Clean energy technologies – supply chain risks and opportunities

Clean energy technologies (CETs) are renewable and offer less environmentally invasive ways to power the global community.[1] Clean technology supply chains include both supply chains for clean energy sources (including wind, solar, geothermal, and hydro), and supply chains associated with the stages of the clean technology value chain (production, transmission of clean energy, and distribution).

Clean energy technology supply chains have some characteristics which make them different from fossil fuel supply chains. Getting the global energy industry to net zero emissions shifts the focus of energy supply chains from fossil fuel supply and fossil fuel geopolitics to clean energy minerals supply, clean energy materials manufacture, and the manufacturing capacity needed to deliver clean energy technologies. It includes energy transition materials (lithium, nickel, cobalt, and copper), solar panels, wind turbines, electrolysers to make electricity and hydrogen, batteries for electric vehicles/hybrids/stabilising the grid (replacement for spinning reserve), transmission lines and shipping infrastructure.

With a global imperative to accelerate the energy transition to get the world to net zero emissions, the successful management of CET supply chains is essential to ensure a successful energy transition. The supply chain associated with CETs is complex, since it is not only concerned with the production, transmission and distribution of clean energy but also provides those involved with the energy transition with new opportunities while encompassing additional risks.

RISK FACTORS

High geographic concentration of raw materials and limited sources for clean energy rare metals, raise concerns about supply security.

Similar to crude oil, the location of minerals critical to clean energy technologies is concentrated, with individual countries having large percentages of global production, and large shares of processing of those minerals. As of 2022, record deployment of clean energy technologies worldwide is propelling huge demand for lithium, cobalt, nickel, and copper. From 2017 to 2022, the energy sector was the main factor behind a tripling in overall demand for lithium, a 70% jump in demand for cobalt, and a 40% rise in demand for nickel.[2] Figure 1 shows recent changes in the trade of selected CETs.

THE DEMOCRATIC REPUBLIC OF THE CONGO IS RESPONSIBLE FOR **70%** OF COBALT OUTPUT, CHINA FOR **60%** OF RARE EARTH ELEMENTS (REEs), WITH INDONESIA ACCOUNTING FOR **40%** OF NICKEL, AUSTRALIA FOR **55%** OF LITHIUM MINING AND CHILE FOR **25%** OF COPPER PRODUCTION.

Processing of clean-energy-related minerals is also concentrated, as China is responsible for the refining of 90% of REEs and 60-70% of lithium and cobalt. Apart from concentration issues, geopolitical tensions, trade disputes, and price fluctuations can disrupt the availability of these crucial raw materials, jeopardising the manufacturing of renewable energy technologies.

Chinese dominance

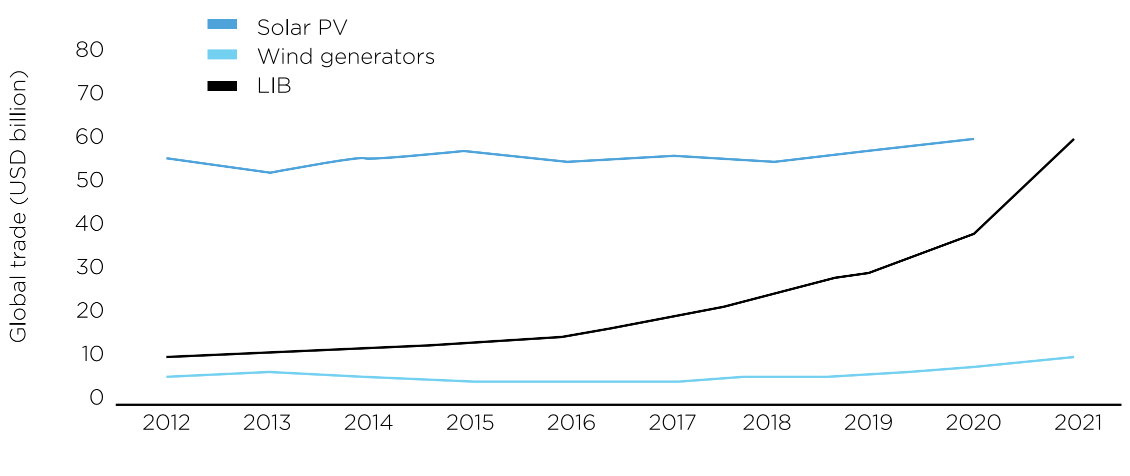
China is the leading global supplier of clean energy technologies today and a net exporter of many minerals and manufactured products. In addition to Chinese dominance of REE production and refining of REEs, lithium and cobalt, China dominates the global output of crude steel, cement, and aluminium, though most is used domestically. In addition, China holds approximately 60% of the global manufacturing capacity for most mass-manufactured technologies (e.g. solar PV, wind systems and batteries), and 40% of electrolyser manufacturing.

