Sustainable Investing *Spotlight*

The new energy horizon

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On the back of disruptive shifts in the economics of alternative energy and expanding climate policies, the global energy transition is moving rapidly. The pace and focus vary by country, depending largely on resource availability, existing infrastructure, and political ambition. Each country's pathway is tied to geopolitical shifts and markets, creating new opportunities across sectors.

Two sectors dominate rapid growth in clean energy investments

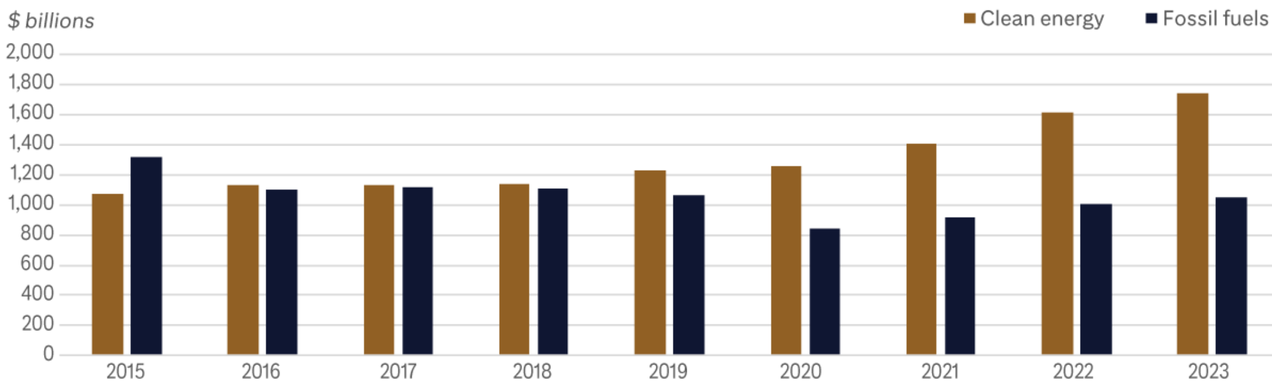
Investment in clean energy systems is reaching new heights. In 2023, the bundle of clean energy, power infrastructure, and energy efficiency investments hit $1.77 trillion, whereas fossil fuels sat just below pre-pandemic levels at slightly more than $1 trillion, according to the International Energy Agency (IEA)[1]. This growing energy transition investment trend emerged despite challenges such as tumultuous supply chain logistics, macroeconomic instability, hawkish monetary policy, and energy market volatility.

Total 2023 energy transition investments doubled the level seen just three years prior. This surge is dominated by the two highest-growth commercial technologies: renewable energy (RE) and electric vehicles (EVs). Of the overall 2023 clean energy investment of $1.77 trillion, RE and EVs accounted for $623 billion and $632 billion, respectively, or 70% of the annual total. The rise of EV investment has been the most significant driver of total increased clean technology flows in recent years[2].

Heat pumps, energy storage, and clean industry make up only about 8% of overall transition financing; however, these areas have been gaining momentum and represent exciting new frontiers for innovation and investment. Technologies that have to date received less private

[1] IEA (2023), *Global Energy Transition Stocktake 2023*, IEA, Paris https://www.iea.org/topics/global-energy-transitions-stocktake, CC BY 4.0
[2] BloombergNEF (2024) *Energy Transition Investment Trends 2024*

Clean energy investment is surpassing fossil fuel flows



Source: IEA (2023), *World Energy Outlook 2023*, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2023, CC BY 4.0

investment, but have at least regional policy and/or funding support include nuclear technologies (both conventional and emerging), clean hydrogen fuels, and carbon, capture, utilization, and storage (CCUS)[2].

Still, annual energy transition and grid expenditures would need to grow at least threefold by the end of the decade to maintain a net-zero by 2050 trajectory, from $1.77 trillion in 2023 to $4.8 trillion by 2030 according to BloombergNEF[2]. Additional funding will be especially important in emerging markets and for new decarbonization technologies; at present, 35% of net-zero technologies have not yet been commercialized[3].

Politics will drive the next breakthroughs

Despite the importance of market forces in driving the energy transition, politics and policies will remain the decisive variables in the pace of decarbonization. Today, approximately 88% of 140 countries are covered by net-zero targets, constituting about 92% of global GDP[4]. While many of these commitments lack the necessary policy backing and existing policies remain insufficient to limit global warming to 1.5 degrees, governments have signaled a move toward decarbonization that is creating opportunities for sustainable investment across many sectors.

