The case for energy transition metals and rare earths

WisdomTree®

WisdomTree.eu
+44 (0) 207 448 4330

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The energy transition from traditional fossil fuels to renewable resources as well as the electrification of several global economic sectors is underway. Many countries are in the process of converting their ambitions into concrete policies to deliver a just and equitable transition away from fossil fuels, in line with the Paris Agreement goal[1] and to maintain energy security.

Metals in the transition

This energy transition will significantly impact commodity demand. The likelihood of persistent demand for future metals to change energy systems bodes well for market prices. Companies across the value chain could also benefit from the production and sale of these metals.

As technology evolves, so does the intensity of metal usage in various applications. (i.e. how much metal is needed in each technological application). This is why the backdrop for metals demand is evolving dynamically. As the energy transition unfolds, network operators will need to build transmission and distribution lines which are aluminium and copper-intensive respectively. In transmission, overhead lines will likely become more important to connect remote renewable sites. Export cables for renewable projects are also critical, lifting copper intensities especially for offshore sites.

Various **energy storage technologies** exist, including chemical, electrochemical mechanical and thermal. Hydrogen (chemical) and batteries (electrochemical) are gaining traction and should boost platinum/nickel and lithium demand.

Wind turbines have traditionally relied on gearboxes, but direct drive turbines are becoming more popular offshore which is likely to reduce copper intensity but increase rare earths demand. Meanwhile as **solar photovoltaic** manufacturers seek out efficiency gains, they are likely to increase their silver usage. In nuclear, pressurised water reactors have been the staple relying on steel and copper.

On the power consumption front, the chassis of **electric vehicles** is likely to boost demand for steel and aluminium. Lithium remains a key component in batteries, the differentiation has been primarily in the cathode materials. The charging infrastructure includes both slow and fast

1 The Paris Agreement is a legally binding international treaty on climate change. Its goal is to limit global warming to well below 2 °C (degrees Celsius), preferably to 1.5, compared to pre-industrial levels.

chargers, with the latter containing up to 25kg of copper per unit[2]. **Fuel cell electric vehicles** are also gaining traction and the platinum-intensive proton exchange membrane technology is key.

Figure 1: Metals and minerals in the energy transition

	Batteries	Vehicles	Traction Motors	Fuel cells	Wind	Solar	Hydrogen Electrolysers	Geothermal
Aluminium	-	Yes	Yes	-	Yes	Yes	-	Yes
Boron	-	-	Yes	-	Yes	Yes	-	-
Cadmium	-	-	-	-	Yes	-	-	-
Carbon	-	-	-	-	Yes	-	Yes	-
Chromium	-	-	-	Yes	Yes	-	-	Yes
Cobalt	Yes	-	-	Yes	Yes	-	Yes	-
Copper	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fluorspar	Yes	-	-	Yes	-	-	-	-
Gallium	-	-	-	-	-	Yes	-	-
Germanium	-	-	-	-	-	Yes	-	-
Graphite	Yes	-	-	Yes	-	-	-	-
Indium	-	-	-	-	-	Yes	-	-
Lead	-	-	-	-	-	-	Yes	-
Lithium	Yes	-	-	Yes	-	-	-	-
Magnesium		-	-	Yes	-	-	-	-
Manganese	Yes	-	-	Yes	-	-	-	-
Molybdenum		-	-	-	Yes	-	-	Yes
Nickel	Yes	-	-	Yes	Yes	-	Yes	Yes
Niobium	Yes	-	-	Yes	-	-	-	-
Platinum		-	-	Yes	-	-	Yes	-
Rare Earths	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Selenium	-	-		-	-	Yes	-	-
Silicon	-	-	Yes	-	-	Yes		Yes
Silver	-	-		-	-	-	-	-
Stainless Steel	-	Yes	-	-	Yes	Yes	Yes	-

