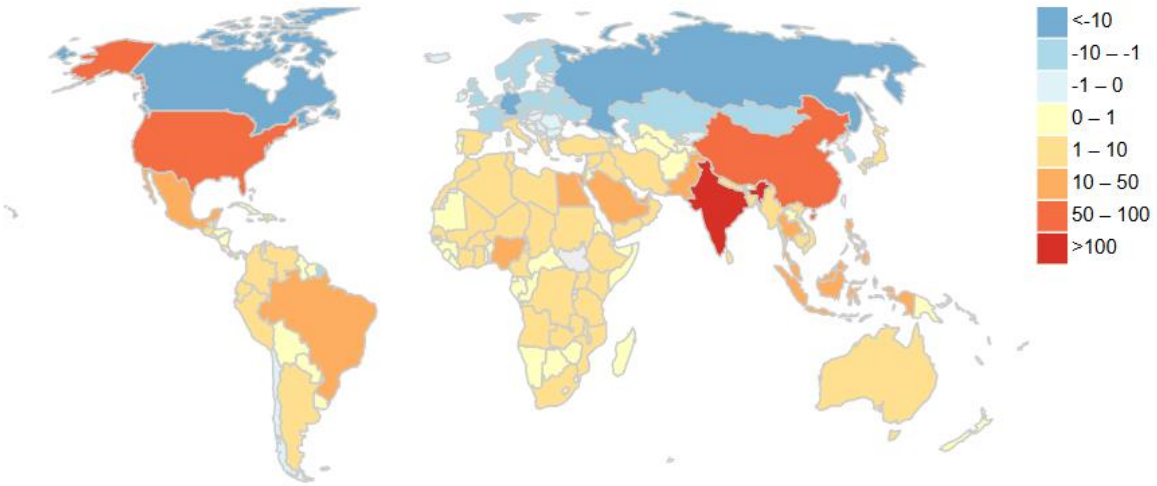
Mining for transition minerals also has negative impacts on the climate. For example, many mining operations use fossil fuels to power their equipment. Leading sources of emissions from mining include haulage trucks, comminution and crushing equipment, bulldozers and excavators. Overall, mining (excluding coal mining) accounts for 2-3% of global CO2 emissions.[28]

However, there may be positive impacts through the end use of these minerals if they speed the energy transition, and in so doing reduce CO2 emissions[29] and boost economic growth and reduce poverty.[30] As the same IEA report as cited above notes, "Mineral wealth can, if exploited responsibly, contribute to public revenue and provide economic livelihoods for many." [31] Africa itself is expected to benefit substantially economically if the global energy transition is achieved, with all of the continent's sub-regions expected to benefit, due to the wider economic effects of the transition. This mainly stems from the benefits of investment in renewable energy in Africa; effects of changes in global demand for fossil fuels are

small (African fossil fuel producers lose out, but these losses would be counterbalanced by gains for African fossil fuel importers).[32]

By contrast, Africa stands to be among the worst-affected regions if efforts to address climate change fail.[33] And African Development Bank, United Nations Environment Programme and United Nations' Economic Commission for Africa estimate that if the world warms to 4 degrees above pre-industrial levels by 2100, by 2050 GDP per capita could shrink by 7.2% in the United Republic of Tanzania, 6% in Guinea-Bissau and 5.9% in Liberia, when compared to a low warming scenario (less than 2 degrees of warming by 2100). (Impacts will be spread across the continent - we highlight these countries because they are some of the worst-affected for which there is high confidence in the model results).[34] And the additional emissions caused by mining transition minerals are expected to be far less than the additional emissions from fossil fuels without the minerals on which the energy transition depends.[35] Thus, overall, mining of these minerals would appear to mitigate climate change.

Figure 2: Estimates of the social cost of greenhouse gas emissions for each country[36]



Social and human rights impacts of transition mineral mining also vary by context. In the DRC, poverty and a lack of better alternatives attract artisanal miners to mine cobalt in hazardous conditions. These include children. [37] Cobalt mining also carries significant negative health impacts for miners.[38,39,40]

Although the social and human rights impacts will vary from country to country, exploitation of transition minerals is often associated with artisanal and small-scale mining. This in turn is often associated with unsafe mining practices and child labour. However, artisanal mining can provide incomes to poor individuals and families who might see mining opportunities instead go mainly to non-nationals from richer countries if they were unable to mine artisanally.[41] In addition to the example of cobalt in the DRC mentioned above, artisanal and small-scale

mining of transition minerals has also been found in the following African countries: Burundi, Ethiopia, Madagascar, Nigeria, Rwanda, Tanzania and Zimbabwe.[42,43,44,45]

Overall, the social and human rights impacts of energy transition mining could be severe. One study (pre-peer review) estimates that mining to meet the energy transition objectives of the European Union alone could result in 15,000-89,000 Africans being forced into modern slavery.[46] Mining can also increase the cost of living for communities surrounding the mine and worsen gender inequities if mining opportunities lead men to reduce their support for household labour.[47] And research by the Business and Human Rights Resource Centre has found widespread accusations of human rights violations in transition mineral mining.[48]

Although in theory environmental and social impacts can be managed, in practice mechanisms for doing so often fail to be effective. For example, in Africa, environmental impact assessments of new mines fail to properly account for local environmental damage of mining. This can lead to mines being approved that would not have been if the environmental effects were properly accounted for. To help manage this risk, Diene et al. (2022) propose that governments ban mining (and, indeed, mineral exploration) in certain areas that are particularly environmentally sensitive ("no-go zones"). The reason for forbidding mineral exploration is that, once a discovery is made, this can create irresistible political pressure for mining to be undertaken in the area. In addition, disclosure of environmental management plans, establishment of environmental monitoring committees for mining and stopping the harassment and violence that many governments inflict on environmental defenders can also help.[49]

2. Africa's production of transition minerals

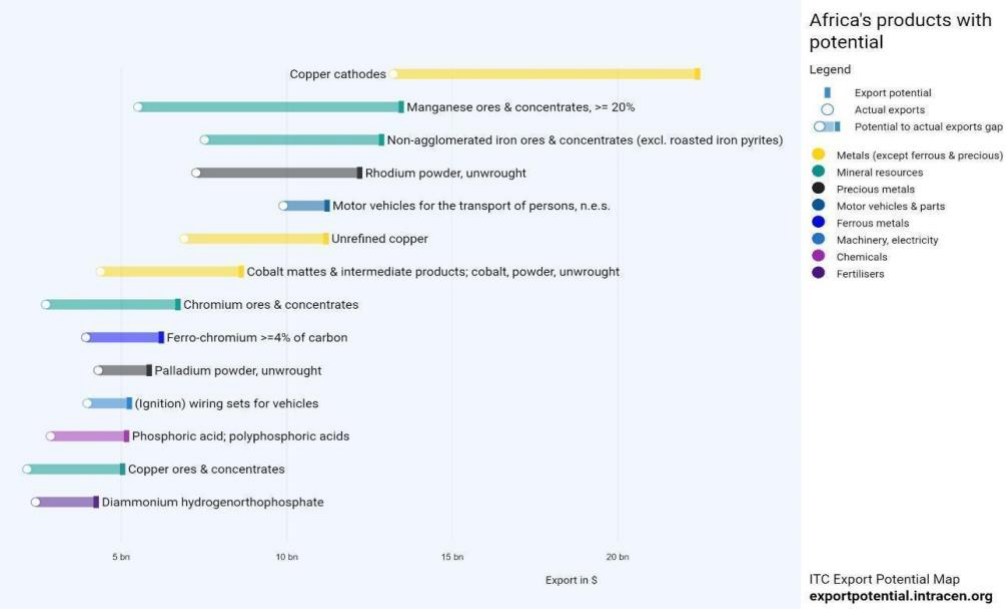
Key messages

- Transition mineral production in Africa is currently dominated by DRC, Zambia and South Africa. For most other countries, these minerals play a marginal role in their economies.
- Demand for the continent's transition minerals has significantly increased over time, following the arrival of 'modern renewable' energy. In addition to solar and wind power, increased use of other energy transition technologies such as electric vehicles is also likely contributing to this rising trend.

2.1 Africa's top producers of transition minerals

Africa produces a wide range of minerals that could be in demand due to the energy transition. Though many such minerals are produced on the continent, the data provided on transition mineral production in this section focuses on a limited number of those considered to provide particular opportunities for the continent to climb the value chain. These include nickel, manganese, cobalt and lithium (for their role in electric vehicle batteries, where Africa could hope to climb the value chain related to electric vehicle batteries). [50] They also include copper and platinum, for which Africa could hope to process more of its existing production, according to the International Trade Centre – see Figure 3 below. Graphite is also important for the production of electric vehicles and Mozambique (10% of global production) and Madagascar (8%) are significant producers. However, we have not seen analysis suggesting that these or other African countries are currently well-placed to add value to their graphite or that this would generate significant economic opportunities, which is why we do not highlight it here.[51]

Figure 3: Africa's export products with potential (expansion of existing exports)[52]



N.B.: Export potential is assessed based on the expected GDP growth in export markets and how far African countries could potentially increase their share of exports to those markets. The potential to increase market share is assessed based on a number of factors including how far the African country's exports are currently "below potential" as measured by the difference between the market share in that market, the exporter's global market share and the cost of trading between the two countries.[53]

The main producers of these metals in Africa (by volume produced), as of 2021, were:

- Cobalt – DRC (which is the largest producer in the world), followed by Madagascar, Morocco, South Africa, Zambia and Zimbabwe, in that order. Together, DRC, Madagascar, and Morocco account for around 70% of global cobalt production.[54]
- Copper – DRC, followed by Zambia, Tanzania, Morocco, South Africa, Eritrea, Mauritania, Botswana, Zimbabwe and Namibia. In 2022 DRC produced around 11% of the world's copper mine output in terms of recoverable metal content, while Zambia produced 4%.[55]
- Lithium – Zimbabwe, followed by Nigeria. In 2023, Zimbabwe was estimated to have produced around 2% of the world's lithium mine output, in terms of lithium content.[56]
- Manganese – South Africa, followed by Gabon, Ghana, Côte d'Ivoire, Zambia, Egypt, Morocco, Namibia and DRC. In 2022, South Africa produced around 37% of the world's manganese mine output in terms of metal content.[57]
- Nickel – South Africa, followed by Madagascar, Côte d'Ivoire, Zimbabwe, Zambia and Morocco. In 2021, South Africa produced 1% of the world's nickel in terms of metal content.[58]
- Platinum – South Africa, followed by Zimbabwe and Ethiopia. South Africa and Zimbabwe together accounted for 82% of the world's platinum production in 2022.[59]

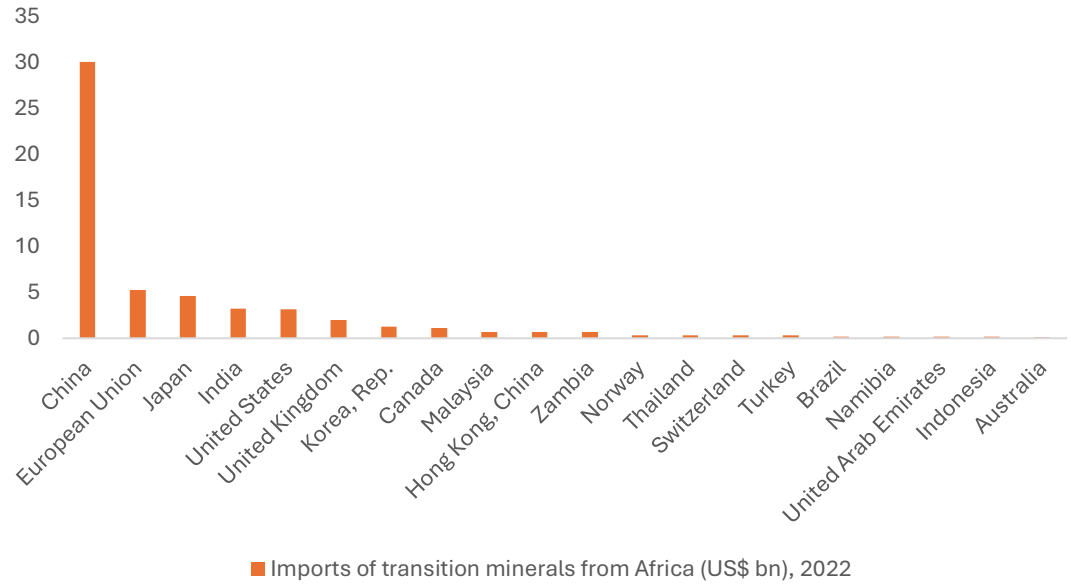
While we currently lack data on the value of production of transition minerals, we do have data on the total value of imports of these minerals from Africa, which can be a proxy for production value to the extent that most of the transition minerals that Africa produces are processed outside of the continent. These minerals currently only make a modest contribution to the continent's economy, as exports of them (and products directly based on

them) account for less than 2% of Africa's GDP.[60] But transition mineral production is also highly uneven across the continent – in some countries that dominate transition mineral exports (e.g., DRC, Zambia), these exports account for a higher share of GDP, whereas in most African countries it will be significantly lower than 2%.

2.2 Africa's key markets for transition minerals

As can be seen from Figure 4 below, China is by far the largest importer of Africa's transition minerals, accounting for 55% of the total by itself.[61]

Figure 4: Imports of transition minerals from Africa (US$ bn), 2022,[62] top 20 importers

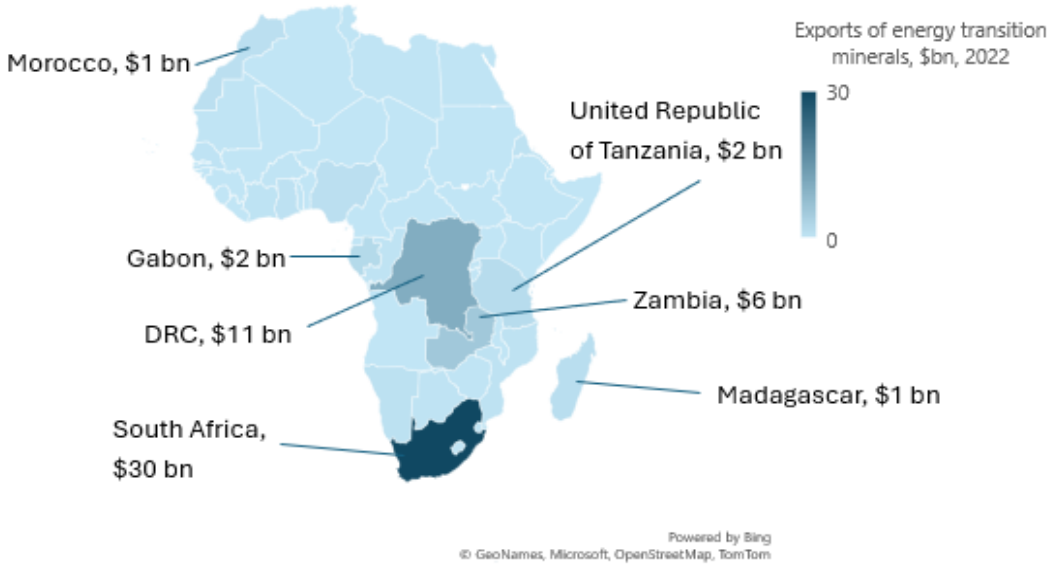


N.B.: See Annex I for the list of transition minerals and products derived from them used to produce this graph.