Emerging markets face specific barriers to decarbonization, compounded by precarious debt levels and inflationary pressures. These challenges are often furthered by limited fiscal bandwidth for subsidies, high cost of capital, and lagging infrastructure for implementation—notably acute in having a renewable-ready power grid. And yet, emerging markets will also reap development benefits from clean power, especially as many are beginning to develop or expand their energy systems.

These opportunities and barriers underscore the importance of bilateral and multilateral funding mechanisms to help unlock private capital in emerging markets, especially concessional finance when clean energy is not the lowest cost option. Traditional blended finance programs provide capital but are not sufficient in scale. Models are emerging such as the Just Energy Transition Partnerships (JETPs) that focus funding from multiple advanced economies onto one recipient country. To date, JETPs have pledged $2.7 billion to Senegal, $8.5 billion to South Africa, and $20 billion to Indonesia. New bilateral financing initiatives include the EU's Global Gateway mechanism and China's Belt and Road Initiative, which has an expanding green focus.

[3] IEA (2023) *Net Zero Roadmap: A Global Pathway to Keep the 1.5 C Goal in Reach*, IEA, Paris https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach, CC BY 4.0
[4] University of Oxford, *Net Zero Tracker*

Investments in the energy transition can take on many forms

To be meaningful, sustainability must drive profitability and financial returns over the long term. Sustainability trends can uncover potential opportunities in companies that demonstrate a commitment to environmental stewardship, social responsibility, and robust governance with material financial impact. Over time, these types of commitments and practices may strengthen resiliency.

Among the many sustainability trends, the energy transition magnifies risks for companies that cannot or will not change. For example, they may be unprepared to face stricter emissions reduction policies or carbon tariffs that result in higher costs or be negatively affected by shifting consumer preferences towards environmentally friendly products and companies.

Various options are available for investors to participate in the energy transition. One approach is seeking exposure to public companies that are enhancing their efficiency. Energy efficiency is a cost-effective way to improve competitiveness, and as a result, many companies are exploring new solutions that can deliver clean, reliable and affordable sources of energy. Another approach is to look for companies that are generating revenues by scaling a new technology along the energy value chain. Green bonds can be a potential consideration for an investor's fixed income allocation and help finance innovation in areas related to climate change mitigation and adaptation.

In public markets, investors also have the option of casting their proxy votes in favor of environmentally and socially conscious initiatives, which aim to mitigate financial risks from rapidly shifting policies or a changing climate. Alternatively, they may choose to select a portfolio manager that casts proxy votes on their behalf and directly engages with company leaders to influence proposals, strategy, and policy.

Private market investors might explore alternative options such as private equity, private credit, direct investments, or venture capital to gain further exposure to new growth markets. These companies may be seeking to commercialize or scale a new product, technology, or business model, such as low-carbon heating systems, battery technology, and lower-emission vehicles. Alternatively, asset managers may take board seats on portfolio companies to offer expertise and guidance on implementing climate or social policies.

Understanding the energy transition and other sustainability trends, in the context of your investment portfolio, can help uncover potential opportunities and serve as a source of risk management.

Environmental justice is a critical component of the energy transition

Environmental goals will not put a stop to basic human needs, and in fact those goals can only be reached if basic needs are met. This is where the concepts of "just transition" and "environmental justice" play a key role. A just transition to clean energy aims to address and resolve social and economic inequalities by prioritizing inclusivity that benefits all stakeholders equally. Environmental justice is the fair and meaningful involvement of all stakeholders, with respect to development, implementation, and enforcement of laws, regulations, and policies related to the environment[5].

Environmental justice is a critical component of a just transition, especially as it relates to developing countries, which tend to be most prone to flooding, drought, heat, and climate-related natural disasters, while historically contributing to climate change the least[6].

Reducing carbon emissions and increasing adaptation are equally important to environmental justice. Developing low-carbon energy systems not only reduces carbon emissions but also improves air quality, which can lead to lower healthcare costs and better health outcomes in the long term. Cleaner energy can also foster healthier ecosystems and biodiversity, as well as lower-cost, more efficient, and accessible energy systems. Similarly, adaptation strategies reduce climate impacts and increase resiliency for people and infrastructure.