2 BofA Global Research

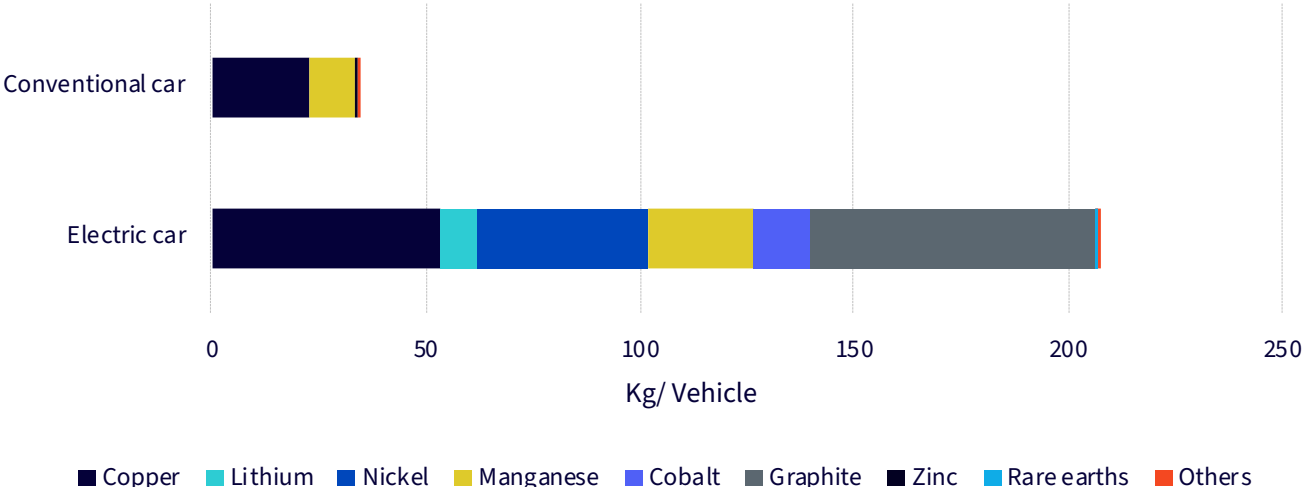
Tellurium	-	-	-	-	-	-	Yes	-
Tin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Titanium	Yes	-	-	-	-	-	Yes	-
Vanadium	-	-	-	Yes	-	-	-	-
Zinc	Yes	Yes	-	Yes	Yes	Yes	-	-
Zirconium	-	-	-	Yes	-	-	-	Yes

Source: WisdomTree, Wood Mackenzie, International Energy Agency.

Rare earths and other critical metals like lithium, copper and nickel are the building blocks of the energy transition. The Rare Earths Elements (REEs) are a group of 17 chemical elements, several of which are critical for the energy transition. Neodymium, praseodymium, dysprosium, and terbium are key to the production of the permanent magnets used in Electric Vehicles (EVs) and wind turbines. As the world races to decarbonize the power and transportation sectors, the shift to a clean energy system will drive a significant increase in demand for metals and REEs.

Electric vehicles use significantly more metals than their internal combustion engine equivalents. Copper for example has 3 times higher loadings in EVs than ICE vehicles.