This is understandable, since China leads refining of many of these minerals, as shown in Part 3 on value addition.

Which are the main exporters of transition minerals in Africa? Figure 5 shows these below.

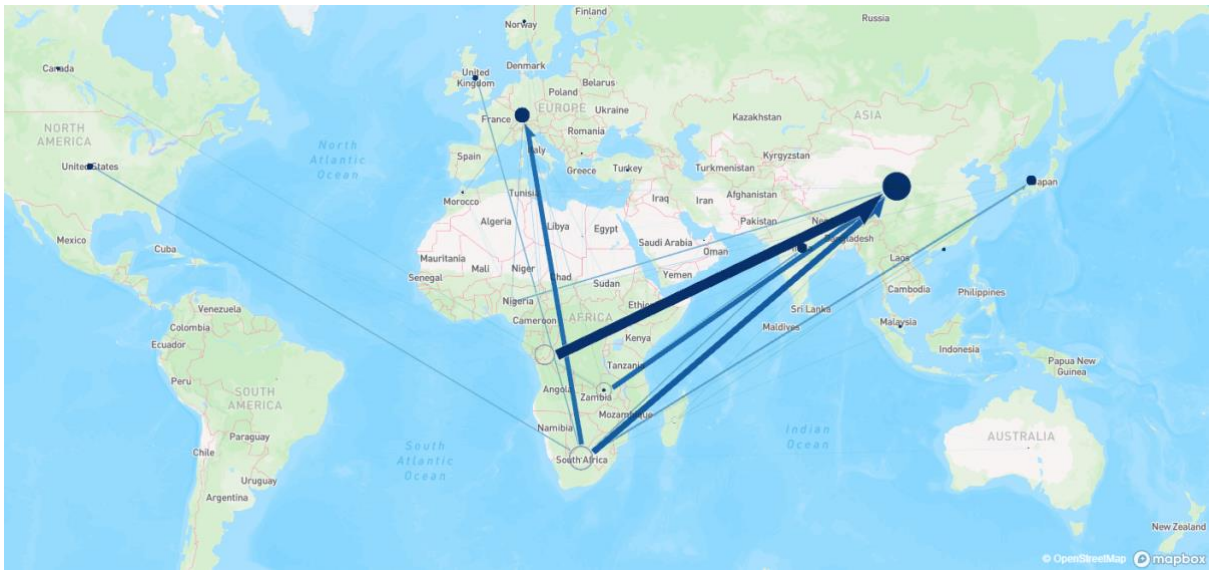
Figure 5 : Exports of transition minerals, $bn, 2022[63]



N.B.: Statistics shown here are based on import data reported by Africa's trading partners. This is because the data may be more reliable as many African countries can suffer from export under-invoicing which can distort export statistics.[64]

In line with their status as the main producers of some of the most important transition minerals for the continent, South Africa, followed by DRC and Zambia, had by far the most valuable exports of transition minerals in 2022. The main trading relationships in transition minerals are shown in the graphic below.

Figure 6: Transition mineral exports from Africa to the rest of the world, 2022 - summary of main trade flows[65]

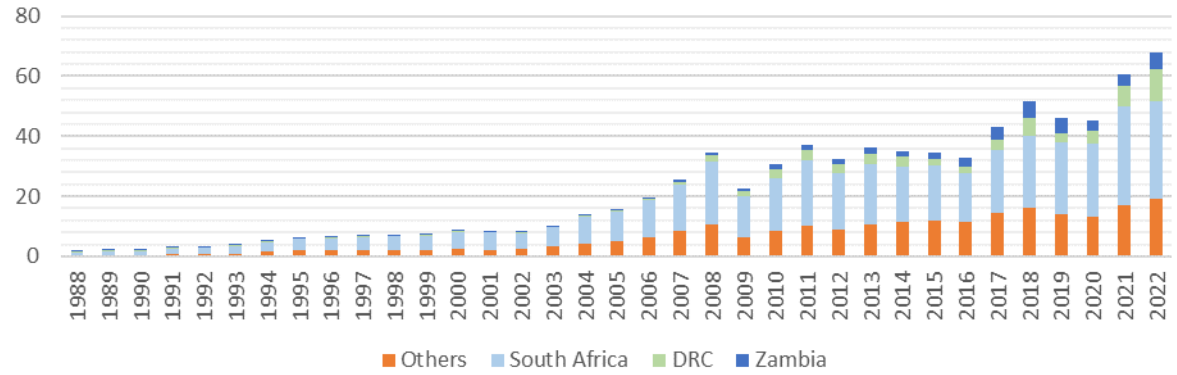


N.B.: the thickness of arrows shows the value of imports from Africa. The arrow shown towards Belgium represents imports to the European Union as a whole. This is done because the EU has a common policy for securing transition minerals from Africa. An interactive version of this map showing the values of the different trading relationships is available here)

2.3 Key market trends

The main trend that Africa is experiencing is that demand for the continent's transition minerals has significantly increased over time, following the arrival of 'modern renewable' energy (i.e., solar and wind power) in the 1980s, as shown by the trend in the continent's exports of transition minerals (see Figure 7 below).[66] While there have been ups and downs in the level of demand, the overall trend is a clear increase over time. In addition to solar and wind power, increased use of other energy transition technologies such as electric vehicles is also likely contributing to this rising trend.

Figure 7: Africa's exports of transition minerals, $ bn, 1988-2022[67]



The trend appears to differ among the continent's producers, however. While South Africa and the 'other' group are seeing larger increases, Zambia and DRC have experienced more modest growth since 2013 (the period for which we have data for all countries) in absolute terms.[68] This may be because of the key role of copper in their transition mineral exports, which is expected to experience slower growth in demand during the energy transition than some other transition minerals (see Figure 1 above). This is in part because a smaller share of demand for copper comes from clean technologies than is the case for other energy transition minerals, so increased demand due to the energy transition will have less of an impact.[69]

Moreover, mining exploration spending in Africa was expected to slow down in 2023 as investors focused on low-risk projects.[70] Improving mining governance is one of the key ways that African countries can attract more investment, both by avoiding conflicts around mine sites and reducing reputational risks for mining companies that operate in Africa.[71,72] In addition to attracting more investment, improving governance is also important as weak institutions have led many countries to be worse off as a result of their mineral resources.[73]

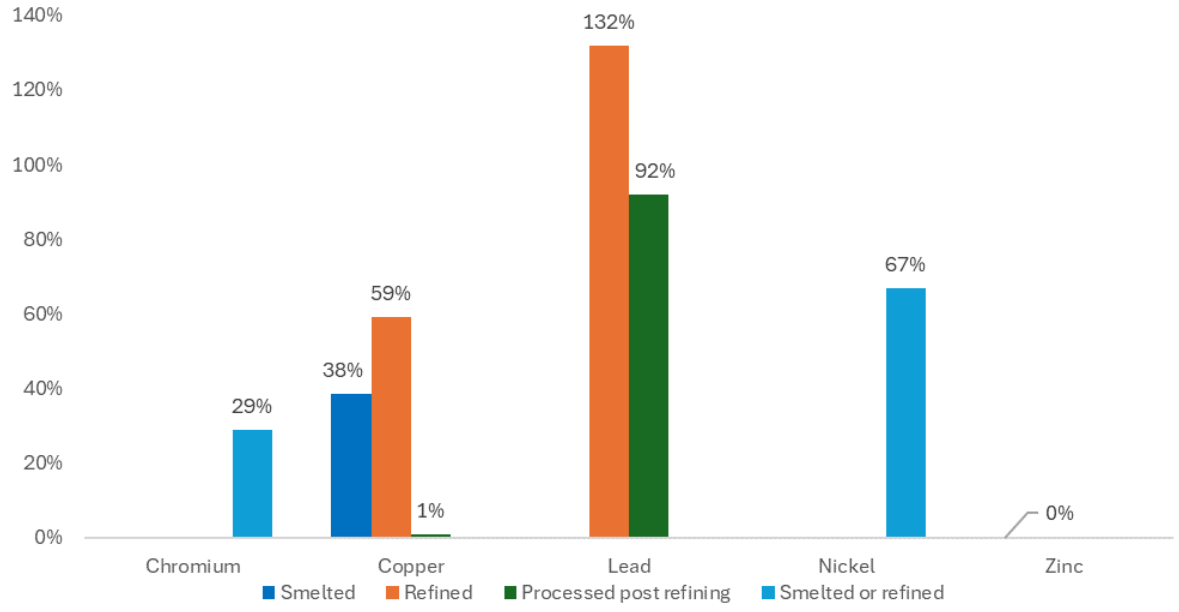
3. Africa's participation in transition mineral value chains

Key messages

- Africa adds some value to its transition minerals but remains at relatively early stages of the value chain.
- Africa's transition minerals are mostly turned into manufactured products in China, which dominates renewable energy value chains. Aside from China, other exports mainly go to high-income countries.
- Africa could increase regional trade in transition minerals value chains, especially in those minerals that it can already process, such as chromium, cobalt, copper, lead and nickel.

Africa adds some value to its transition minerals, but this could be increased. In this section, we look at mineral processing, i.e., removing impurities from minerals to turn them into a purer form that can be used in manufacturing. While the picture varies greatly from mineral to mineral, several of the continent's minerals are mostly exported raw.

Figure 8: Share of Africa's transition mineral production that is processed on the continent, selected minerals, 2021[74]



N.B.: These minerals are the only ones for which we were able to calculate the share of processing. Statistics for chromium are the author's estimate, inferred from trade and production data. They show the level of processing, but it is unclear whether this is smelting or refining. Statistics for lead exceed 100%

because Africa imported a significant amount of lead in 2021 for processing and as a result the amounts processed exceed the amount of raw lead mined. It is unclear whether this is smelted or refined. Based on the data we have, no zinc was smelted or refined in Africa in 2021. Refined copper may be greater than smelted copper because the former includes copper refined through electrolytic refining, which is not smelted.

Although production process for different metals vary, "smelting" and "refining" refers to removal of impurities from minerals, with refining generally occurring after smelting. Post-refinery processing involves all other processes that the metal undergoes along the way to becoming a finished product that will be used in industry or by consumers.

Africa smelts only around 5% of the tin that it produces. And although Africa (specifically, South Africa) produces magnesite ore, it does not refine any of this into primary magnesium metal.[75] In addition, manganese in battery supply chains is processed into battery-grade manganese sulphate exclusively in China (which produces 97% of this material), Belgium and Japan.[76] And only China, Kazakhstan, the US and Vietnam can currently refine phosphorus into the form used into lithium-iron-phosphate electric vehicle batteries.[77] Graphite is also currently exclusively refined in China, even though Africa accounted for 14% of raw graphite in 2021.[78]

However, there are several other transition minerals that Africa does process, at least to some degree, on the continent. For instance, most cobalt produced in Africa undergoes at least some processing. While in the DRC (which accounts for over 90% of cobalt production in Africa by metal content)[79] it undergoes basic processing into cobalt oxide or hydroxide,[80] in Morocco and South Africa, cobalt is refined.[81] (Nevertheless, most cobalt undergoes further processing once it leaves Africa, even before starting to be manufactured into products. 99% of this processing occurs outside Africa).[82] Platinum Group Metals are also mostly processed on the continent. South Africa processes over 70% of the global supply of these metals, with Zimbabwe processing a further 8%. South Africa and Zimbabwe also together process 98% of the world's iridium.[83] Madagascar, Morocco and South Africa all smelt and/or refine nickel.[84] In summary, though Africa could process its minerals more, several countries on the continent do already process most or all of certain minerals, rather than exporting them raw. This underscores that value addition is possible under the right conditions.

Beyond smelting or refining minerals to remove impurities, African countries do not tend to process their minerals further – instead they are largely exported to China, Europe and the US (as shown in Figure 10 below).

If Africa was able to increase its processing of these minerals, there could be significant economic benefits. Take the example of copper refining. In 2022, the refined copper that Africa exported earned twice the price per kilogramme (of copper content) that certain unrefined copper (copper mattes and cement copper) earned. [85]

3.1 China as the main exportation hub for African transition minerals

As shown in Figures 9 and 10 below, most of Africa's transition minerals and products derived from that are exported go to China, with the remainder being sold to high-income countries. While there is some intra-African trade in these products, it is very small, and accounts for only 2% of the continent's exports of transition minerals. The main hub

for importing transition minerals from within Africa is Zambia, which imports mainly raw copper and cobalt oxides and hydroxides from other African countries for further processing. The country has a refinery that produces refined copper as well as cobalt carbonates. The refinery is targeting an expansion of its cobalt production to be able to process around 1% of the continent's mine production of cobalt (in terms of metal content.[86]

Aside from copper and cobalt, intra-African trade occurs in a wide range of transition minerals or metals derived from them, including arsenic, boron and boronic acids, cadmium, chromium, germanium, graphite, lithium, manganese, nickel, niobium, platinum, silver, tantalum, tin, tungsten, germanium, zinc, zirconium and possibly other minerals. However, in many cases the value of this trade is very low (less than $1000 imported annually from one African country to another), which raises the question of whether it is being imported for refining or rather for other purposes (e.g., use in scientific laboratories).[87]

Figure 9: Main processing centres for African transition minerals, 2022, total (% by destination)[88]