At its heart, the transition is multidimensional and offers environmental, economic, and social benefits as well as the opportunity to create a more equitable, healthier, and secure future for all.

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[5] US Environmental Protection Agency, Environmental Justice
[6] Bathiany et al., 2018, Science Advances Climate models predict increasing temperature variability in poor countries

Industrial policy goes green

Today, climate policy has become intertwined with a resurgence of industrial policy, creating a green industrial policy and driving investment toward low-carbon economic growth. These trends have emerged in the US to build domestic production following escalating tensions with China, the pandemic's supply chain disruptions, and energy security concerns following the Russian invasion of Ukraine. Green industrial policy has taken different forms and scale across the EU, India, and Canada (while remaining omnipresent, if not further accelerated, in China).

While China is currently the leading producer of technologies such as solar and batteries, new manufacturing markets are taking form in Asia, Europe, and North America[7]. In India, for example, an estimated 110 gigawatts (GW) of solar module factories are forecasted to come online by 2026, enough to reach near self-sufficiency according to research from the Institute for Energy Economics and Financial Analysis[8]. In the battery manufacturing sector, the US is experiencing a wave of new factories from Michigan to Missouri known as the "Battery Belt," while similar industrial clusters are taking form in parts of Europe, including the Nordics and Eastern Europe. For investors, these tensions pose risks and opportunities—especially to invest in firms well-positioned to circumvent products or commodities at risk of being caught in geostrategic crosshairs.

In Europe, the EU is embracing another form of green protectionism: carbon tariffs. Brussels' Carbon Border Adjustment Mechanism will impose a fee on selected imports into the EU from countries that do not have commensurate carbon prices. The fee will begin in 2026 on electricity, cement, steel, aluminum, chemical fertilizers, and hydrogen but could be expanded to encompass other imports, spurring international carbon policies from countries dependent on EU markets in these sectors.

Benefits of the energy transition

Environmental

- Decreased air pollution
- Reduced greenhouse gas emissions
- Protected ecosystems and biodiversity

Economic

- Economic growth
- New employment opportunities
- Localized energy production
- Diverse energy sources
- Increased efficiency

Social

- Better health outcomes
- Lower healthcare costs
- Greater energy security
- Decreased dependence on imported fossil fuels

[7] IEA (2022), *Securing Clean Energy Technology Supply Chains*, IEA, Paris https://www.iea.org/reports/securing-clean-energy-technology-supply-chains, CC BY 4.0
[8] Institute for Energy Economics and Financial Analysis (2023) *India could become the world's second-largest solar photovoltaic manufacturer by 2026*

Clean power is the transition frontrunner with new innovations on the horizon

To date, the power sector has been the primary area of energy transition development, led by renewables and energy storage. Recent jumps in interest rates have affected the growth of capital-intensive renewables, especially wind, but clean power has proven nonetheless resilient[9]. Eurasia Group expects that in 2024, US and European central banks will begin modest monetary loosening, which could help deliver lower project financing costs and abate some of these economic challenges.

The power sector transition will be increasingly dominated by wind and solar power on a utility-scale as well as by a mass rollout of residential rooftop solar power, although the specifics will vary by region. Solar will likely see the biggest capacity gains of any power globally[10], it is cheap and scalable on a retail level – wind could prove slower to be rolled out but will nonetheless be important, especially in areas with less abundant solar resources. A large-scale solar build-out places increasing importance on innovative and creative methods of deployment such as "agrivoltaics" where solar panels are constructed symbiotically with farmland.

As grids become increasingly saturated with variable renewables, energy storage is emerging as the backbone of a decarbonized grid and the next frontier of power investment. Today, the battery energy storage market is dominated by lithium-ion battery technologies that can typically hold four-six hours of energy[11]. However, several new technologies are beginning to be deployed as alternatives—with the added bonus of reducing mineral demand. For similar short-term applications, sodium-ion batteries offer lower material costs and low risks of thermal disruption. For long-duration applications, advances are being made in flow batteries and nickel-hydrogen batteries, which claim 12 hours—if not days—of storage. But beyond electro-chemical batteries, a range of alternatives are emerging like thermal batteries used to produce heat for factory applications, as well as systems such as compressed air, geothermal, and hydrogen storage facilities.