Figure 2: Minerals used in electric cars versus conventional cars

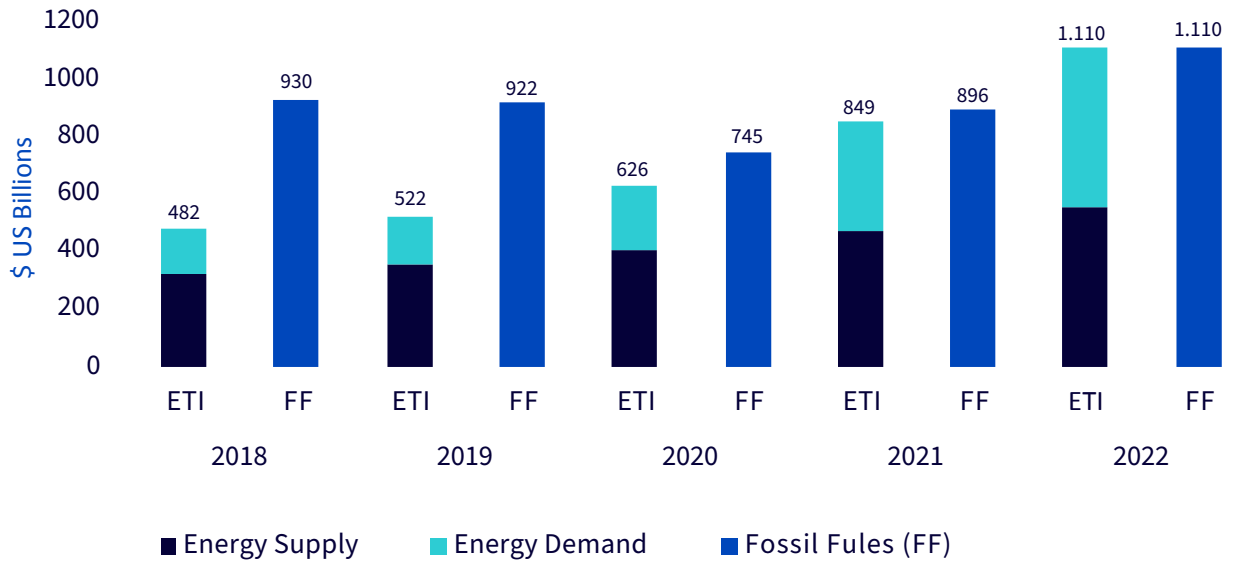


Source: International Energy Agency, WisdomTree as of 31 December 2023

Investment in energy transition is on the brink of overtaking fossil fuel investment for the first time. In 2022, annual global investment in energy transition technologies exceeded US$1 trillion for the first time, hitting a new record of US$1.11 trillion, marking a 31% annual increase[3].

3 Source: Bloomberg New Energy Finance – Investment Trends 2023

Figure 3: Investment comparison: Energy transition vs fossil fuels



Source: WisdomTree, Bloomberg New Energy Finance (BNEF), IEA. Note: **ETI** stands for Energy Investment and FF stands for Fossil Fuels. 2018- 21 FF values were derived from the IEA World Energy Investment 2022 report. 2022 fossil fuel investments are BNEF estimates, and include upstream, midstream, downstream sectors and unabated fossil power generation. **Historical performance is not an indication of future performance and any investments may go down in value.**

What are the drivers of growth?

Growth in the energy transition is being propelled by several factors:

Growing policy support and the increasing competitiveness of clean energy technologies are accelerating the energy transition. Major policy initiatives such as the EU's REPowerEU and the US's Inflation Reduction Act (IRA) are significantly backing this transition, each supporting the wider industry's drive towards 2030 and 2050 net-zero targets. China, the major player in the field, spent US$546 billion on energy transition in 2021, nearly half of the world's total[4]. This investment has cemented China's leadership position in renewable energy and electric vehicle sectors.

The COP28 UN climate conference in Dubai also played a critical role in December 2023 by committing to new renewable electrification initiatives and other climate action plans, reinforcing the movement towards a cleaner energy system.

Transport electrification and renewable power generation, core components of the zero-carbon pathway, are inherently metals intensive. There has been a remarkable surge in the manufacturing of electric vehicles since the COP21 Paris agreement eight years ago, now constituting a quarter of new car sales—a substantial increase from less than 1% in 2015. The mass production of Li-ion batteries has evolved from conception to a tangible reality. Concurrently, the global addition of 165 gigawatt (GW) of solar and wind capacity annually since 2015 underscores the expanding footprint of renewable power.