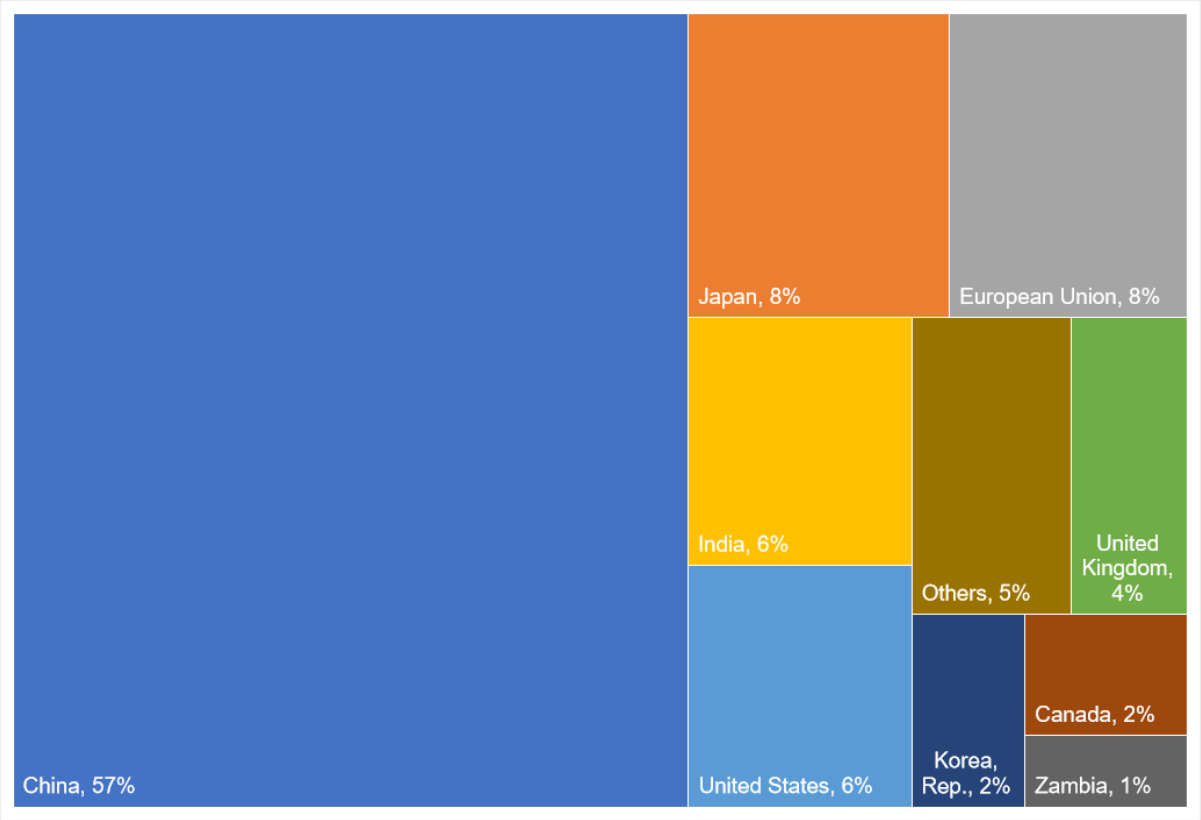
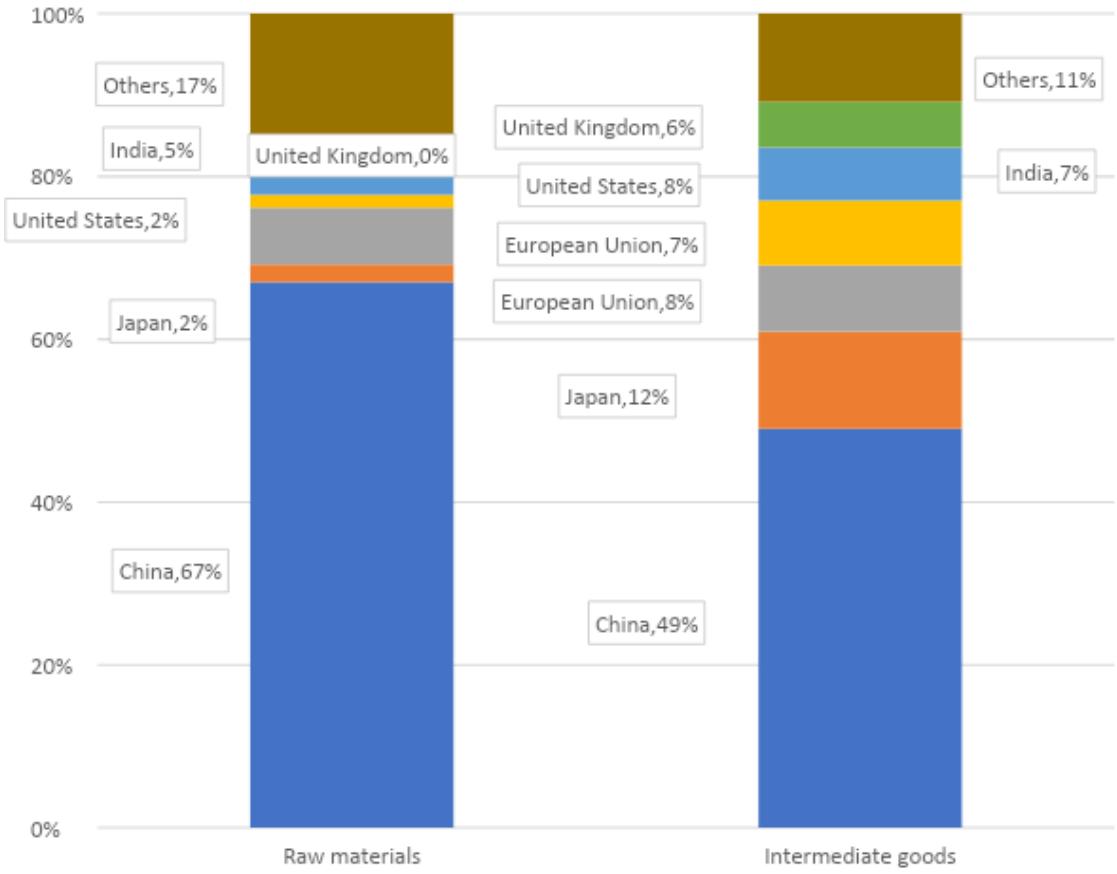


Figure 10: Main processing centres for African transition minerals (% by destination), 2022 - raw materials vs. intermediate goods

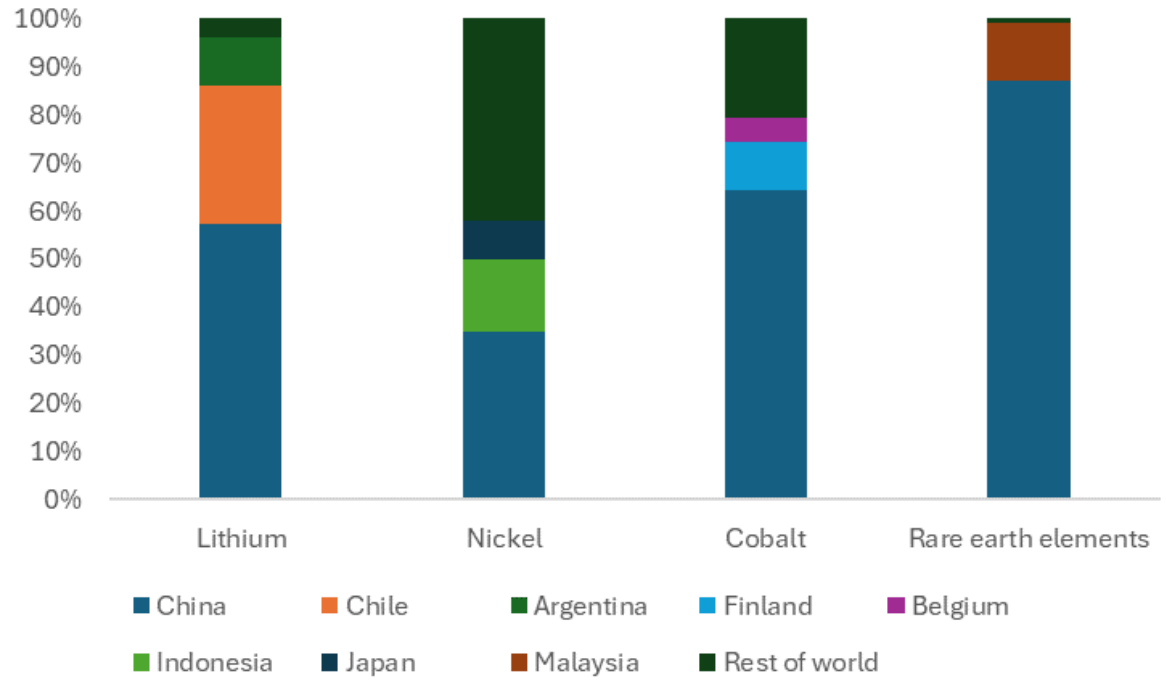


Some of this trade occurs in the context of agreements with importing countries to promote good governance of transition mineral value chains and/or value addition in producing countries. and to secure supply of these minerals. These include a Memorandum of Understanding signed between the EU and Namibia on access to rare earth elements.[89]

China's purchases of Africa's minerals could be considered to be more like a government-led effort to secure mineral supplies. Chinese companies have invested in mines across Africa and as a result control a significant share of the continent's energy transition mineral supply.[90] For example, a 2021 World Bank study reported that Chinese-owned mines control almost half of the DRC's production of cobalt.[91] Given the frequent links between the Chinese government and companies from that country, investments by Chinese companies could be seen as investments by proxy by the Chinese state.

As mentioned in Part 2 on production, China is the main processing hub for transition minerals worldwide - see Figures 11-15 below.

Figure 11: Geographical distribution of commodity refining for selected minerals, 2019[92]



As shown in figure 12 below, some African countries refine a significant share of the world's copper output - indeed, the DRC (Africa's largest copper producer) refines more than half the copper that it produces (measured in terms of metal content). This corroborates figure 8 above which shows that the continent as a whole refines more than half of the copper it produces. Unlike with many other transition minerals, China refines less than half of the world's copper, although it still refines more than any other single country.

Figure 12: Estimated global share in copper refining (measured by refinery output), 2023[93]

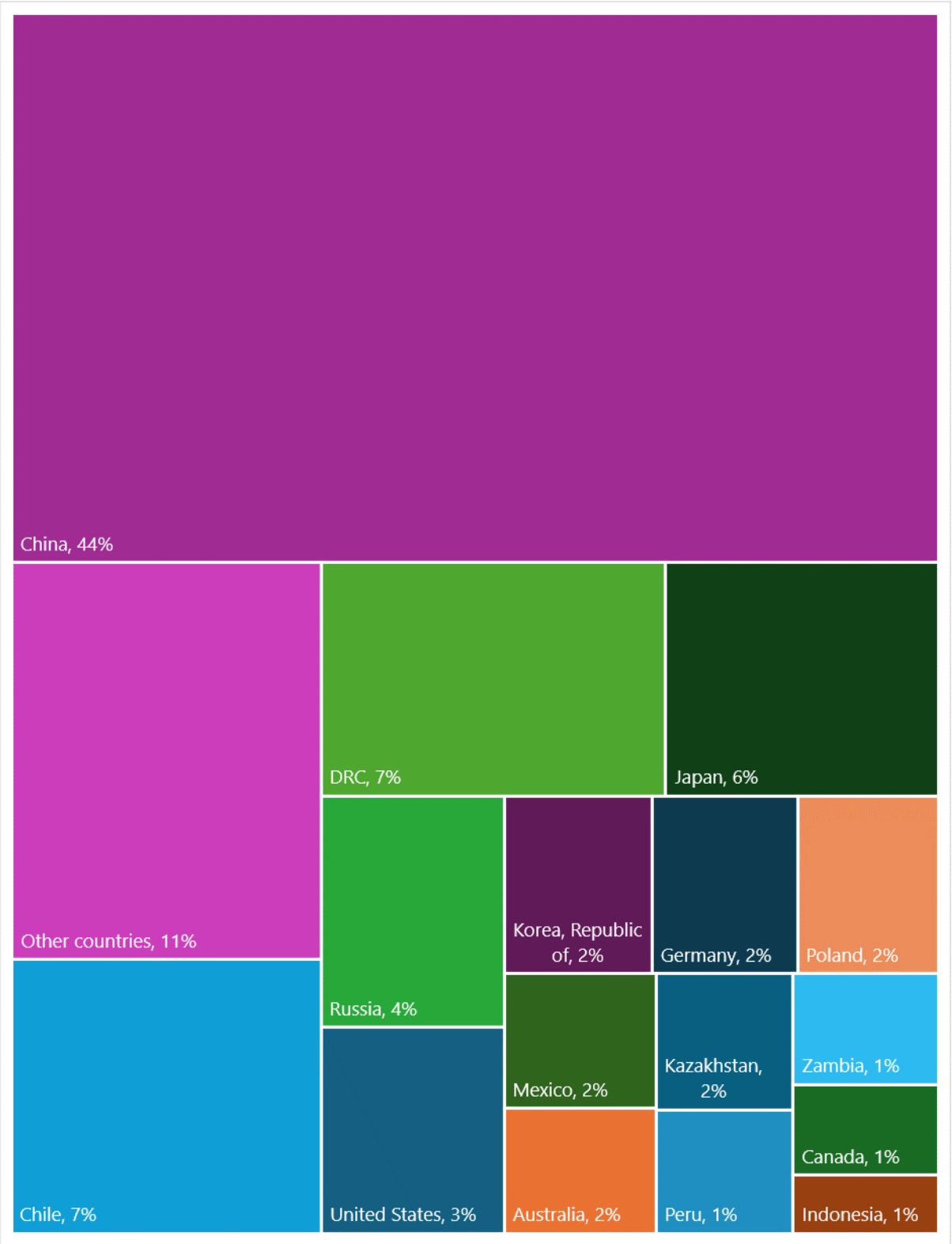


Figure 13: Geographical distribution of graphite processing[94]

As shown in Figure 14 below, China appears to have maintained its position as the world's leading refiner of cobalt, lithium and nickel up to 2022.

Figure 14: Mining and refining of selected transition minerals, 2022[95]

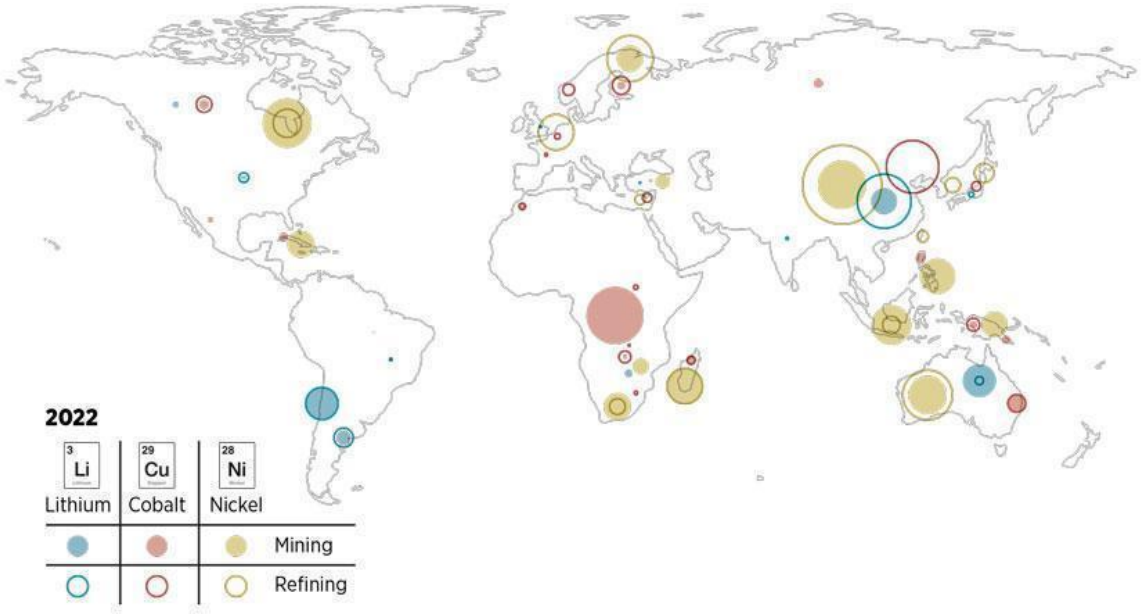
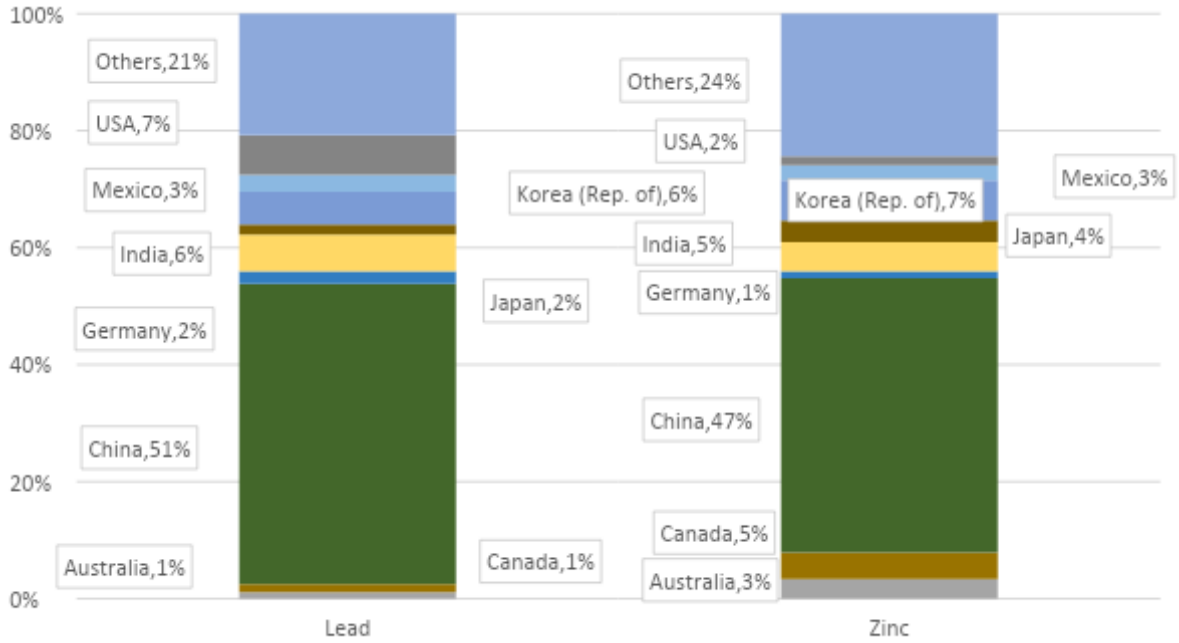


