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# Investment Insights

## The Geopolitics of Clean Energy Commodities

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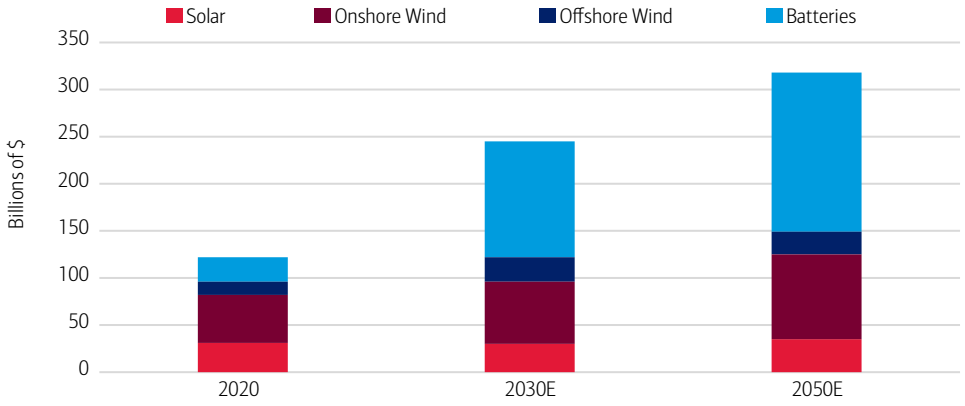
Data as of 05/13/2022 and subject to change.

The energy system of the future will likely be increasingly powered by renewables, but the growth and stability of global green energy are reliant on an abundance of commodities and the ability to coordinate and collaborate the supply of these commodities across borders. If the geopolitics of fossil fuel commodities is a sign of what is likely to come, it could be a bumpy road. Broadly, there are a greater number of green commodity inputs concentrated in fewer countries that are less politically stable and more corrupt, on average, than fossil fuel producing countries. For investors, the volatile geopolitical backdrop for clean energy supports our version of FAANG 2.0—fuels, aerospace & defense, agriculture, nuclear and renewables, and gold and metals/minerals—theme.

**The course has been set. Fuel is being pumped into green energy demand.** The Paris Climate Accords, an international treaty on climate change, set long-term goals for nearly 200 nations in regards to climate change mitigation, policy adaptation and clean energy financing. The agreement requires recommitment every five years to ensure goals are met.[1] Based on the stated goals, the market for clean energy is anticipated to more than double in size over the next 30 years. Batteries alone are anticipated to move from a market size of $26 billion to $169 billion by 2050 (Exhibit 1).[2] Importantly, much of the private sector appears willing to move even without a formal treaty.

### Exhibit 1: Estimated Market Size for Select Clean Energy Technologies.




E=Estimate. Source: International Energy Agency. Data as of 2021.

PORTFOLIO CONSIDERATIONS

The volatile geopolitical backdrop for clean energy commodities supports several investment ideas within our FAANG 2.0 theme: fuels, aerospace & defense, nuclear and renewables, and gold and metals/minerals.

[1] United Nations Framework Convention on Climate Change. June 1992.

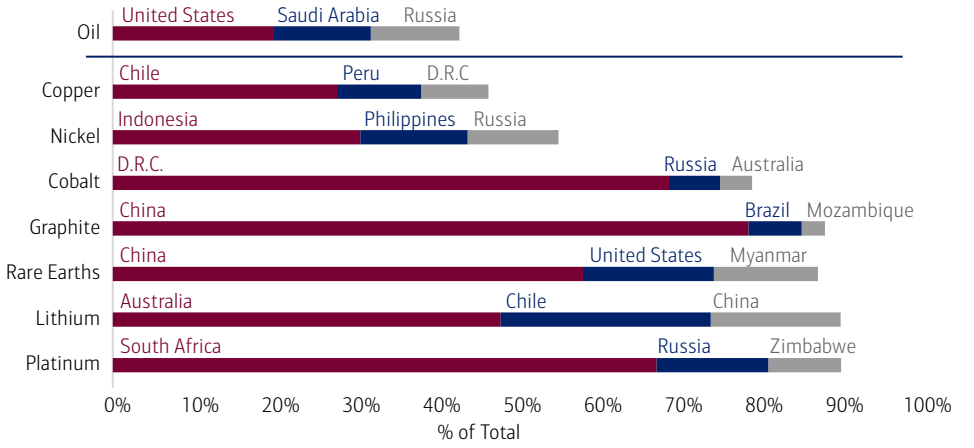
[2] International Energy Agency "The Role of Critical Minerals in Clean Energy Transitions," 2021.