Despite the surging deployment of renewables and batteries, constraints in building necessary transmission and distribution (T&D) infrastructure are limiting RE penetration in many countries and regions. Alongside the use of storage systems to reduce congestion, grids with large quantities of renewables will also require upgrades in more niche technologies such as synchronous condensers, grid-forming inverters, and more advanced monitoring and management systems to help balance increasingly variable loads. New innovations are likely to arise from looming grid constraints.

In addition to technologies, power market structures are being scaled to integrate an increasingly electrified world. Known as Virtual Power Plants (VPPs), utilities are offering agreements to businesses and homeowners for distributed energy systems—rooftop solar, backup battery storage, EV charging, heat pumps and more—to not only use power from the grid but to be a part of it. These market structures already exist in California and Texas as well as parts of Germany and Australia. The US Department of Energy has subsidized VPP software and forecasts that deploying between 80-160 GW of VPPs by 2030 could meet 10%-20% of peak demand[12].

Others are looking to abate T&D constraints by using aging former thermal power plant sites to house new clean power plants,

[9] IEA (2023) Financial headwinds for renewables investors: What's the way forward. IEA, Paris https://www.iea.org/commentaries/financial-headwinds-for-renewables-investors-what-s-the-way-forward, CC BY 4.0
[10] IEA (2023), *The State of Clean Technology Manufacturing*, IEA, Paris https://www.iea.org/reports/the-state-of-clean-technology-manufacturing/analysis - abstract, CC BY 4.0
[11] Argonne National Laboratory (2021), Reshaping the future of the electric grid through low-cost, long-duration discharge battery
[12] US Department of Energy (2023), *Pathways to Commercial Liftoff: Virtual Power Plants*

thereby repurposing existing transmission infrastructure. A Eurasia Group analysis has found that at least 70 projects of this sort are currently underway across the world, with a noticeable trend underway in the US. Many of the analyzed projects involve replacing a geriatric coal facility with battery storage[13]. However, other examples include potentially using the site of a Wyoming coal plant for a small-modular reactor (SMR) and using a New York City natural gas plant as a substation for offshore wind. The success of these various projects could have important implications for the decarbonization pathways of coal-dominated markets including Indonesia, India, and South Africa.

Finally, numerous new technologies that provide clean, flexible power are vying for entrance into the market. Key examples include a possible revival of nuclear power with SMRs and a rise of geothermal technologies that leverage innovation from the shale revolution to tap previously unexploitable resources. The success of these new systems will hinge in part on the economic and technological viability of depth of battery penetration, digital integration, and variable RE rollout.

Electric options will dominate ground transport, with innovations in shipping and air likely through green fuels

Over the past decade, the EV market has moved from a niche industry to a competitive race between nearly every global automaker.

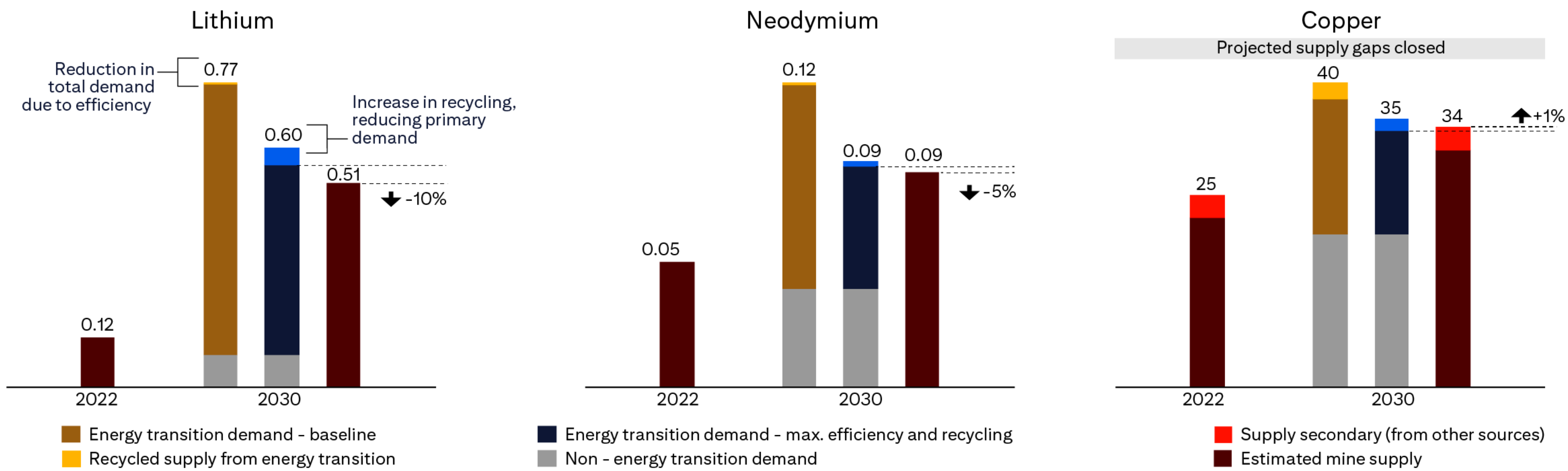
A policy signpost in gauging the potential for EV penetration will be the scale of public charging infrastructure. In certain markets such as the US, EV charging lags significantly behind deployment thresholds seen in China and the EU (as well as other European countries such as Norway, Switzerland, and the UK)[14]. Alongside policies to enhance the widespread deployment of charging infrastructure, innovative charging solutions will be critical. For example, firms are beginning to develop EV charging in commercial parking lots with solar panel covers and starting to integrate charging into urban areas where spatial constraints remain acute.