Figure 15: Lead and zinc refining by country, 2021[96]

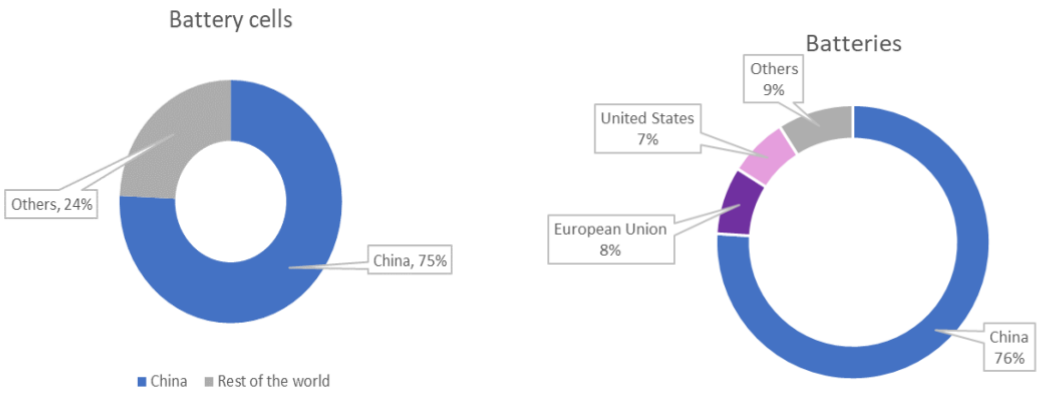


Even though Figure 8 above shows that Africa refines more lead than it produces, the continent's marginal role in global lead production (accounting for only 2%) means that it still accounts for only a small share of total production of refined lead (only 1%).[97] The mismatch between these two percentages may be explained by some countries having stockpiled lead in previous years that was refined in 2021.

3.2 Africa's marginal role further down the value chain

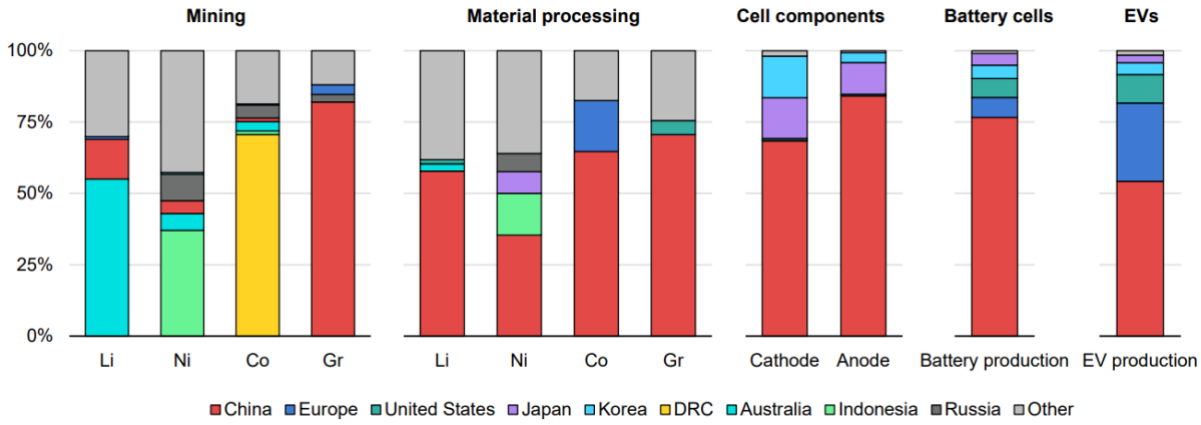
China is even more dominant further along the value chain, in the manufacture of energy transition technologies. It leads the world in its ability to transform cobalt and lithium into components, for example.[98] Africa is not a major player in the manufacture or sale of technologies linked to the energy transition such as batteries or renewable energy, as shown in the figures below.

Figure 16: Production of battery cells and batteries by country, % [99]



Zooming in in more detail on the countries that participate in electric vehicle battery value chains, it is clear that Africa's role is marginal in the more advanced stages of the value chain (i.e., after material processing).

Figure 17: Geographical distribution of the global EV battery supply chain[100]



N.B.: In the mining and material processing sections of this chart, minerals are shown by their chemical symbols.

China also dominates the manufacture of other components for batteries, such as separators and electrolytes.[101]

Figure 18: Manufacture of electric vehicle (EV) batteries and manufacture and sale of electric vehicles, by country[102]

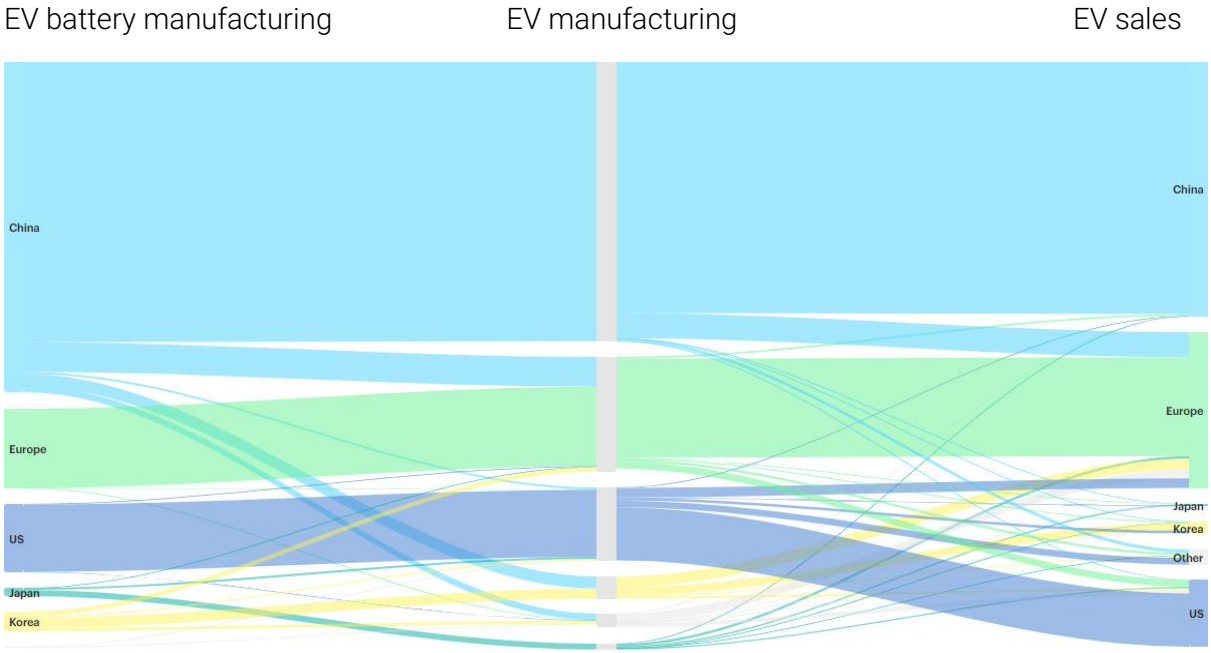
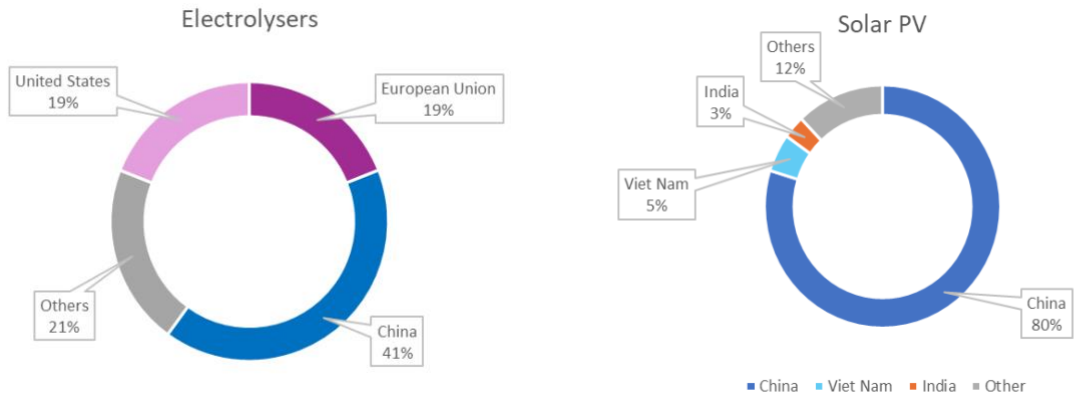
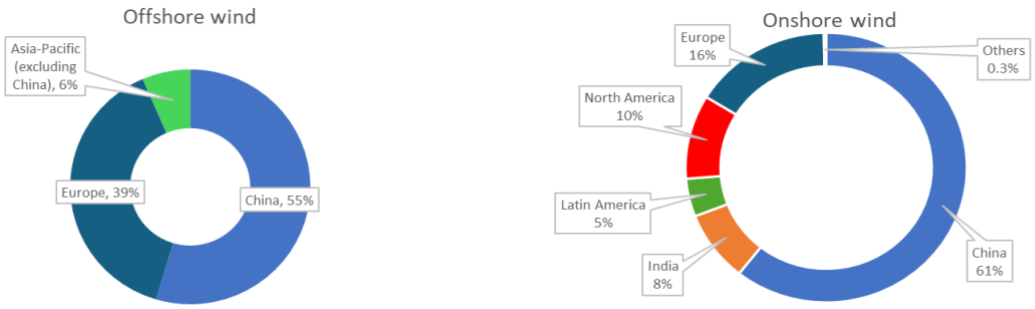


Figure 19: Share of manufacturing of electrolysers and solar PV by country, 2022[103]



Electrolysers are a key element in green hydrogen production and a potentially important source of demand for nickel or platinum-group metals.[104] Solar PV cells are the building blocks of solar modules or panels used to make solar energy.[105]

Figure 20: Capacity to manufacture wind turbine nacelles by producing country, 2023[106]



Overall, China controls the vast majority of other key wind turbine components such as gearboxes (where its share is 80%), wind power converters (82%), wind power generators (73%) and castings capable of supplying wind (82%).[107]

However, the continent does manufacture some technology relevant to the energy transition. For example, a facility producing batteries for energy storage started production in South Africa in 2022.[108] In addition, investors have committed to invest in producing battery cathodes (one of the stages in the value chain for producing electric vehicle and energy storage batteries) in Morocco.[109]

Moreover, Africa already produces electrical wiring in significant quantities. Countries including Angola, Egypt, the United Republic of Tanzania and Zambia all produce or have produced this product. As demand for electrification increases with the energy transition, demand for electrical wiring is likely to increase, creating an opportunity for these and other African countries. In addition, countries including Algeria, Angola, Egypt, Eritrea, Ethiopia, Madagascar, Morocco, Nigeria, Senegal, Tunisia, United Republic of Tanzania and Zimbabwe produce or have produced (electrical) primary cells, batteries and/or electrical accumulators, though it is not clear to what extent these batteries may be used in energy transition technologies.[110]

4. Making the most of Africa's transition minerals

Key messages

- Africa has valuable reserves of transition minerals that could contribute to sustainable development if the continent can avoid the resource curse. But unless they spur broader industrial development, they are unlikely to be transformative for any of the countries that possess them.
- African countries can realistically add value to their transition minerals. Based on data from the International Trade Centre and others, expanding existing value addition on the continent could add up to $24 bn to Africa's GDP and create 2.3 million jobs. African countries could also have further opportunities in solar, wind and electric vehicle battery value chains, inter alia.
- DRC, South Africa, Sudan, Zambia and Republic of Congo account for the overwhelming majority of opportunities to increase existing mineral processing in Africa.
- African countries should be strategic in deciding how to increase participation in energy transition value chains (i.e., which opportunities to pursue). Rather than trying to keep the entire value chain for renewable energy production in the continent, African countries should target those activities that they can do most competitively.
- In some cases it may be better to process minerals imported from elsewhere rather than a country's own minerals.
- Supplying mining companies is also an important opportunity for the continent. African countries have had limited success in this area to date. But there are a number of policies for supporting domestic companies to supply the mining sector that have worked well in Africa and elsewhere.
- To seize these opportunities, African countries should adhere to the principles of effective industrial policy.

In this section, we seek to identify opportunities for African countries to competitively increase their participation in transition mineral value chains. We do not analyse in detail opportunities for Africa to capture more of renewable energy value chains where the continent would not be competitive but could nonetheless retain more economic activity on the continent through providing permanent subsidies to firms involved, or using permanent trade restrictions to force firms operating in Africa to use products manufactured on the continent. This is because focusing on those activities in which they are most competitive could achieve similar economic benefits, but at a lower financial cost (whether in terms of subsidies or higher prices faced by consumers), allowing the savings to go towards other priorities.

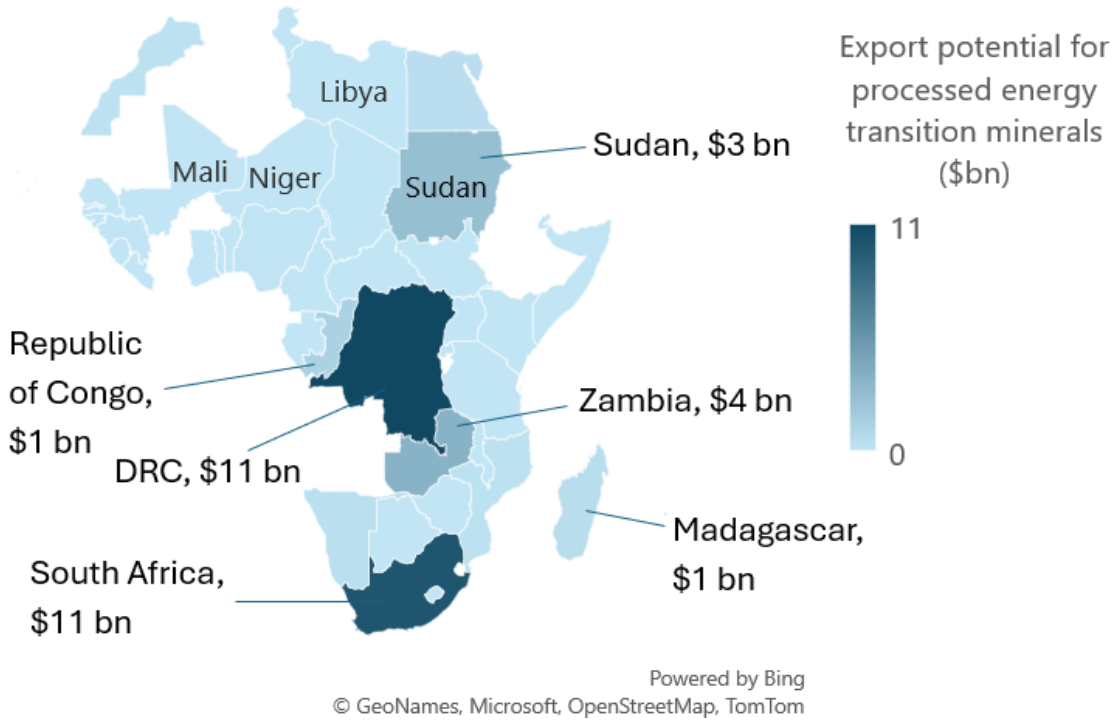
Focusing on developing the parts of the value chain that they can carry out competitively is also the right approach for promoting energy access. Where African can source inputs used in energy value chains more cheaply from outside the continent than from inside it, doing the former will cut the cost of energy. African countries should then be collaborative, strategic and prioritise

developing the parts of mineral (and other) value chains in which they are most competitive, rather than seeing it as a necessity to retain the entire value chain on the continent.