Where will the commodity inputs come from? A study commissioned by Eurometaux—a group that represents some of Europe's biggest metal producers—suggests the answer is very unclear. According the Financial Times: "Europe faces a critical shortage of clean energy metals and needs to decide urgently how it will bridge the supply gap or risk new dependencies on unsustainable producers." The Eurometaux report estimates Europe will need 35 more times lithium and 26 times more rare earth metals to reach its goal. The Ukraine/Russia conflict has expedited efforts to reduce Europe's dependence on Russian fossil fuels, but the clean energy commodity supply chain is not yet ready.[3] Europe's situation is mirrored across the globe as countries and companies scramble to secure the inputs to clean energy.

**And the inputs are expansive. Clean energy sources rely on minerals, and far more of them than their fossil fuel-based counterparts.** For example, onshore wind plants tend to require nine times the mineral input that a gas-plant of the same capacity does.[4] The inputs for wind, EVs and solar photovoltaic technology comprise a large basket of minerals and metals, including copper, cobalt and rare earth elements among others.[5] The scavenger hunt for required inputs spans globally—demanding a far more intentional and deliberate production process. A larger number of inputs creates more opportunity for geopolitical strife.

**Geographical concentration is also a prominent factor that adds to risk.** The raw materials required to produce clean energy are far more geographically concentrated than are fossil fuels. For essential minerals such as cobalt, graphite and platinum, the top three producers account for over 80% of global supply. In comparison, oil is more diversified with the top three producers comprising 40% of global supply. While production already faces a high concentration, the concentration of mineral *processing* is arguably denser. (Exhibit 2)

**Exhibit 2: Top Three Producing Countries for Each Commodity.**




Source: U.S. Geological Survey. Data as of 2021-latest data available.

**Country-level governance data reveals that the production of clean energy commodities has the potential to be at least as volatile (likely more volatile) as fossil fuels.** The concentration of essential minerals brings its own risks to the table. However, where those minerals are concentrated intensifies concerns. For example, cobalt appears in wind turbines, solar panels and electric vehicles acting as a key component of rechargeable lithium-ion batteries.[6] Essentially—no cobalt, no energy storage, no renewables. The Democratic Republic of the Congo leads the pack by a

[3] Hume, Neil, "Europe urged to bridge supply gap in metals for clean energy," *Financial Times*, April 27, 2022.
[4] International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions," 2021.
[5] International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions," 2021.
[6] Ibid.

landslide in cobalt mining, accounting for 70% of global supply. Russia earns itself second place producing 4.5%. The remaining notable producers are Australia, The U.S., Philippines, Canada, Cuba, Morocco and Madagascar.[7]

The World Bank's Political Stability Index quantifies a country's political soundness based on the absence of violence and seeks to predict the likelihood of instability. For cobalt, more producing countries are deemed unstable than not. Data from the World Bank show 85 percent of global cobalt supply originates from unstable countries. As it stands, many of these countries face a plethora of intense social issues.

Taking a weighted average of the producing countries for various energy commodities shows most clean energy commodities score below zero in Political Stability. On balance, clean energy commodities have a similar stability profile to oil and natural gas, but there are more of them, and in some instances it only takes one bad apple to blow up the supply chain. (Exhibit 3)