Raw materials required in EV batteries are another critical signpost, as they are forecasted to experience unprecedented surges in demand. The Energy Transition Commission expects that demand for lithium and graphite—the two most essential battery metals—could grow as much as sevenfold by 2030 from 2022 levels[15]. These supply challenges can be addressed through the expansion of mining projects as well as the rollout of recycling facilities in the very long term. Estimates from KU Leuven and Eurometaux find that modest secondary supplies could be brought online in 2030, but that by 2040, recycling will materially reduce primary demand growth for some battery metals[16]. This significant battery recycling potential can be considered a circular off-ramp toward a more sustainable, closed-loop economy.

New battery technologies are poised to enter the increasingly competitive EV market. The legacy nickel-cobalt batteries are being challenged by a rise in batteries that use iron-phosphate, offering negligible safety risks[17] and the potential to avert the environmental, social, and governance-related risks endemic to nickel and cobalt production in Indonesia and the Democratic Republic of Congo. Today, numerous firms are pioneering advanced battery technologies that boast lower material use and ultra-long drive ranges. Key examples include silicon-based anodes and solid-state

[13] Eurasia Group, *forthcoming.*
[14] IEA (2023), *Global EV Outlook 2023*, IEA, Paris https://www.iea.org/reports/global-ev-outlook-2023, CC BY 4.0
[15] ETC (2023), *Material Requirements for the Energy Transition.* Available at: https://www.energy-transitions.org/publications/material-and-resource-energy-transition/
[16] EuroMetaux and KU Leuven (2022), *Metals for Clean Energy: Pathways to solving Europe's raw Materials challenge*
[17] BloombergNEF (2023), *Lithium-ion Battery Pack Prices Hit Record Low of $139/kWh*

Energy transition metal demand is set to surge



Source: IEA (2023), *World Energy Outlook 2023*, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2023, CC BY 4.0

batteries, widely regarded as a "holy grail" of battery efficiency.

While EVs are poised to dominate the roads in many countries, long-term questions remain about decarbonizing aviation with an array of technologies from hydrogen, biofuels, synthetic fuels, and batteries all fending for competition. Low-carbon methanol and liquid ammonia are emerging as possible solutions to decarbonize maritime shipping, although the long timeline allows opportunities for new technologies to enter into the race.

Decarbonizing heavy industry will rely on new technologies

The last stage of decarbonization will be the so-called "hard to abate" facets of heavy industry activity. In 2022, industrial emissions contributed to slightly more than 29% of total greenhouse gas emissions, led primarily by steel, cement, and chemical production—these three areas are the most notable industrial decarbonization efforts[18].