4.1. Adding value to Africa's transition minerals

African countries have opportunities to add value to their transition minerals. For example, Figure 21 shows African countries' potential to export more of processed transition minerals (or products derived from them) that they already export. The statistics in Figure 21 are based on analysis of markets where African countries might be able to increase their exports (i.e., where either a) they export less than expected to those markets, given the cost of trading with them and Africa's current market share in the product in question; or b) demand from those markets is expected to increase).[111] They are not based on a feasibility analysis of specific processing projects. The numbers consider only opportunities for each African country to increase its share in foreign markets of products that it already exports. This could be achieved either through making more sales, or achieving higher prices for export sales, e.g., through better marketing. Our method does not allow us to quantify the size of opportunities to start exporting new products. See Annex II for a description of the methodology.

Figure 21: Potential for increased annual exports of transition minerals in Africa, 2022-2028112

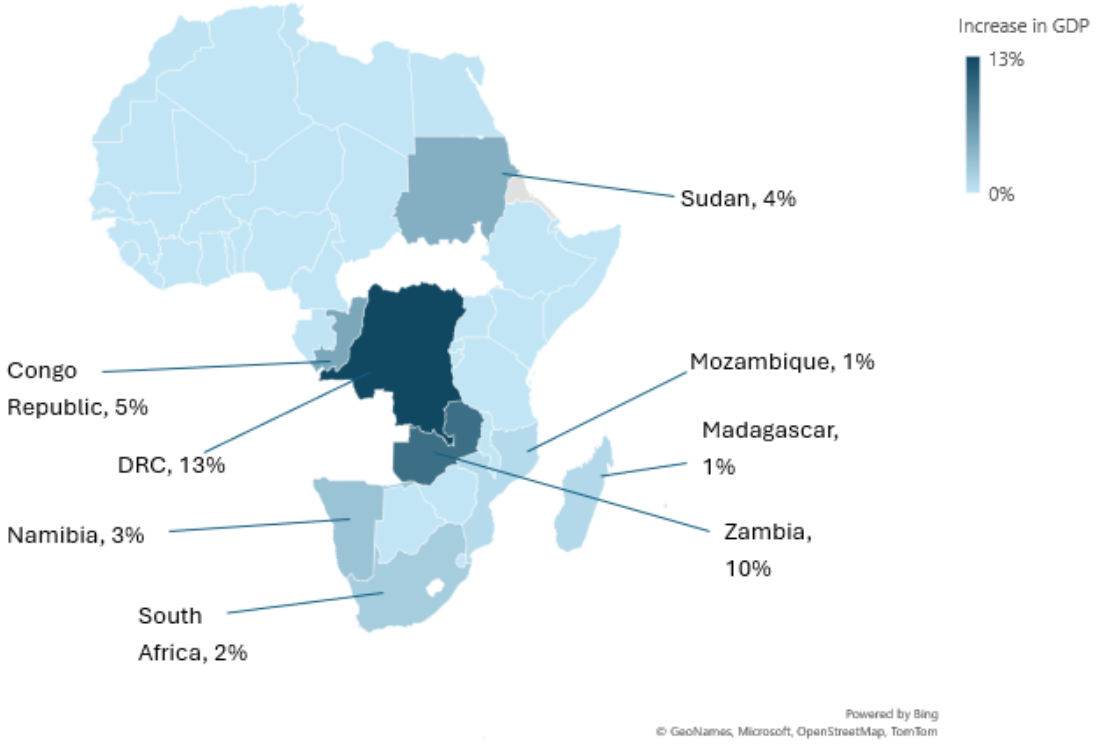


N.B.: Numbers shown here are rounded to the nearest $1bn. Countries shown in white either lack data, or our model suggests that there are no opportunities for adding more value to transition minerals (i.e., processing them and/or using them to manufacture products).

These opportunities total $32 billion in annual exports for the entire continent.[113] They are dominated by DRC, South Africa, Zambia, Sudan and Republic of Congo, which together account for over 90% of the continent's export opportunities.[114] These countries have the opportunity to increase their annual exports of processed mineral products by billions of dollars (over $10 billion each for DRC and South Africa). Madagascar, Egypt, Namibia, Morocco and Mozambique also have opportunities for hundreds of millions of dollars in additional annual exports.

These opportunities can make a significant contribution to the GDP of the countries benefiting from these opportunities, though for most countries on the continent these opportunities would add less than 1% to their current GDP. Although it has some of the largest opportunities in absolute terms, because South Africa is one of Africa's largest economies the impact on its GDP is more modest in percentage terms. The dataset accompanying this report provides data on the specific opportunities by country.

Figure 22: Potential increase in GDP from adding more value to transition minerals by country, 2022-28[115]



N.B.: For countries shown in white, we lack data on export opportunities

Most of these opportunities are for exports of processed metal, primarily copper ($14 bn) but also platinum group metals ($9bn), intermediate cobalt products (mattes - $4bn), lead ($3bn) and nickel ($1bn).

There are also opportunities for Africa to export more products with a greater degree of value addition beyond metal processing and semi-manufacture. The main among these are production of copper wiring and (copper-based) coaxial cable, with $5bn of annual export opportunities. The fact that these estimates are limited to only those products that the continent already exports may conceal some opportunities for individual African countries to move into exporting new products that they do not currently produce.

How will these export opportunities affect African economies more broadly? We estimate the potential impact on African countries' GDP if they are able to seize all of the relevant export opportunities. (See Annex II for an explanation of the methodology). We find that these opportunities could add $24 bn to the continent's GDP. Why is this figure less than the $32 bn added to exports? Because the figure for exports includes the value of imported inputs used to produce those exports, which is not included in GDP. The same countries with the largest export potential (DRC, South Africa, Zambia, Sudan and Republic of Congo) also dominate the effects on the continent's GDP. These opportunities could create around 2.3 million jobs across the continent, if they could all be seized.[116] Our estimates suggest that these are likely to be concentrated in the same five countries mentioned above. However, South Africa's manufacturing sector appears to create fewer jobs for a given level of production than the average for African countries for which we have data (because its manufacturing workers are more productive), so these opportunities may create fewer jobs there relative to the size of the expected boost to GDP.[117] As a result, DRC would see the highest level of job creation on the continent - our estimates suggest that almost half of these opportunities to create new jobs lie in that country.[118]

Though the export opportunities themselves are highly concentrated, they could also have positive economic effects for the rest of Africa. This is because other African countries may supply inputs to the countries expected to have the greatest export opportunities. Republic of Congo (at around $ 1bn in indirect economic benefits) and Egypt (at around $400 m) are among the African countries that could experience the greatest 'indirect benefits' from other African countries processing more transition minerals for export.

To seize these opportunities, African countries may need to put in place policies to attract investment in the relevant activities, and/or use commercial diplomacy to support existing African firms to expand their share in foreign markets.[119] See the sub-section below on 'How can Africa seize these opportunities?' for further details.

4.2 Entering new segments of the energy transition value chain

Africa's opportunities are not limited to exporting more of the products that the continent already produces. The continent could also enter into new segments of energy transition value chains. Some examples of these related to solar and wind energy are outlined in the case study linked to this report.

Another opportunity is in the value chain for nickel-manganese-cobalt batteries. Both DRC and Zambia may be able to start

producing cobalt sulphate, a more processed form of the mineral than what the countries currently produce. [120] There is also research suggesting that a battery precursor plant may be viable in the region if it has a sufficient supply of raw minerals.[121] DRC and Zambia have agreed to produce together. However, political and practical challenges of agreeing where the plant will be located and sourcing enough raw materials for it to have sufficient scale cast doubt on the likelihood of success.[122]

Countries far from consumer markets for electric vehicles using nickel-manganese-cobalt batteries have not generally been able to advance further than battery precursors along the electric vehicle battery value chain. This is because battery cathodes (the next link in the chain) are difficult to transport, and cell manufacturing (which occurs after cathodes, "[T]tends to be located close to EV manufacturers to benefit from quicker, more flexible delivery to customers."[123]

Some opportunities for adding value to transition minerals may not necessarily involve adding value to producing countries' own minerals, but rather in entering the value chain at later stages. This includes construction of some parts of wind turbines, for example, as explained in the case study attached to this report on wind energy. In addition, Diene et al. (2022) argue that Africa could be well-placed to enter the value chain for lithium-iron-phosphate batteries by assembling batteries, using imported components for use in the African market, rather than trying to transform the minerals into battery components. This is because a) Africa does not currently produce much lithium; and b) as noted above, electric vehicle battery assembly generally takes place close to the consumer market for the vehicles, and Africa is more likely to use electric vehicles based on this type of battery rather than nickel-manganese-cobalt batteries (for which it does produce the necessary minerals).[124]

African countries could potentially add other stages in the value chain (e.g. mining, lithium refining and battery cell manufacturing) in the future. However, according to Diene et al (2022), in order to attract investment in refining and battery cell manufacturing, they would need to achieve economies of scale through increasing both the level of lithium production and demand for electric vehicles, using lithium-iron-phosphate batteries in the region. This could be achieved through putting in place charging infrastructure and removing barriers to trade between African countries in feedstock for a lithium refinery, as well as lithium-iron-phosphate battery cells and/or the vehicles that use them.[125]

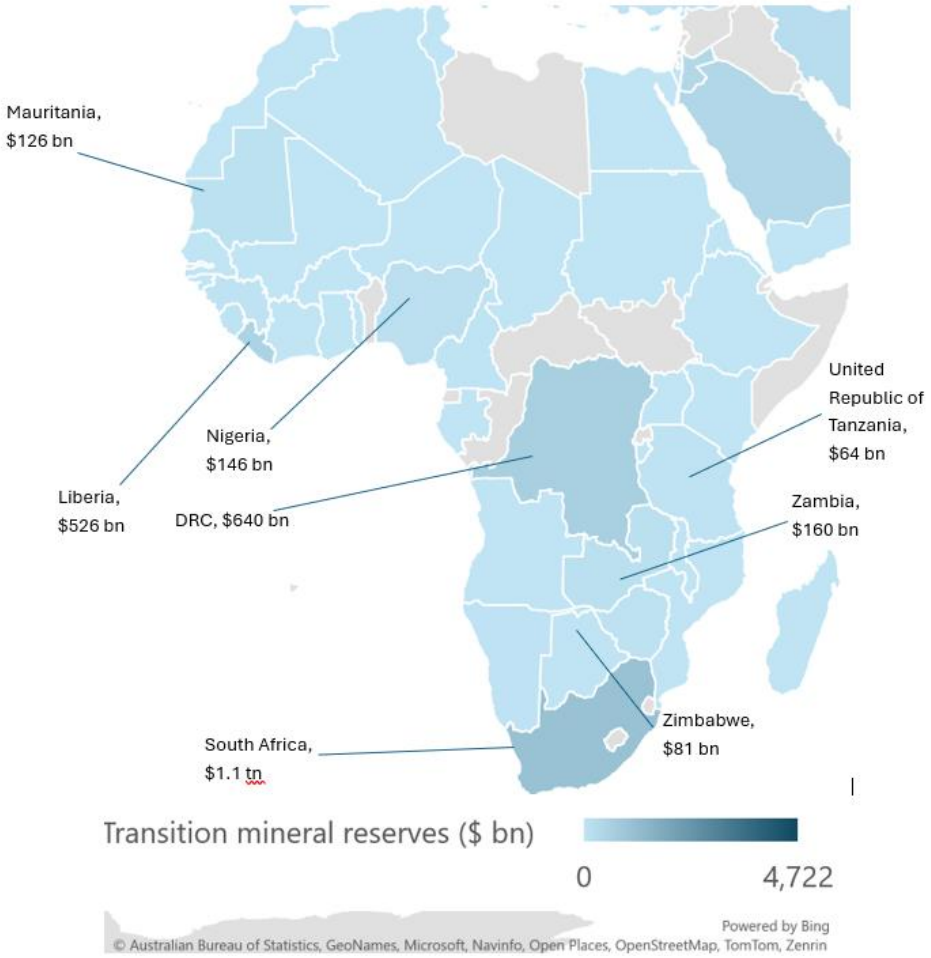
Some African countries have already been able to manufacture batteries based on imported components. South Africa is one example, entering the battery manufacturing value chain using imported cells.[126]

ITC's Export Potential Map identifies further potential opportunities for African countries to process transition minerals and produce other products at other stages in the value chain. This information can be found here.

In the long term, African countries' reserves of transition minerals will be an important factor in determining their opportunities to participate more in transition mineral value chains. Africa has substantial reserves of transition minerals. Figure 23 below shows countries' transition mineral reserves, with several African countries highlighted. As can be seen from the graphic, South Africa, the DRC and Liberia have by some distance the most valuable reserves in Africa. Please note that the reserves data covers different transition minerals to those listed above in footnote 1 (e.g., it includes bauxite, iron ore and phosphates).[127] This is in part why countries such as Liberia and Mauritania, which have substantial reserves of iron ore,

are not among the main producers above.[128] Nigeria also has some of the most valuable reserves of transition minerals on the continent (including lithium), as shown in Figure 23, but the underdevelopment of the country's mining sector and recency of some discoveries means that production remains limited for now.[129] Similarly, while Tanzania possesses reserves of a range of transition minerals, in some cases (e.g., nickel) they are not yet being produced on a large scale.[130]

Figure 23: Countries with the most valuable transition mineral reserves in Africa[131]



N.B.: Countries that are highlighted with data labels do not necessarily have the most valuable reserves.