4, 6 Source: Bloomberg New Energy Finance (BNEF)

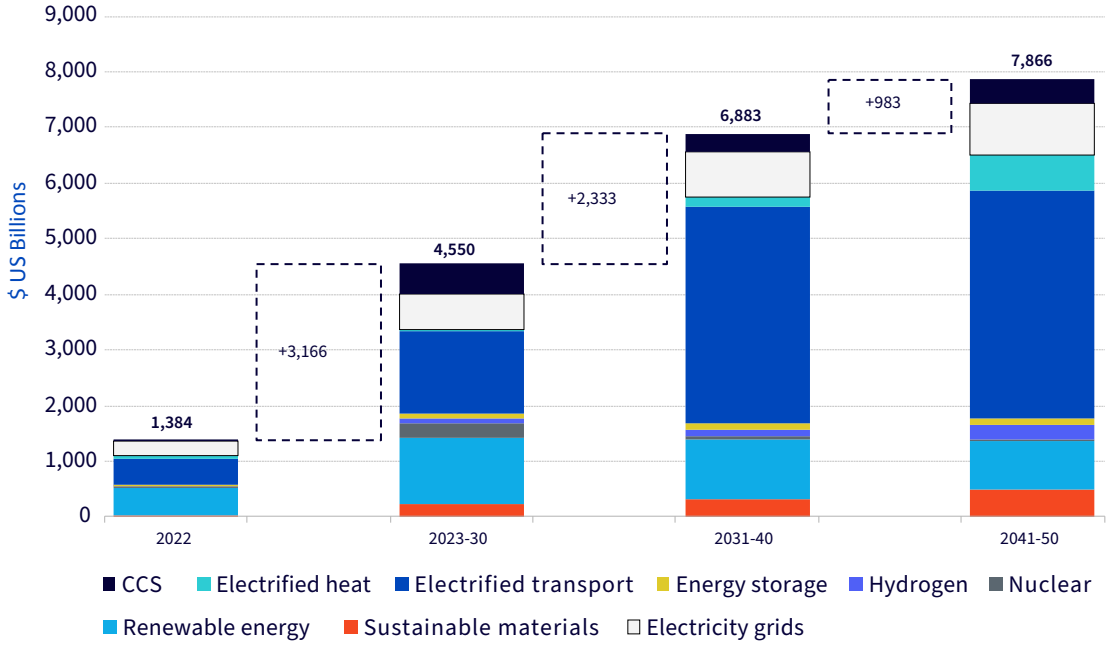
Metal demand in these energy transition-related sectors has soared, and this is already driving the fortunes of numerous metals. Over 85% of lithium is now consumed in batteries, up from 45% in 2015[5]. Nickel demand is dominated by stainless steel, but 15% is now consumed in battery precursors – up from 2% in 2015 – and precursors alone will drive over 60% of primary nickel demand to 2040[6].

> Energy transition and grid investment need to average US$4.55 trillion between 2023 and 2030.

What are the growth expectations?

To align with global net-zero objectives, investments in energy transition and grid infrastructure need to triple from their 2020 levels. Energy transition and grid investment need to average US$4.55 trillion between 2023 and 2030, triple the amount spent in 2022[7].

Figure 4: Annual investment growth in the energy transition



Source: Bloomberg New Energy Finance (BNEF). The future values are from the New Energy Outlook 2022, excluding electrified transport which is from the Electric Vehicle Outlook 2021 Net Zero Scenario. **Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.**

5 Source: International Energy Agency

7 Source: Bloomberg New Energy Finance – Investment Trends 2023

Across 2023-2030, electrified transport, renewable energy, and grids are anticipated to be the most significant investment opportunities, accounting for 72% of the combined share at US$1.47 trillion, US$1.18 trillion, and US$630 billion per year, respectively. This will require enhanced cooperation between the public and private sectors. In the 2030s, annual investment is expected to rise to US$6.88 trillion, with a substantial portion directed towards electrifying mobility demand.

Clean energy technologies are expected to see a significant surge by 2030, given the current policy settings. By the end of the decade, the number of electric cars on roads worldwide is set to be nearly ten times higher than present levels. Solar energy is projected to generate more electricity than the entire United States currently does, with renewables nearing 50% of the global electricity mix, up from around 30% today.

Access to the theme

The investment theme can be accessed through multiple channels – primarily via equity and commodity strategies that invest in equity of miners or the underlying metals exposed to the energy transition theme, respectively.