Pushed by the EU's industrial policy and carbon pricing, green steel manufacturing is rising with a notable emphasis on clean hydrogen being used in blast furnaces to produce high-grade steel products (electric arc furnace growth is more modest but nonetheless important)[19]. China is also

[18] Rhodium Group (2023), *Global Greenhouse Gas Emissions: 1990-2021 and Preliminary 2022 Estimates.*
[19] Vogl, V; Sanchez, F; Torres Morales, E; Gerres, T; Lettow, F; Bhaskar, A; Swalec, C; Mete, G; Åhman, M; Lehne, J; Schenk, S; Witecka, W; Olsson, O; Rootzén, J. 2023, Green Steel Tracker, Version 04/2023, Stockholm, Dataset, www.industrytransition.org/green-steel-tracker/

Steel

- 5% of global CO_2 emissions
- Solutions include already-deployed electric arc furnaces and commercializing hydrogen-based blast furnaces

Chemical

- 4% of global CO_2 emissions
- Solutions include energy efficiency measures and utilizing low-carbon fuels derived from hydrogen

Cement

- 5% of global CO_2 emissions
- Some emissions can be abated from energy efficiency and CCUS, but new processes will be needed to reach net-zero

Note: Figures are from 2021 levels
Source: Rhodium Group

introducing similar policies. The US has also committed strong policy support to using hydrogen in steel production, but these efforts will take time to implement. Despite these movements, coal-based blast furnaces are still being built at record speed, highlighting the future importance of retrofitting legacy blast furnace technology to be hydrogen-ready.

Clean hydrogen-produced ammonia is showing promise as a viable climate solution to natural gas-based fertilizers. Today, green premiums of clean hydrogen production remain a challenge to fuel swapping clean fuels for legacy polluting ones, but over time aggressive subsidy regimes and learning rates for green hydrogen could alter this outlook. Decarbonizing fertilizers is one piece of a multifaceted and complex approach to sustainable food systems, for further reading, please see the report from Citi Global Wealth, Sustainable Investing Spotlight: Planting for Tomorrow.

Decarbonizing cement poses a unique challenge. The widely used material comprises nearly 5% of global carbon emissions[20] and much of the process emissions come from combusting limestone, a process some hope can be abated with CCUS. Alternatively, several firms in Asia, the US, and Europe are looking at chemical innovations to circumvent this energy-intensive process altogether. Some firms are even pioneering technologies that sequester carbon and use it as an input to produce cement. Similar to aviation, the solutions remain distant from widespread commercialization but will be an important sector to monitor in the coming years.

For the industrial sector, energy efficiency efforts play an essential role in further reducing emissions in the near and medium term while new, breakthrough technologies reach commercialization. The recent success of energy efficiency measures in Europe could prove a template for demand reduction; EU industry reduced its gas demand by 15% in 2022 and still managed to avert de-industrial trends[21].

[20] Rhodium Group (2023), *Global Greenhouse Gas Emissions: 1990-2021 and Preliminary 2022 Estimates.*
[21] McWilliams, Ben and Zachmann, Georg (2024), Bruegel, *European natural gas demand tracker*

Hydrocarbons are near their peak but pace of decline will depend on policies

Hydrocarbons remain the backbone of the global energy system. Most forecasters expect oil demand to peak later this decade and then slowly decrease from there[22]. There are several signposts to consider when understanding when hydrocarbons will peak.

In the near and medium term, the rate of electrification of road transport will be the most critical signpost to gauging peak oil demand. These trends were noticeable in 2023 across China where EVs likely surpassed 8 million new car sales[23]—about one-third of China's passenger vehicle market—but the key markets to watch will be the US and Europe. In the long term, key signposts will include the extent that EVs penetrate emerging markets such as India, as well as whether policies or alternative products can curtail oil demand in aviation, shipping, and key industrial sectors including petrochemicals.

The decarbonization of the power sector will cut into coal and natural gas consumption, but the importance of natural gas to flexible power, heating, and industrial sectors makes its phasedown difficult. Key medium-term signposts for the heating sector include the acceleration of heat pump policies, manufacturing, and costs, as well as clean alternatives for district heating such as biomass, geothermal, and so-called "thermal" batteries that convert electricity into heat. In the long term, the extent to which natural gas can be replaced in the power sector will hinge on the development of flexible replacements. For example, batteries could emerge as a challenge to combined-cycle facilities given their ability to perform similar tasks in grid management. Gas turbine makers, meanwhile, hope that clean hydrogen gas can start to be blended with fossil gas and eventually replace it.