As an aside, the opportunities to produce these products rely on inputs manufactured either in the producing country or elsewhere in Africa. In order to seize these opportunities, African countries may therefore wish to improve the competitiveness of the sectors that supply inputs to the manufacture of these products, and that add to the cost of transporting inputs across the country (or across Africa) to where the product in question will be manufactured.[132]

5. How can Africa seize these opportunities?

5.1 Industrial policies

To increase their participation in transition mineral value chains and ensure that doing so it benefits the economy, African countries may need to maintain dialogue with the private sector, adapting regulations and taxes to encourage the development of these new activities.[133] Governments will also need to monitor policies used to develop these new industries, and be ready to stop them when they are not working.[134] They will need to coordinate actions across several government ministries, and be able to call on a more senior government department, e.g., the President or Prime Minister's office, to resolve coordination problems or disputes between different parts of government.[135]

In addition, successful policies to support industrial development ("industrial policies") typically provide incentives for firms to succeed, e.g., by making government support conditional, and/or looking for firms that have invested their owners' own resources and have something to lose if they fail to be competitive.[136] And they are more likely to succeed if they focus on supporting national firms to export, rather than protecting them from import competition. [137] Boosting firms' competitiveness, rather than mandating domestic processing (or penalising the export of raw minerals) is also usually more likely to succeed, except where producers have a high level of market power.[138]

Further recommendations from the United Nations Industrial Development Organization for successful industrial policies are as follows:

- Ensure adequate infrastructure
- Combine "horizontal" policies (e.g., government efficiency, basic infrastructure) with interventions targeted at specific activities
- Co-operate regionally
- Strengthen firms' and workers' skills
- Plan industrial policies for the long term
- Provide adequate public financial support.[139]

5.2 Regional economic integration and preferential trade agreements

Renewable energy technology requires combining sets of minerals located in different countries. Regional cooperation and preferential trade agreements among African countries are crucial for creating an environment conducive to industrial growth.

By collaborating, African countries can develop regional value chains that leverage various competitive advantages, share resources, and create larger markets for their products. This approach can help build competitive industries that are capable of adding significant value to transition minerals.

Regional economic integration notably within the Southern African Development

Community (SADC) gathering most of the countries with substantial reserves, and preferential trade agreements among African countries as being negotiated within the African Continental Free Trade Area (AfCFTA) Framework, would allow minerals import and export within the continent at best price and enhance the continent's competitiveness. The measures that can increase this integration include: waiving export taxes on raw commodity exports to others within the region; investing in infrastructure to develop trade corridors; investing in joint processing and transformation facilities; cutting intra-African tariffs on products that would form part of intra-African value chains in renewable energy technology.

Deeper trade integration on the continent can be pursued within the AfCFTA, as well as through agreements between specific groups of African countries, such as the SADC, and bilateral trade agreements between neighbouring countries. The AfCFTA helps to reduce the complexity currently facing businesses within Africa, which have to navigate many different intra-African trade agreements, each with its own set of rules. By covering the whole continent, the AfCFTA supports greater trade between all African countries, simplifying the trade landscape. At the same time, smaller regional groups like the SADC as well as bilateral agreements can complement the AfCFTA by fostering closer economic ties among neighbouring countries, laying the groundwork for the much needed industrial cooperation (see above). Additionally, civil society organisations have concerns that need to be addressed in the design and implementation of the AfCFTA. The overall process has lacked democratic participation, and it is essential to involve civil society organisations to ensure their concerns are addressed. This participation will help foster policies that benefit all stakeholders and support sustainable economic development across the continent. The African Union is currently developing an African Green Minerals Strategy to make the most of the continent's transition minerals. In line with the above, the Strategy should emphasise deeper regional economic integration and coordination of industrial policies to support the development of transition mineral value chains on the continent.

Finally, joint investments in infrastructure, research and development can further enhance the competitiveness of African industries. Working together, African countries can ensure that the benefits of the transition mineral boom are widely shared and contribute to sustainable economic development across the continent

5.3 Transparency and accountability of government action

Transparency and accountability of government action in these areas are also likely to be key to ensure that government officials use these policies to promote national economic interests, rather than their own personal ones, and take into account the voices of marginalised groups such as women and Indigenous peoples. Good governance will also remain central to ensuring mining itself makes a positive contribution to the societies in which it occurs. [140]

In the interest of transparency and accountability around efforts to promote greater participation in mineral value chains, governments should publish:

- The reasoning behind the granting of measures designed to support specific industries, including cost-benefit analyses.
- Clear criteria used to decide whether support measures should remain in place and which firms can qualify. On top of providing transparency and accountability around the use of these measures, publishing these criteria in advance and sticking to them will also make policy more predictable for business, which is helpful for attracting investment.

In addition, where governments use tax incentives to promote these industries, these should be tightly controlled. Tax incentives refer to exemptions or reduced rates from general tax laws that apply to specific industries or firms. Such incentives should be subject to both ex-ante and ex-post cost-benefit analyses and compared against other uses for the same funds. Ex-ante analyses are recommended by the International Monetary Fund, Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development and World Bank, which provide guidance on how countries can conduct these evaluations,[141] while the African Tax Administration Forum (ATAF) and the United Nations' Economic Commission for Africa (ECA) recommend ex-post monitoring.[142]

In addition, the ATAF and the ECA also recommend publishing details of tax incentives and requiring that they be authorised in law (rather than allowing government agencies to issue them on an ad-hoc basis), time-limiting them and preparing tax expenditure budgets (i.e., forecasts of the costs of the various tax incentives being granted). They provide a methodology for the preparation of such budgets.[143]Along with the Organisation for Economic Co-Operation and Development, the ATAF and the ECA recommend that such incentives are included in the budgeting process.[144] Governments should also publish information on the costs and benefits of each of these incentives. This is because such incentives can be very costly, and the benefits are often unclear. They can be useful in some cases, such as addressing market failures or for activities that have knowledge spillovers to other sectors, but in general they do not appear to boost economic growth (though they might do so if targeted at sectors that grow particularly fast over time, such as manufacturing).[145]

It is worth noting that one popular policy measure for encouraging greater domestic processing, the use of export restrictions, appears to often have been ineffective in promoting domestic value addition, except where the country in question has a high level of market power such that buyers of the processed mineral are 'forced' to purchase processed minerals from that country, even if it is more expensive.[146] In any case, countries restricting exports of raw minerals are less likely to develop competitive downstream processing if they do not invest in enhancing productivity and/or do not put performance requirements in place for mineral processing firms, restrictions on exports of raw minerals. They may also face a trade-off between the competitiveness of the upstream mining sector and the downstream processing sector;[147] and governments are often unpleasantly surprised by the extent of the negative impacts of such restrictions on their mining industries.[148] Before using these restrictions, countries should carefully weigh their costs, benefits and likelihood of success, and consider alternative policy tools such as improving the business environment for downstream processing by investing in infrastructure, skills, access to finance and ensuring that the regulatory framework is appropriate, inter alia.[149]

More broadly, although African countries may have opportunities to develop new industries linked to transition minerals, they

might have even better opportunities in other parts of their economies. In addition, policies to promote greater participation in mineral value chains can come at a cost and African countries should consider whether this is worth the benefits. For example, and as discussed above, if African countries use scarce public funds for subsidies or tax breaks to promote greater participation in transition mineral value chains, they should ask themselves whether these funds could be better used elsewhere. Or if they oblige the mining sector to supply cheap raw materials to the mineral processing sector, or use domestic suppliers even when they are not competitive, governments should consider whether the potential lost investment, jobs and revenues from mining are worth the benefits that they expect to get from greater participation in transition mineral value chains.

5.4 Strong safeguards against corruption, human rights abuses and environmental degradation

Mining is already plagued with corruption, governance issues, human rights abuses and environmental degradation. Transition minerals mining and activities linked to value addition won't be different if strong safeguards are not in place. Many of the most valuable sources of cobalt are located in environmentally sensitive areas such as forests.[150] For lithium, local environmental impacts can be significantly larger than other types of mining, depending on the technique used. Both cobalt and lithium mining can drastically reduce available water.[151] Transition mineral mining can also pollute the air and soil, harming local populations' health and livelihood, and undermining agriculture and food security.[152]

The social impacts of energy transition mining could also be severe. Corrupt networks increase the poverty gap and the power asymmetry between government, companies and communities. It is notably impeding any chance of equitable redistribution of revenues. In addition, one study estimates that mining to meet the energy transition objectives of the EU alone could result in 15,000-89,000 Africans being forced into modern slavery.[153] Mining can also increase the cost of living for communities surrounding the mine and worsen gender inequities if mining opportunities lead men to reduce their support for household labour.[154]

Although in theory environmental and social impacts can be managed, in practice mechanisms for doing so often fail to be effective. This can notably lead to mines being approved that would not have been if the environmental effects were properly accounted for.[155] The rush to transition minerals can increase pressure on African governments to fast track licensing and open up mining in sensitive and high risk areas.

Transition minerals extraction and value addition must break with mistakes of the past. As highlighted below, value addition has to go hand in hand with strengthening public institutions, policy development and implementation to ensure good governance, transparency, accountability[156] of the whole extractive sector, as well as effective public participation and benefit sharing.

All communities affected by mining and value addition activities must be meaningfully consulted and empowered to participate. No-

go zones and safeguards must be put in place to protect ecosystems and the rights of affected populations, including a fair, ongoing process of Free, Prior and Informed Consent (FPIC) as required by the International Labor Organization's Convention 169 on Indigenous and Tribal Peoples (ILO Convention 169). Extraction must happen following the highest international standards to avoid further environmental destruction and human rights violations, in line with the UN guiding Principles on Business and Human Rights. This should include consulting communities in their own languages.

5.5 Legal and policy frameworks

To achieve these measures, African countries may wish to consider implementing the Africa Mining Vision to a greater degree. The Vision emphasises adding value to Africa's minerals. Adopting country mining visions can be an effective way to put the vision into practice.[157]

Furthermore, maintaining legal sovereignty is essential. Resource rich countries must retain the right to regulate and oversee the exploitation of their natural resources without undue interference from investor-state dispute settlements (ISDS) that prioritise corporate interests over public welfare. This requires robust legal frameworks that empower governments to enact and enforce laws protecting the environment and human rights, ensuring that the benefits of resource extraction contribute to sustainable development and the well-being of all citizens.

5.6 Increasing local content

In addition to processing its transition minerals and/or manufacturing products in value chains related to the energy transition, African countries could also try to capture a greater share of the economic value of mining itself.

In mining

According to NRGI, "Local content" in the mining sector refers to the "[Value that an extraction project brings to the local, regional or national economy beyond the resource revenues."[158] It is often taken to mean the share of economic value created by mining itself (rather than adding value to minerals) that is paid to workers and businesses in the country where the mine is located.

Increasing local content in mining could have significant potential to contribute to African economies. Local procurement in mining typically accounts for 50-70% of all spending in host countries, outstripping payments to government and social investment.[159] Yet in most developing countries, only an estimated 45% of mining supplies come from domestic companies.[160] Moreover, output of the mining services sector alone was at least $71 billion in 2019, based on data for only 31 countries;[161] another source estimates that, worldwide, the sector is several times that size.[162] In addition, African countries imported around $7 billion in mining

equipment from outside of the continent in 2022. [163]

How well are African countries doing in capturing local content? Diene et al. (2022) argue that African countries could significantly improve their local content policies and provide recommendations as to how to do so. These include:

- Financing the expansion of supplier companies
- Targeting requirements for local content to goods and services that businesses in the host country can produce, based on consultation with mining companies and national industry, as is the case in Ghana.[164]

Other literature also supports this point.

- Developing regional markets for mining suppliers to benefit from economies of scale
- Requiring partnerships between experienced and new mining suppliers.[165]

In addition, local content policies often fail to make provision for marginalised groups, such as women and Indigenous people, to benefit from local content.[166]

One example of where African countries could increase their mining local content is the manufacture of mining equipment. South Africa already manufactures significant amounts of such equipment, accounting for around 40,000 jobs and $2 billion in turnover as of 2017.[167]

According to the International Trade Centre's Export Potential Map, Africa could have significant potential for increasing its exports of mining equipment (suggesting that it can also manufacture more for domestic use). The most significant opportunity is in manufacturing parts of mining equipment, where ITC estimates that the continent could increase its annual exports by over $500m.[168]

In other parts of transition mineral value chains

African countries can also try to boost local content in other parts of mineral value chains that input into the mineral processing sectors or other manufacturing activities that use transition minerals as inputs. This can increase the likelihood that transition mineral processing or other transition mineral-based manufacturing will be successful if it can competitively provide inputs to those activities. It can also increase the economic benefits that African countries derive from transition mineral-based manufacturing.[169]

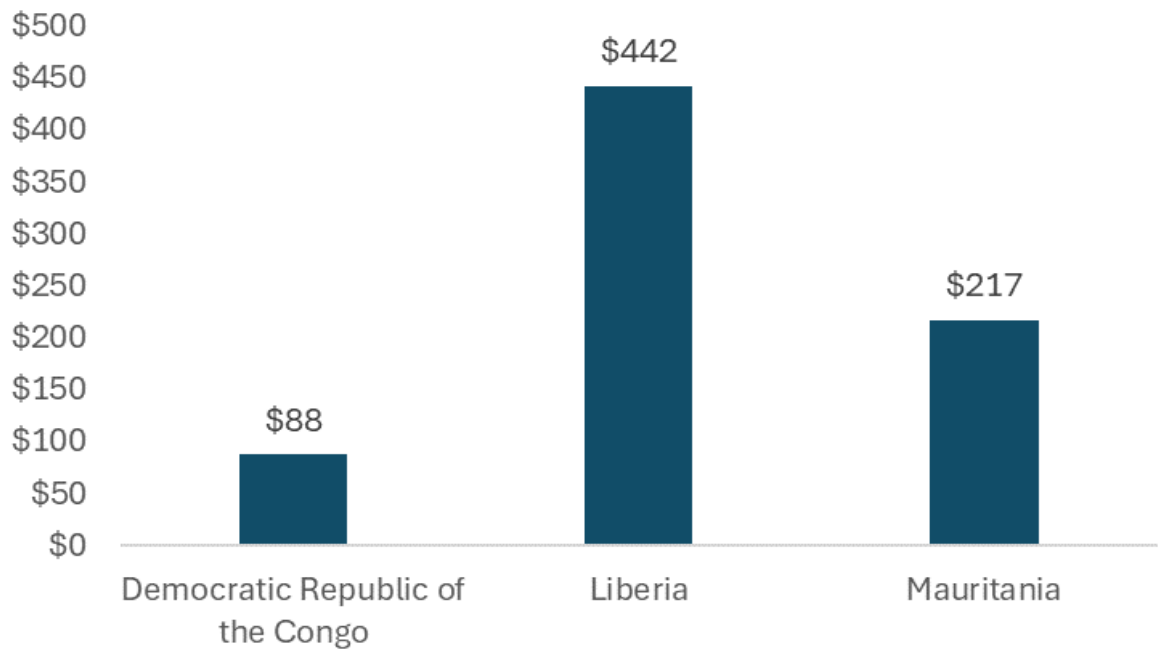
Mobilising additional revenues

As an alternative to increased value addition or local content, African countries could focus on trying to mobilise additional revenues from their mining sectors. If countries use policies to try to oblige mining companies to add value in-country (or use local suppliers - see above), this could hit investment in the mining sector itself, which is an important source of government revenues and can significantly contribute to jobs.[170]

We estimate that some African governments currently manage to collect as tax revenue around 16 to 56% of the value of mineral reserves. Based on the most recent data on collection rates and the data shown above on the continent's transition mineral reserves this could mean, for example, that DRC would collect around $357 billion from its reserves, Liberia $82 billion, Mauritania $89 billion, if the countries can exploit their transition mineral reserves. These are total amounts (i.e., not per year) based on its currently discovered reserves.[171] Figure 25 below shows these amounts in terms of government revenues per person, per year,

spread out between 2024 and 2050 (the period during which demand for transition minerals is expected to be highest).

Figure 25: Potential government revenues per capita from transition minerals based on current reserves, annual average 2024-2050, selected countries, in 2022 US dollars[172]



N.B.: These revenues represent taxes levied on the mining sector directly. They ignore any tax revenues that may result from taxing mining sector suppliers, or from taxing additional economic activities that result from adding value to these minerals.