**Exhibit 3: Clean Energy Commodities Subject to Geopolitical Volatility.**

| Commodity | Aggregated Political Stability Index | Commodity | Aggregated Corruptions Perception Index | Commodity | Aggregated Government Effectiveness Index | Commodity | Aggregated Democracy Index | Regime Type |
|---|---|---|---|---|---|---|---|---|
| **Scale** | **-2.5 to 2.5** | **Scale** | **-2.5 to 2.5** | **Scale** | **-2.5 to 2.5** | **Scale** | **0 to 10** | |
| Lithium | 0.42 | Lithium | 1.13 | Lithium | 1.16 | **Lithium** | **7.67** | **Flawed Democracy** |
| Natural Gas | -0.22 | Natural Gas | 0.27 | Rare Earths | 0.63 | **Platinum** | **6.40** | **Flawed Democracy** |
| Copper | -0.22 | Copper | 0.21 | Natural Gas | 0.63 | **Nickel** | **6.19** | **Flawed Democracy** |
| Rare Earths | -0.30 | Oil | 0.20 | Graphite | 0.48 | **Copper** | **6.07** | **Flawed Democracy** |
| Platinum | -0.31 | Rare Earths | 0.16 | Oil | 0.45 | **Natural Gas** | **5.38** | **Hybrid** |
| Graphite | -0.33 | Platinum | -0.08 | Nickel | 0.43 | **Oil** | **4.90** | **Hybrid** |
| Nickel | -0.36 | Graphite | -0.12 | Copper | 0.38 | **Rare Earths** | **3.97** | **Authoritarian** |
| Oil | -0.36 | Nickel | -0.16 | Platinum | 0.21 | **Graphite** | **3.00** | **Authoritarian** |
| Cobalt | -1.31 | Cobalt | -1.18 | Cobalt | -1.19 | **Cobalt** | **2.26** | **Authoritarian** |

Full Democracies: Democracy Index greater than 8;
Light blue Flawed Democracies: Democracy Index greater than 6 and less than or equal to 8;
Pink Hybrid: Democracy Index greater than 4 and less than or equal to 6;
Red Authoritarian: Democracy Index less than or equal to 4.
Sources: U.S. Geological Survey; The World Bank, Natural Resources Governance Institute; Economic Intelligence Unit. As of April 15, 2022.
**Please refer to index definitions and important disclosures at the end of this report.**

Scoring clean energy commodity production based on the Corruptions Perception Index also shown in Exhibit 3 tells a similar story. Rare earth, platinum, graphite, nickel and cobalt production all score "more corrupt" at the country level than oil and natural gas. Accredited to its heavy Australian supply, lithium proves itself to be the most stable and least corrupt leader of the pack when taking a weighted average of the producing countries.

Overall, clean energy commodities have the potential to exhibit just as much if not more geopolitical volatility as fossil fuels. Using the Economic Intelligence Unit's Democracy Index, rare earths, graphite and cobalt all qualify as "authoritarian" regimes based on the weighted average of production country of origin. Oil and natural gas are scored as "hybrid."

To reiterate, if a single input is disrupted, some clean energy products cannot make it to the consumer. When considering the likelihood of disruption due to lack of political stability or the presence of government corruption, one could aggressively default to the worst. Relatively more politically stable lithium cannot outweigh the instability brought about by cobalt, nickel, graphite, platinum and rare earth elements. This adds yet another layer of complexity investors must consider. Disruption at the initial step is likely for not just one, but many, clean energy inputs.

[7] U.S. Geological Survey, 2021.

**Inputs then face a lengthy journey from extraction to final product.** Clean energy supply chains are wildly more complex than that of fossil fuels. Gasoline has a fairly straightforward process: produce, refine, blend, distribute. Lithium-ion batteries are commonly used across various green energy channels. The final product requires a bundle of materials, each with its own supply chain. Once mined and processed in their own respective locations, inputs are sent to be constructed into batteries, again sent off to be cased, and finally make their way to producers to be installed into the final product.[8] Mineral inputs are required to make multiple stops on the way to their final destination, making room for increased disruption potentials.

**Inputs largely funnel through a singular processing gate: China.** China, an Authoritarian country ranked 151 out of 165 counties in the Economist Intelligence Unit's Democracy Index has a tight grip on the key to step two in the clean energy progression. As the lead processing country for a slew of green energy inputs, China holds a near monopoly on the processing of copper, lithium, nickel, cobalt and rare earth elements. Wind turbines and EV both require permanent magnets that are reliant on Chinese mineral processing. The governance risk that goes along with it should be considered.