Each approach has its advantages and disadvantages. The commodities approach provides the purest play to price dynamics, but it is difficult to access all the materials in the transition as many don’t have liquid futures. Also, commodity investment tend to use futures , which tend to be very raw materials-focused and don’t provide access to complementary industries like recycling or cell manufacturing. Equities, while carrying more idiosyncratic risk and equity market beta, can reach deep into the value chain and provide access to all aspects of the transition story. The commodity beta may, however, be lower for this option.

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Investing in equities	Investing in commodities
Pros	**Pros**
+ Provides capital to the energy transition producers, allowing them to grow their business and deploy their product.	+ A pure play exposure to the commodity price dynamics.
+ Allows investors to reach broadly and deeply across the production value chain.	+ Rolling futures can benefit from market backwardation.*
+ Investors can exert influence on governance, labour and environmental practices.	+ Engagement in the futures market improves the price discovery process and provides the producers a venue for hedging.
	+ Engagement with the futures exchanges can influence producer practices.
Access to the Energy Transition	
Cons	**Cons**
– Not the most pure-play exposure to the commodity price dynamics.	– Futures market positions do not inject capital into the producers.
– More idiosyncratic risk and equity market beta.	– Futures markets investors don't have a direct influence on the producer's practices.
– Exposed to country of listing/production.	

Source: WisdomTree. *Backwardation means a futures curve which is downward sloping, which presents positive roll yields.

Why invest?

Rising geopolitical and economic concerns, have the potential to hasten the transition to a more sustainable, cleaner and efficient energy system. Since Russia's invasion of Ukraine, new trade restriction within commodity markets have increased as producers impose curbs on shipments. As countries race to meet their net zero emissions targets, they will need vast supplies of REEs and energy transition metals. REEs and energy transition metals are extremely vulnerable as their global production is extremely concentrated rendering them more vulnerable to trade disruptions. At the same time, mining projects are expensive and long-term in nature. The combination of concentrated supply and weaker reactivity of supply makes REEs and energy transition metals susceptible to shortages amidst rising geopolitical risks and trade restrictions.

In conclusion, investing in energy transition metals, rare earths, and companies in the battery value chains is not just a potential market opportunity; it is a crucial step towards a sustainable future. As we navigate these transformative times, the role of metals and miners in the energy transition will be pivotal in decarbonizing the economy and achieving the ambitious goals set by the global community for a cleaner, more sustainable future.

WisdomTree has identified both equity and commodity routes for investors to invest in the evolving energy transition theme. We aim to build innovative and differentiated investment strategies, designed to directly address today's most pressing and durable investment themes. We have recognised the growth opportunities and challenges facing countries globally as they seek to achieve their net zero targets and given the evolving nature of the energy transition, we constantly strive to adapt to the ever-changing nature of the energy transition value chain but also position ourselves for an informed view of where the megatrend is headed. With our industry leading commodities and thematic expertise, we have developed multiple Exchange Traded Funds (ETFs) and Exchange Traded Products (ETPs) that offer various ways to gain targeted exposure to the Energy Transition Metals and Rare Earths theme.

WisdomTree Energy Transition Metals and Rare Earths Miners strategy

+ Provides access to energy transition metals and rare earths producers through equities.
+ The value chain includes mining, refining, smelting, chemical production and conversions.

WisdomTree Strategic Metals strategy

+ Provides targeted access to a broad selection of energy transition metals by replicating price performance of liquid, tradeable metal futures such as copper, nickel, aluminum, silver, zinc, tin, platinum, lithium, and cobalt.

WisdomTree Solutions

WisdomTree Battery Solutions strategy

+ Provides access to the battery value chain through equities.
+ The value chain includes metal producers, battery manufacturers, recyclers, grid edge and many other industry enablers.

WisdomTree Battery Metals strategy

+ Provides targeted access to battery metals by replicating prices of liquid, tradeable metal futures such as copper, nickel, aluminum, zinc, lead, lithium, and cobalt.

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