However, a recent study by GIZ and Econias also concludes that the contribution of transition minerals to government revenues across Sub-Saharan Africa on average would be more modest (though the picture may differ for individual countries). The authors estimate that the region would be able to mobilise around $20 billion in total (not per annum) in additional government revenues between now and 2040.[173] This equates to around 5% of the region's annual government revenues as of 2020 (this is the most recent year for which we have data; in spite of the effects of the COVID19 pandemic, the decline in government revenues that Africa experienced in 2020 was relatively modest).[174] In addition to mining revenues, if African countries can capture more of the value chain (whether through supplying mining companies, or adding value to commodities), this could spur economic growth and industrial development on the continent. We discuss this further later in the present report.

Yet as noted in part 1, some African resource-rich countries failed to benefit from the last commodity boom in spite of higher government revenues, which may suggest that in those countries, these revenues by

themselves make a limited contribution to development. To respond to this, countries can either strengthen institutions for public financial management to ensure that resource revenues are spent well,[175] and/or increase their participation in mineral value chains to generate wider economic benefits outside of the mining sector. Countries will need to judge to what extent there is a trade-off between these objectives, and which is likely to bring greater gains.

Royalty/tax concessions remain the prevalent fiscal regime in the mining industry in Africa. While the type of fiscal regime does not necessarily determine the financial outcomes for resource rich countries, the terms of royalty/tax concessions in African countries are often contained in negotiated mineral agreements rather than being unilaterally determined and set in legislations as is the practice in developed countries. Bilaterally negotiated mineral agreements have been found to undermine the development of an effective mining legal system and prone to information asymmetries that incure to the benefit of private corporations. The negotiation processes of such agreements have often lacked the level of transparency that will be necessary for probity and accountability, which are fundamental in the use and management of natural resources. Further, the involvement of several state and quasi-state agencies may pose multiple principal-agency challenges, leading to even higher enforcement costs.

For African countries to successfully mobilise the much-needed additional revenue from its transition minerals, it is instructive to ensure that legal systems are strengthened. Fiscal terms must be clearly and unilaterally defined in a general mining law and any conditions for any exceptions stated to curb abuse of discretion and subjectivity.

Knowledge and capacity asymmetries of state and quasi-state institutions - including ministries of finance, mining ministries and central banks - tend to undermine effective governance of the sector. African countries must invest in capacity building so that these stakeholders can effectively monitor and accurately ascertain the production of transition minerals.

Lastly, the governance framework of transition minerals in Africa must be open for active civil society participation and community engagement. This will ensure transparency in the mobilisation and use of taxes for the common good of society especially communities most impacted by mining activities.

6. What role should development partners play?

Countries to which Africa sells its transition minerals can also play a role in supporting the continent's ambitions to become more involved in value chains. This is particularly true because, in some cases, (such as the EU and US Memoranda of Understanding (MoUs) with Zambia and DRC, and the EU's MoUs with Namibia and Rwanda) development partners have promised to support African countries to process their transition minerals domestically, as part of agreements designed to facilitate access to those minerals.[176] Where Africa's partners have made these promises, they should keep them. This support need not be restricted to processing transition minerals in-country, but could also cover efforts to boost local content, i.e., a greater role for domestic companies in supplying the mining sector.

Partner countries can support greater participation in transition mineral value chains in Africa by cutting the barriers that they sometimes impose against imports from Africa. These can include tariffs on imports of processed transition minerals, as they may significantly add to the cost of processing in some cases.[177] Most major trading partners provide duty-free, quota-free market access[178] for processed transition minerals from least-developed countries, but this preferential access becomes meaningless if African countries are prevented from implementing industrial policies aiming to integrate higher stages of the value chain.

The energy transition pushes all regions towards industrial policies that entail various degrees of protectionism. For example, the United States' Inflation Reduction Act provides tax advantages for electric vehicles that are manufactured using transition minerals that were extracted or processed in the United States or countries with which it has a free trade agreement, or recycled in North America.[179] The EU has also committed itself to processing 40% of the "critical raw materials" that it consumes from within its borders by 2030. And the UK has also committed to increasing its processing capacity for its list of "critical minerals". Africa's partners shouldn't prevent Africa from using similar measures if they wish to support Africa's aspirations to process more of the transition minerals that it produces. African governments should focus on preferential continental trade, as national protectionism is less conducive to competitiveness in the global market. However, Africa's development partners should support African countries' efforts to move up the value chain without hindering them through free trade agreements and trade disputes.[180]

Another way in which partner countries can support African countries to participate more in transition mineral value chains is to provide financing to support upgrading infrastructure, transferring and developing skills, etc. to help African countries participate in transition mineral value chains more competitively. Related to this, in pursuing trade agreements with African countries, where African countries are part of a customs union they should try to sign trade agreements with the customs union as a whole rather than its individual members. In doing so they can avoid undermining political trust in the regional integration process among customs union members.

7. Conclusions and Recommendations

Africa is an important supplier of transition minerals to the world. Yet the continent is stuck at a relatively low level in transition mineral value chains, where it processes some of its minerals but is largely absent from the manufacturing of many technologies linked to clean energy. As a result, the continent may be missing out on a key opportunity to support inclusive growth, create jobs and reduce poverty.

To have the best chance at seizing this opportunity, African countries will need to apply the principles of effective industrial policy. This includes being strategic about which parts of the value chain they try to develop and weighing the costs and benefits of different types of government intervention. It is also likely to mean making industrial policies in a transparent, accountable and participatory way. Managing negative side-effects of mining and mineral processing on the environment, society, communities and human rights will be crucial.

Some commentators argue that Africa should use its transition minerals to build entire renewable energy value chains on the continent. Yet as outlined in the case study in this report, Africa may not (yet) be in a position to do so efficiently. The continent may benefit more from using its minerals to spur industrial development and raise incomes and living standards by creating jobs and growing the tax base to provide more funds towards public spending. Higher private incomes and greater public resources can then be used to finance improved energy access and/or other development priorities in Africa, at a lower financial cost to Africans than if African governments tried to develop entire renewable energy value chains on the continent.

In this context, our recommendations for Africa to make the most of its transition minerals are as follows:

African countries should:

- Develop strong policies and appropriate regulations to encourage value addition of their transition minerals or greater participation of national companies in supplying mining companies. But they should weigh this against other opportunities to promote new businesses. African countries should prioritise the opportunities with the greatest chance of delivering the widest long-term economic benefits. They should also take into account broader impacts of promoting greater participation in transition mineral value chains, such as effects on human rights and climate, and more localised environmental impacts.[181]
- Ensure that policies to promote greater participation in energy transition supply chains are developed through dialogue with the private sector and civil society on what new industries are feasible and desirable, and how to achieve them.
- Ensure that policies that they adopt to promote value addition and local content in transition minerals are made in a transparent and accountable way and are

implemented. This will reduce risks of corruption, cronyism and waste of resources, and give a greater chance of delivering positive outcomes.

- Closely monitor how policies to promote value addition and local content are working, and be prepared to abandon those that have failed to focus on reforms that would harness greater strategic opportunities.
- Not expect transition mineral value chains alone to provide all of the economic growth that they need, and consider pursuing other economic opportunities, taking into account the limits to governments' capacity to promote many initiatives simultaneously.
- Not expect all efforts to promote a greater share of transition mineral value chains to work as intended. Industrial policymaking is difficult to get right, and it is normal to have some failed efforts to develop new industries (but still worth trying, as the successes should more than make up for the failures).
- Consider promoting transfers of technology and skills relevant to transition mineral value chains between African countries.[182]
- Guarantee free and protected civic space, allowing stakeholders from across the country to participate freely in debates on politics and policy. This should include restricting the use of strategic lawsuits against public participation (SLAPPs).
- Ensure meaningful consultation and participation for all communities affected by mining. Indigenous peoples' Free, Prior and Informed Consent - their right to give or withhold consent - must be prioritised and respected, as aligned with the UN Declaration on the Rights of Indigenous Peoples.
- Ensure the creation of "no-go zones" to protect people and the environment in high risk areas. Only extract minerals in line with the most rigorous international human rights and environmental standards through meaningful, transparent and gender-responsive mandatory human rights and environmental due diligence. Guarantee effective, independent monitoring of mitigation and corrective measures, including access to justice and effective remedy for all victims of corporate abuses.
- Ensure that national environmental regulators are independent from the companies they regulate.

Development partners (e.g., countries and institutions that provide aid to or trade with Africa) should:

- Support African countries' efforts to capture more value through transition mineral supply chains, where these are realistic. They can do this through:
    - Supporting knowledge - including research and development - and technology transfer to African firms along the length of transition mineral value chains.
    - Not opposing African countries' sensible use of active industrial policies to capture more of the economic value in global transition mineral value chains.
    - Not using trade policies to make it difficult for African countries to export processed transition mineral products to their markets.
    - Where they use carbon border adjustment mechanisms, taking into account the pollution involved in transporting minerals to another country to be processed.

    - Consider providing financing to make greater participation in transition mineral value chains more viable in Africa (e.g., through industrial, infrastructure, skills development, etc.).
    - Ensure that their support to value addition initiatives respects the needs of local communities, human rights and the environment.
    - Support Africa's efforts to develop regional value chains. When pursuing trade agreements with African countries that are members of customs unions, they should try to sign them with the customs union as a whole rather than individual members, to avoid undermining the political trust that underpins the regional integration process.
- Ensure that their efforts to acquire transition minerals (whether processed or otherwise) from Africa do not contribute to negative side-effects (e.g., the suffering of local communities and/or destruction of the environment in mining or mineral processing areas). In addition, they should do their utmost to ensure that workers in transition mineral value chains and affected communities receive a fair share of economic benefits created by them. Development partners can do this by conducting due diligence of the supply chains through which they source transition minerals, and carefully considering the design of international agreements that encourage international trade in transition minerals and/or govern transition mineral value chains. In doing so, they should listen to perspectives from civil society, communities affected by transition mineral value chains, and organisations representing workers and equity-seeking groups, etc .[183]
- Pursue policies to limit demand for metallic transition minerals, due to the high levels of emissions from metal supply chains.[184] This should not imply slowing the transition away from fossil fuels, which cause far more emissions, but rather encouraging public and private consumption choices to take into account the negative impacts of metals on the climate.
- Contribute to the fight against international tax avoidance, illicit financial flows and corruption, including the mining sector.

Civil society should:

- Push African governments to develop policies to capture a greater share of transition mineral value chains, where this would carry economic benefits for the country in question
- Hold governments to account over how they do this, ensuring that policymaking is well-reasoned, inclusive, participatory and that both policymaking and policy delivery are transparent and accountable.
- Push African governments to reinforce protection of human rights, including Indigenous people's rights, and the environment, and address corruption and integrity risks, including in transition mineral value chains.
- Campaign to protect and enhance civic space so that stakeholders across Africa can freely participate in discussions on politics and policy; this should include campaigning for restrictions on SLAPPs

- Put pressure on development partners to support African countries to experience greater participation in transition mineral value chains, through knowledge and technology transfer, and through not opposing the sensible use of active industrial policies to promote these activities.

Annexes

Annex I – commodity codes used for transition mineral exports

Used Harmonized System 2022 classification. N.B.: We omit some products derived from minerals that our data indicates are not currently produced in Africa.

HS 2022 (Selected Classification)

250410 -- Graphite; natural, in powder or in flakes

250490 -- Graphite; natural, in other forms, excluding powder or flakes

260200 -- Manganese ores and concentrates, including ferruginous manganese ores and concentrates with a manganese content of 20% or more, calculated on the dry weight

260300 -- Copper ores and concentrates

260400 -- Nickel ores and concentrates

2605 -- Cobalt ores and concentrates

260800 -- Zinc ores and concentrates

2609 -- Tin ores and concentrates

2610 -- Chromium ores and concentrates

261100 -- Tungsten ores and concentrates

261510 -- Zirconium ores and concentrates

261590 -- Niobium, tantalum, vanadium ores and concentrates

261610 -- Silver ores and concentrates

262011 -- Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly zinc, hard zinc spelter

262019 -- Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter

262030 -- Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly copper

280450 -- Boron; tellurium

280480 -- Arsenic

2810 -- Oxides of boron; boric acids

281000 -- Oxides of boron; boric acids

281700 -- Zinc; oxide and peroxide

2819 -- Chromium oxides and hydroxides

282010 -- Manganese dioxide

282090 -- Manganese oxides; excluding manganese dioxide

2822 -- Cobalt oxides and hydroxides; commercial cobalt oxides

282520 -- Lithium oxide and hydroxide

282530 -- Vanadium oxides and hydroxides

282540 -- Nickel oxides and hydroxides

282550 -- Copper oxides and hydroxides

282560 -- Germanium oxides and zirconium dioxide

282735 -- Chlorides; of nickel

282741 -- Chloride oxides and chloride hydroxides; of copper

283324 -- Sulphates; of nickel

283325 -- Sulphates; of copper

283691 -- Carbonates; lithium carbonate

284321 -- Silver compounds; silver nitrates

284329 -- Silver compounds; excluding silver nitrates

284520 -- Boron enriched in boron-10 and its compounds

284530 -- Lithium enriched in lithium-6 and its compounds

290433 -- Derivatives of hydrocarbons; lithium perfluorooctane sulphonate, whether or not halogenated

320642 -- Colouring matter; lithopone and other pigments and preparations based on zinc sulphide

380120 -- Graphite; colloidal or semi-colloidal

381511 -- Catalysts, supported; reaction initiators, reaction accelerators and catalytic preparations, with nickel or nickel compounds as the active substance, n.e.c. or included

710610 -- Metals; silver powder

710691 -- Metals; silver, unwrought, (but not powder)

710692 -- Metals; silver, semi-manufactured

710700 -- Base metals clad with silver; not further worked than semi-manufactured

711011 -- Metals; platinum, unwrought or in powder form

711019 -- Metals; platinum, semi-manufactured

711021 -- Metals; palladium, unwrought or in powder form

711029 -- Metals; palladium, semi-manufactured

711041 -- Metals; iridium, osmium, ruthenium, unwrought or in powder form

711049 -- Metals; iridium, osmium, ruthenium, semi-manufactured

711292 -- Waste and scrap of precious metals; of platinum, including metal clad with platinum but excluding sweepings containing other precious metals

711510 -- Metal; catalysts in the form of wire cloth or grill, of platinum

740100 -- Copper mattes; cement copper (precipitated copper)

740200 -- Copper; unrefined, copper anodes for electrolytic refining

740312 -- Copper; refined, unwrought, wire-bars

740313 -- Copper; refined, unwrought, billets

740319 -- Copper; refined, unwrought, n.e.c. in item no. 7403.1

740321 -- Copper; copper-zinc base alloys (brass) unwrought

740322 -- Copper; copper-tin base alloys (bronze) unwrought

740400 -- Copper; waste and scrap

740500 -- Copper; master alloys of copper

740610 -- Copper; powders of non-lamellar structure

740620 -- Copper; powders of lamellar structure, flakes

740710 -- Copper; bars, rods and profiles, of refined copper

740721 -- Copper; bars, rods and profiles, of copper-zinc base alloys (brass)

740729 -- Copper; bars, rods and profiles, of copper alloys (other than copper-zinc base alloys)

740819 -- Copper; wire, of refined copper, of which the maximum cross-sectional dimension is 6mm or less