Increasing focus has been placed on decarbonizing the value chain of oil and gas production, notably methane that is flared and vented in extraction and leaked during transportation. The IEA has specifically outlined goals of reducing value-chain methane emissions 75% by 2030 as an essential facet of a 1.5-degrees Celsius climate scenario. This agenda has been set on the global stage with the UN-backed Global Methane Pledge that includes 111 countries.

The copper question:

The energy transition will emerge as a new demand driver for critical minerals such as copper—the hyper-conductive base metal required in everything from T&D, EVs, and wind turbines. And regardless of potential breakthroughs in new power generation or battery technology, copper will still be in rising demand, with forecasts suggesting that it could more than double by 2050 from 2020 levels in a net-zero scenario[1]. Meeting this new scale of demand in a smooth and timely manner could be hindered by permitting timelines for copper mines, which are among the longest of all critical minerals, up to an estimated 17 years in some cases[2]. These dynamics risk price spikes, but they also create opportunities to promote more recycling capacity and substitution with steel, silver, aluminum, or other nascent and advanced materials.

[1] International Copper Association (2023) Copper – The Pathway to Net Zero
[2] ETC (2023), Material Requirements for the Energy Transition. Available at: https://www.energy-transitions.org/publications/material-and-resource-energy-transition/

[22] DNV (2023), Energy Transition Outlook 2023; BloombergNEF (2023), Electric Cars Have Dented Fuel Demand. By 2040, They'll Slash It; Rhodium Group (2023), Rhodium Climate Outlook 2023; IEA (2023), IEA (2023), World Energy Outlook 2023, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2023, CC BY 4.0
[23] BloombergNEF (2023), Electrified Transport Market Outlook Q4 2023: Growth Ahead

In addition to government pledges, a group of 50 oil and gas companies—both national and independent—have pledged to reduce value chain emissions as well. Already, some countries are setting policies, such as the US Inflation Reduction Act's methane fee that imposes a penalty on fugitive emissions. These policies will be enhanced and supported by a growing trend of utilizing satellites to monitor methane and pinpoint where emissions are taking place.

Coal demand is expected to peak this decade as usage decreases across the OECD and China while rising in most developing and emerging markets[24]. In the near term, decarbonizing the coal sector could be a challenge given its current importance to energy security in Asia, especially as countries got burned with the 2022 spike in LNG prices. The recent investments in coal assets make early sunsetting financially unpalatable in many cases. These challenges will be most acute in markets such as China, India, Indonesia, Vietnam, and South Africa. In the near term, the success of "brownfielding" projects in the US, EU, Chile, and Australia could dictate how viable these developments will be for emerging markets down the line. In addition, innovations in Japan and South Korea using clean ammonia and hydrogen as a fuel swap could open further potential pathways to repurpose coal assets.

Global trends with local flavors

Although the energy transition is underway, it is taking place at different rates across various sectors and geographical locations. As a result, there will not be a one-size-fits-all approach; yet there will be technological winners that can yield results across a greater range of markets. Conventional fuels remain an essential facet of the energy mix and their peak—let alone wind-down—must be gauged carefully and with attention to relevant signposts. While clean energy alternatives are gaining ground beyond the conventional roster of renewables and EVs that dominate the market today, innovations abound and will prove disruptive.

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"Our general rule of thumb is when there's a gold rush, don't go digging for gold, invest in the makers of the picks and shovels."

Malcom Spittler
Global Investment Strategist
and Senior US Economist
Citi Global Wealth

[24] DNV (2023), Energy Transition Outlook 2023; Rhodium Group (2023), Rhodium Climate Outlook 2023; IEA (2023), IEA (2023), World Energy Outlook 2023, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2023, CC BY 4.0

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Bond credit quality ratings	Rating agencies		
Credit risk	**Moody's[1]**	**Standard and Poor's[2]**	**Fitch Ratings[2]**
Investment Grade			
Highest quality	Aaa	AAA	AAA
High quality (very strong)	Aa	AA	AA
Upper medium grade (Strong)	A	A	A
Medium grade	Baa	BBB	BBB
Not Investment Grade			
Lower medium grade (somewhat speculative)	Ba	BB	BB
Low grade (speculative)	B	B	B
Poor quality (may default)	Caa	CCC	CCC
Most speculative	Ca	CC	CC
No interest being paid or bankruptcy petition filed	C	D	C
In default	C	D	D

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