Increased input costs

While the industry still faces challenges as central banks continue to raise rates and some clean energy manufacturers are not yet passing cost savings on to buyers, the last few years of turmoil have been an exception to otherwise consistent project cost declines.[3] Recent supply chain disruptions combined with rapidly growing demand for CETs increased the cost of CET materials. The average price of lithium was nearly four times higher in 2022 than in 2019, and twice for cobalt and nickel. Battery metal price hikes in early 2022 led to increasing battery prices – up nearly 10% globally relative to 2021 – reversing years of continuous decline, though the long-term trend resumed in 2023.

THE PRICE OF SOLAR PV-GRADE POLYSILICON, COPPER, AND STEEL ALL ROUGHLY DOUBLED BETWEEN THE FIRST HALF OF 2020 AND THAT OF 2022.

Figure 1: Annual global trade of solar, wind generators, and lithium-ion batteries



Source: Authors' analysis based on UNCOMTRADE (2023) data

Manufacturing, transport, and logistics challenges

Production of clean energy components such as solar panels and wind turbines requires intricate supply chains involving multiple suppliers in a sequence of highly interdependent events. Disruptions including natural disasters, factory accidents, unanticipated production interruptions, or labour disputes, may result in delays and shortages. CETs often involve large-scale and heavy components that require efficient transportation and logistics. Delays or disruptions to transportation infrastructure (ports, roads, and railways) can impede the delivery and installation of these components, leading to project delays and cost overruns.

OPPORTUNITIES

With risks, however, come opportunities. The move away from global supply chains towards regional supply chains has provided **opportunities for nearshoring/friend-shoring** logistics for regions that would otherwise not be globally competitive, as the higher supply chain costs will be more than offset by the increased security of supply. Additionally, reducing dependence on a single country or region for critical minerals and components can enhance resilience and minimise the impact of disruptions. Similarly, promoting local manufacturing capabilities and establishing domestic/regional supply chains can reduce reliance on global supply chains, decreasing transportation risks and supporting local economies. In the same vein, building strategic stockpiles of critical minerals and components can ensure a steady supply during times of scarcity or disruption.

Several CETs (advanced batteries to green hydrogen production to wind turbines) are reliant on critical minerals such as neodymium, cobalt and platinum. Scientists are working on **innovative ways to use less of these materials or eliminate them** altogether. One example is the shift to cobalt-free lithium-iron-phosphate batteries in electric cars. Many car companies are also redesigning power trains and the magnets inside them to reduce the need for neodymium and dysprosium.

WHAT DOES THIS MEAN FOR THE CARIBBEAN?

The CET transition in the region has been hobbled by the existing economic realities of the islands. Nevertheless, Caribbean countries should pursue significant investments in CETs and energy efficiency as much as is practicable. These investments will also provide benefits in support of diversifying local economies and allow expansion into emerging sectors. There is significant job creation potential from both investing in CETs and investing in the supply chain and local content associated with clean energy. Further, introducing (and enforcing) improved energy efficiency standards for buildings (and retrofitting existing building stock) will trigger the construction industry, cost less than large infrastructure investments and promote solid job creation opportunities. Finally, investments in CETs have a significant GDP multiplier that can benefit the overall economy of Caribbean countries.

References:
[1]https://www.rti.org/focus-area/clean-energy-technology
[2]https://www.iea.org/news/critical-minerals-market-sees-unprecedented-growth-as-clean-energy-demand-drives-strong-increase-in-investment
[3]https://about.bnef.com/blog/cost-of-clean-energy-technologies-drop-as-expensive-debt-offset-by-cooling-commodity-prices/

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