740821 -- Copper; wire, of copper-zinc base alloys (brass)

740822 -- Copper; wire, of copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver)

740829 -- Copper; wire, of copper alloys (other than copper-zinc base alloys, copper-nickel base alloys or copper-nickel-zinc base alloys)

740911 -- Copper; strip, of a thickness exceeding 0.15mm, of refined copper, in coils

740919 -- Copper; plates and sheets, of a thickness exceeding 0.15mm, of refined copper, not in coils

740921 -- Copper; strip, of a thickness exceeding 0.15mm, of copper-zinc base alloys (brass), in coils

740929 -- Copper; plates and sheets, of a thickness exceeding 0.15mm, of copper-zinc base alloys (brass), not in coils

740931 -- Copper; strip, of a thickness exceeding 0.15mm, of copper-tin base alloys (bronze), in coils

740939 -- Copper; plates and sheets, of a thickness exceeding 0.15mm, of copper-tin base alloys, not in coils

740940 -- Copper; plates, sheets and strip, of a thickness exceeding 0.15mm, of copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver)

740990 -- Copper; plates, sheets and strip, of a thickness exceeding 0.15mm, of copper alloys (other than copper-zinc base alloys, copper-tin base alloys, copper-nickel base alloys or copper-nickel-zinc base alloys)

741011 -- Copper; foil, not backed, of a thickness not exceeding 0.15mm, of refined copper

741012 -- Copper; foil, not backed, of a thickness not exceeding 0.15mm, of copper alloys

741021 -- Copper; foil, backed with paper, paperboard, plastics or similar backing material, of a thickness (excluding any backing) not exceeding 0.15mm, of refined copper

741022 -- Copper; foil, backed with paper, paperboard, plastics or similar backing material, of a thickness (excluding any backing) not exceeding 0.15mm, of copper alloys

741110 -- Copper; tubes and pipes, of refined copper

741121 -- Copper; tubes and pipes, of copper-zinc base alloys (brass)

741122 -- Copper; tubes and pipes, of copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver)

741129 -- Copper; tubes and pipes, of copper alloys (other than copper-zinc, copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel-silver))

741210 -- Copper; tube or pipe fittings (e.g. couplings, elbows, sleeves) of refined copper

741220 -- Copper; tube or pipe fittings (e.g. couplings, elbows, sleeves) of copper alloys

741300 -- Copper; stranded wire, cables, plaited bands and the like, not electrically insulated

741510 -- Copper; nails and tacks, drawing pins, staples and similar articles of copper, or of iron or steel with copper heads

741521 -- Copper; washers, (including spring washers), not threaded

741529 -- Copper; rivets, cotters, cotter-pins and similar articles, not threaded

741533 -- Copper; screws, bolts and nuts, threaded

741539 -- Copper; articles n.e.c. in heading no. 7415

741810 -- Copper; table, kitchen or other household articles and parts thereof; pot scourers and scouring or polishing pads, gloves and the like

741820 -- Copper; sanitary ware and parts thereof

741920 -- Copper; cast, moulded, stamped or forged, but not further worked

741980 -- Copper; articles thereof n.e.c. in chapter 74

750110 -- Nickel; nickel mattes

750120 -- Nickel; oxide sinters and other intermediate products of nickel metallurgy

750210 -- Nickel; unwrought, not alloyed

750220 -- Nickel; unwrought, alloys

750300 -- Nickel; waste and scrap

750400 -- Nickel; powders and flakes

750511 -- Nickel; bars, rods and profiles, not alloyed

750512 -- Nickel; bars, rods and profiles, of nickel alloys

750521 -- Nickel; wire, not alloyed

750522 -- Nickel; wire, of nickel alloys

750610 -- Nickel; plates, sheets, strip and foil, not alloyed

750620 -- Nickel; plates, sheets, strip and foil, of nickel alloys

750711 -- Nickel; tubes and pipes, not alloyed

750712 -- Nickel; tubes and pipes, of nickel alloys

750720 -- Nickel; tube and pipe fittings

750810 -- Nickel; cloth, grill and netting, of nickel wire

750890 -- Nickel; articles thereof n.e.c. in item no. 7508.1

790111 -- Zinc; unwrought, (not alloyed), containing by weight 99.99% or more of zinc

790112 -- Zinc; unwrought, (not alloyed), containing by weight less than 99.99% of zinc

790120 -- Zinc; unwrought, alloys

790200 -- Zinc; waste and scrap

790310 -- Zinc dust

790390 -- Zinc; powders and flakes

790400 -- Zinc; bars, rods, profiles and wire

790500 -- Zinc; plates, sheets, strip and foil

790700 -- Zinc; articles n.e.c. in chapter 79

80 -- Tin; articles thereof

810110 -- Tungsten (wolfram); articles thereof, including waste and scrap, powders

810194 -- Tungsten (wolfram); unwrought, including bars and rods obtained simply by sintering

810196 -- Tungsten (wolfram); wire

810197 -- Tungsten (wolfram); waste and scrap

810199 -- Tungsten (wolfram); articles n.e.c. in heading no. 8101

810320 -- Tantalum; unwrought, including bars and rods obtained simply by sintering, powders

810330 -- Tantalum; waste and scrap

810391 -- Tantalum; crucibles

810399 -- Tantalum; articles n.e.c. in heading no. 8103

8105 -- Cobalt; mattes and other intermediate products of cobalt metallurgy, cobalt and articles thereof, including waste and scrap

810921 -- Zirconium; unwrought, powders, containing less than 1 part hafnium to 500 parts zirconium by weight

810929 -- Zirconium; unwrought, powders, containing not less than 1 part hafnium to 500 parts zirconium by weight

810931 -- Zirconium; waste and scrap, containing less than 1 part hafnium to 500 parts zirconium by weight

810939 -- Zirconium; waste and scrap, containing not less than 1 part hafnium to 500 parts zirconium by weight

810991 -- Zirconium; other than unwrought, n.e.c. in heading no. 8109, containing less than 1 part hafnium to 500 parts zirconium by weight

810999 -- Zirconium; other than unwrought, n.e.c. in heading no. 8109, containing not less than 1 part hafnium to 500 parts zirconium by weight

811100 -- Manganese; articles thereof, including waste and scrap

8112 -- Beryllium, chromium, hafnium, rhenium, thallium, cadmium, germanium, vanadium, gallium, indium and niobium (columbium), articles of these metals, including waste and scrap

811221 -- Chromium and articles thereof; unwrought chromium, powders

811222 -- Chromium; waste and scrap

811229 -- Chromium and articles thereof; wrought other than waste and scrap

811269 -- Cadmium; other than waste and scrap

811292 -- Gallium, germanium, indium, niobium (columbium) and vanadium; articles thereof, unwrought, including waste and scrap, powders

811299 -- Gallium, germanium, indium, niobium (columbium) and vanadium; articles thereof, other than unwrought including waste and scrap and powders

850610 -- Cells and batteries; primary, manganese dioxide

850640 -- Cells and batteries; primary, silver oxide

850650 -- Cells and batteries; primary, lithium

850660 -- Cells and batteries; primary, air-zinc

850730 -- Electric accumulators; nickel-cadmium, including separators, whether or not rectangular (including square)

850750 -- Electric accumulators; nickel-metal hydride, including separators, whether or not rectangular (including square)

850760 -- Electric accumulators; lithium-ion, including separators, whether or not rectangular (including square)

853221 -- Electrical capacitors; fixed, tantalum

853921 -- Lamps; filament, (excluding ultra-violet or infra-red), tungsten halogen

854411 -- Insulated electric conductors; winding wire, of copper

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Annex II: Methodology used to estimate economic benefits of adding value to a greater share of Africa's energy transition minerals

We use the following steps to produce these estimates.

1. Export potential: We collect data from the International Trade Centre's Export Potential Map on where African countries have potential to export more processed goods based on energy transition minerals.[185] These are disaggregated at the product level (6- level according to the Harmonized System classification). For South Africa, we only cover the 40 most important sectors since there are so many opportunities that it was difficult to extract them from the database. It should be noted that these estimates do not necessarily represent opportunities for African countries to add more value to their *own* transition minerals, but could reflect opportunities to add value to minerals imported from elsewhere.

   The Export Potential Map estimates potential to expand exports based on 3 main factors: demand, supply and ease of trade. In particular, for demand, it considers how global demand for different products is forecast to evolve to 2028. For supply, it considers where the producing country is 'underperforming' in certain markets relative to its current global market share. The Map assumes that the country has the potential to increase its market share in each of those markets to match its current global market share. Finally, it considers various indicators of the ease of trading between the producing country and different markets around the world. Decreux et al. (n.d.) provide details of the methodology.[186]

   It is worth noting that the level of production of minerals could constrain exports of processed goods. This is because, if the country runs out of minerals to which it can add more value and would have to import them from elsewhere to expand its exports of processed goods, which could be too costly for it to do competitively, meaning that it can no longer export the processed goods in question. The Export Potential Map methodology does not take into account the current level of production of minerals, or mineral reserves that are ready for extraction, in determining export potential for products based on minerals, which is a limitation of the methodology.[187]

   Readers should also take into account that the International Trade Centre's data on export potential could include some products that the country does not produce but only re-exports. While ITC has attempted to adjust for this and eliminate such cases (as explained in Decreux et al., n.d.), this may not have been fully successful.[188] As a result, we make further adjustments, as follows. Where a country reports re-exports, but does not report exporting the product in question as a 'domestic export' (where 'domestic exports' are given by exports minus re-exports), we consider that it does not in fact export the product and remove it. For the export of refined or smelted but unwrought metals, we check the British Geological Survey's World Mineral Statistics data[189] on whether the exporting country carries out these processes. If the data indicates that it does not do so as of 2021 (the latest year available at the time of writing), then we remove this opportunity from consideration.

2. Impact of value addition on GDP: Using the data obtained under step 1, for each country – sector pair, we multiply the dollar value of export potential by the corresponding share of African value added in total value added for exports by that sector from that country in 2022, obtained from the UNCTAD-Eora Global Value Chain Database, with several adjustments to this share detailed as follows.[190]

   The first adjustment that we make to the data is to exclude value added imported from fossil fuel-producing African countries (for reasons that will become clear below). This gives us the share of African countries in creating these exports, excluding fossil fuels. However, if we use this multiplier without further adjustments, we would be including value already added under existing levels of value addition. To estimate the share of *additional* value added that results from African producers ascending the value chain, we make the assumption that all value added from the mining and quarrying sector that is exported from the country is exported either in the form of unprocessed mineral products, or in products from the same sectors where the country has the potential to produce more energy transition minerals.[191] Although this assumption may not be entirely correct (as some countries may use African minerals in other products that have undergone further processing), we consider that it is likely to be largely correct given that Africa has a marginal share in the later stages of value chains for energy transition minerals (as shown in section 3 of the present document), so most of the value added from the continent's mining sector is indeed likely to be exported by those sectors from which it currently exports.

   On this basis, we assume that we can obtain the additional value added from this sector by starting with the total value added from the country's mining and quarrying sector as a share of the country's total exports of value added, less the share in total exports of value added that comes direct from Africa's mining and quarrying sector (i.e., exports of minerals that have undergone no or only minimal processing). We do not subtract value added from the mining and quarrying sector for fossil fuel producing countries, since the 'mining and quarrying' sector also includes the production of fossil fuels. An exception is South Africa, because it reports separate data for its non-coal mining sector that excludes fossil fuels. For those countries, we instead use the average share of the mining and quarrying sector in total exports for African countries that do *not* produce fossil fuels. We also produce different versions of the estimates where we remove some of these adjustments, for the purposes of comparison.

   Our model currently assumes 'constant returns to scale', i.e., that as countries expand their processing of energy transition minerals, they will increase their spending on different inputs in direct proportion to the increase in export value. While it is likely that returns to scale could change (e.g., economies of scale could improve productivity as exports increase, or shortages of skilled workers or electricity could have the opposite effect), we maintained the constant returns to scale assumption because we were not able to obtain data on how the production structure was likely to change with increased scale.

   We also considered including the effect of workers moving from other jobs into energy transition mineral value chains. However, we concluded that it would be too difficult to include this in the model. This is because there could be a 'cascade effect', where skilled workers would take jobs in energy transition mineral value chains, and other

slightly less-skilled workers would be hired to fill the jobs that they vacated, and so on, so that the final effect on the labour market would be a reduction in the level of unemployment, so there would be no loss of GDP as a result of their movement into these new roles. In countries with low levels of unemployment (e.g., with 'frictional unemployment' only), it could be the lowest-paid workers who would stop working in those jobs. However, workers in African countries work informally in low-productivity jobs and it might therefore be difficult to estimate the 'lost production' of these workers.

3. Potential job creation: For the number of jobs created, we multiply the dollar value of exports in step 1 by ratio of export value to number of jobs created in the country in question by its manufacturing exports (excluding those created in extractive industries) from the Labor Content of Exports database. For those countries for which there is no data on job intensity of manufacturing exports, we use the simple average of values for those countries with data. Unfortunately we are forced to ignore the jobs that export opportunities in one African country could create in another, as we lack the data to calculate these.

   For calculations of job opportunities created, all indicators of value added are taken from the UNCTAD-Eora Global Value Chain database, while all indicators for production and jobs are taken from the World Bank Labor Content of Exports Database.[192] As under item 1. above, the estimates of export opportunities are taken from the ITC's Export Potential Map. [193,194]

Endnotes

[1] These are Arsenic, Boron, Cadmium, Chromium, Cobalt, Copper, Dysprosium, Gallium, Germanium, Graphite, Hafnium, Indium, Lanthanum, Lead, Lithium, Magnesium, Manganese, Molybdenum, Neodymium, Nickel, Niobium, Platinum Group Metals, Praseodymium, Selenium, Silicon, Silver, Tantalum, Tellurium, Terbium, Tin, Titanium, rare earth elements, Tungsten, Vanadium, Yttrium, Zinc and Zirconium. See 'Critical Minerals Data Explorer', IEA, 11 July 2023, https://www.iea.org/data-and-statistics/data-tools/critical-minerals-data-explorer. This list does not include some minerals and metals, such as iron ore, which will be used in renewable energy technologies; however this may be because demand for some minerals is not expected to increase, despite their use in renewable energy, due to increased recycling or declining demand from China. Scott Nyquist, Matt Rogers, and Jonathan Woetzel, 'The Future Is Now: How to Win the Resource Revolution', McKinsey Sustainability, 12 October 2016, https://www.mckinsey.com/capabilities/sustainability/our-insights/the-future-is-now-how-to-win-the-resource-revolution.

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https://www.iea.org/data-and-statistics/data-product/critical-minerals-demand-dataset; the latter dataset is used for platinum-group metals only. The 'Stated Policies' scenario is based on government policies as of August 2023. For further details please see IEA, 'Global Energy and Climate Model' (Paris: IEA, 2023), https://www.iea.org/reports/global-energy-and-climate-model, Licence: CC BY 4.0. Projections for platinum-group metals are based on an older version of the scenario using less up-to-date information about government policies.

[5] Author's analysis based on This graph is based on an older version of the Stated Policies Scenario that included less up-to-date information on government policies.

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of less-processed minerals would decrease, meaning that the net increase in exports would be less than the amounts shown in Figure 21 or the $43 bn total.

[114] The main opportunities for each of these countries are as follows: DRC - copper and cobalt processing; South Africa - platinum group metal and copper processing; Zambia - copper processing; Republic of Congo - copper processing; Sudan - lead processing.

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