National security concerns are pushing the U.S. and others to secure control over strategic supply chains, but for now rare earths and other minerals must run through China.

## Key takeaways for investors

The backdrop for clean energy commodities supports our version of FAANG 2.0, which reflects a new world of geopolitical risks and resource/hard asset intensity. It's within these areas of the market—fuels, aerospace & defense, agriculture, nuclear, and gold/metals/minerals—that we see future value given the defining market rotations we expect.

For the time being, fossil fuel (the F in FAANG 2.0) needs are here to stay, and prices are likely to remain elevated. Currently, Europe is tasked with finding alternative sources to wean itself off of Russian gas. The long-term solution lends itself to a green energy system. However, that is a timely and costly process. In the meantime, they must seek substitutes, such as U.S. liquefied natural gas. The same can be argued for nuclear energy (the N in FAANG 2.0).

Country selection across Fixed Income, currencies and Commodities should consider both rewards and risks. Mineral-rich countries could benefit, but investors cannot ignore the political stability (or instability) of the countries responsible for input production. However, investors cannot ignore the political stability (or instability) of the countries responsible for input production. Supplies of clean energy commodities originating in more politically stable countries will likely be welcomed by market participants. Australia and Chile stand out as possibly more stable, resource-rich countries that have a history as commodity producers. Poorer democracies in Latin America may also be beneficiaries.

Clean energy commodities are also likely to face a supply chain reorganization, as allies are more likely to selectively globalize. New sources will require physical and transportation infrastructure development. The supply and demand balance for clean energy inputs favors exposure to the underlying commodities or to companies that will both produce and recycle the materials.

Lastly, the potential for conflict is arguably greater than with fossil fuels, reinforcing aerospace and defense (the A in FAANG 2.0) as a theme. Gold (the G in FAANG 2.0) is also viewed as a store of value and diversifier from concerns over war and inflation related to the scramble for clean energy commodities.

[8] International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions," 2021.

# Index Definitions

**Securities indexes assume reinvestment of all distributions and interest payments. Indexes are unmanaged and do not take into account fees or expenses. It is not possible to invest directly in an index. Indexes are all based in U.S. dollars.**

**Aggregated Corruptions Perception Index:** Source: Transparency International. The Corruption Perceptions Index ranks countries and territories based on how corrupt their public sector is perceived to be. It is a composite index "a combination of polls" drawing on corruption-related data collected by a variety of reputable institutions. The index reflects the views of observers from around the world, including experts living and working in the countries and territories evaluated.

**Aggregated Democracy Index:** Source: Economist Intelligence Unit. The Democracy Index is based on five categories: electoral process and pluralism, civil liberties, the functioning of government, political participation, and political culture. Based on their scores on 60 indicators within these categories, each country is then itself classified as one of four types of regime: full democracy, flawed democracy, hybrid regime or authoritarian regime.

**Aggregated Government Effectiveness Index:** Source: World Bank/NRGI/Brookings. Capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

**Aggregated Political Stability Index Source:** World Bank/NRGI/Brookings. Political Stability and Absence of Violence/Terrorism: capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.

**Corruptions Perception Index:** Source: Transparency International. The Corruption Perceptions Index ranks countries and territories based on how corrupt their public sector is perceived to be. It is a composite index "a combination of polls" drawing on corruption-related data collected by a variety of reputable institutions. The index reflects the views of observers from around the world, including experts living and working in the countries and territories evaluated.

**Democracy Index:** is an index based on 60 indicators grouped in five different categories, measuring pluralism, civil liberties and political culture. In addition to a numeric score and a ranking, the index categorizes each country into one of four regime types: full democracies, flawed democracies, hybrid regimes, and authoritarian regimes.

**Economist Intelligence Unit's Democracy Index:** The Democracy Index is based on five categories: electoral process and pluralism, civil liberties, the functioning of government, political participation, and political culture. Based on their scores on 60 indicators within these categories, each country is then itself classified as one of four types of regime: full democracy, flawed democracy, hybrid regime or authoritarian regime.

**World Bank's Political Stability Index Source:** World Bank/NRGI/Brookings. Political Stability and Absence of Violence/Terrorism: capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.

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