ESG.
IDENTITY
ASSET
MANAGER
ASSESSMENT

ESG.IAMA WORKING PAPER / 3

ASSET MANAGERS ADVANCING THE TRANSITION

ETGroup
THE ESG KNOWLEDGE COMPANY

ESG.IAMA WORKING PAPER / 3

ASSET MANAGERS ADVANCING THE TRANSITION

EDITED BY ET.GROUP - SEPTEMBER 2025

ET Group
THE ESG KNOWLEDGE COMPANY

INTRODUCTION

Luca Testoni
Founder ET.Group

Transition is increasingly becoming a key word in the world of Esg. Not only because it implies a genuine systemic shift, from the current state of declared unsustainability, to a future state of claimed sustainability. But also, and perhaps above all, because the concept has had a disruptive effect on investment analysis frameworks. The idea of measuring the value of an asset based on its future sustainability (or its future impact on sustainability) has made it necessary to ground such measurements in the credibility of the actors involved. In other words, in the credibility of their future Esg commitments. This marks a profound conceptual evolution, most clearly evidenced by how quickly European Esg transparency regulation has fallen behind: the forthcoming reform of the Sfdr will need to respond, first and foremost, to the market's explicit demand to move beyond the current static approach, towards a dynamic framework that can take proper account of the Transition.
It is, therefore, a complex and multifaceted concept, as is often the case in the realm of Esg phenomena. This working paper offers a snapshot of the variety of approaches and strategies revolving around the principle of Transition. It does so through the testimonies of asset managers who have adopted ESG.IAMA, from whom come reflections on the role of debt, on banks' commitments (and on investing in banks), on the importance of decarbonisation pathways, on opportunities in the infrastructure sector, and on the centrality of critical minerals.
The paper also presents some of the aggregated results from the 2024 assessment on the topic. The message is that asset management companies express a clear ambition to take part in the Transition, but still seem to lack the tools (for example, minimum investment thresholds) and the full capacity to monitor their own activities. There is, without doubt, much work to be done.

Enjoy the reading

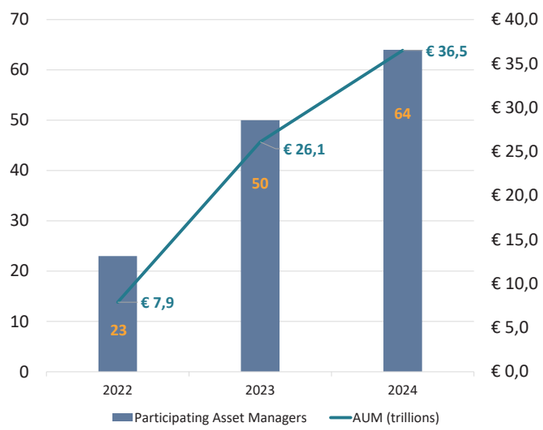
ABOUT US

by ESG.IAMA

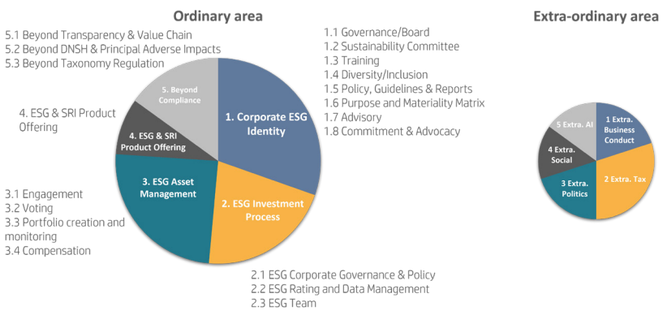
This paper is a spin off of ESG.IAMA (ESG Identity Asset Manager Assessment), now in its fourth edition in 2025. Developed by ET.Group, it is the first international quantitative assessment solution designed to measure the ESG Identity of Asset Managers.
The issue of sustainability is shifting from the product to Asset Managers as companies. ESG Identity is emerging as a crucial variable to enable the system to identify Asset Managers that are truly Esg and consistent with their offerings. This makes it possible to distinguish critically among the tide of "sustainable" products that has filled the market, and to protect against possible risks due to reputational and credibility crises of the Asset Managers to whom capital has been entrusted.
The ESG Identity is the set of distinctive elements of an entity, starting with its governance and ending with the Esg consistency and coherence of its offering to the market, through the ways in which the entity thinks (its Esg corporate culture) and engages on the sustainable front (its Esg purpose).
The ranking of the ESG Identity is assigned through the processing of the scores obtained by the Asset Managers on about more than 500 Kpis in the ESG.IAMA assessment. The methodology is based on the study of best practices and regulations, as well as research and know-how developed by ET.Group in the 10 years of work on the ESG Identity Corporate Index (ESG.ICI). The ESG.IAMA questionnaire methodology is further developed with independent input from the ESG.IAMA Scientific Committee.
The results are presented in the salone.SRI organized by ET.Group, in the Italian Stock Exchange, where also the best Asset Managers are awarded during the ESG Identity Awards ceremony.
This paper gathers the views and forecasts towards the financial risks and value of energy & transition of four Asset Managers participating to ESG.IAMA 2024.

ESG. IDENTITY ASSET MANAGER ASSESSMENT

ESG.IAMA participants



The assessment main areas



SUMMARY

ENERGY & TRANSITION ARE THE FRONTIER

ESG.IAMA asset managers reveal their desire to take action, but do not have investment targets. However, significant AUM figures are emerging

ESG.IAMA primarily assesses the ESG Identity of Asset Managers, considered as corporate entities, by analysing their governance structures, investment processes, and asset management activities. In the 2024 edition, however, the scope was expanded to include questions on their specific focus on the Transition, with particular attention to their commitment to a Just Transition and to Enabling and Transitional investments:

- Just Transition refers to ensuring that no people is left behind, or negatively impacted, in the transition to a low-carbon and sustainable future;

- Enabling activities are those that directly enable other activities to make a substantial contribution to an environmental objective;

- Transitional activities are those for which low-carbon alternatives are not yet available and among others have greenhouse gas emission levels corresponding to the best performance.

JUST TRANSITION

When asked in a multiple-choice question whether they had attended any events or working groups focused on Just Transition during 2023, half of the respondents answered positively: 46.88% participated in expert-led events or working tables on the topic, while a further 6.25% organised such initiatives themselves.

ENABLING AND TRANSITIONAL MINIMUM AND AUM

Regarding the existence of self-imposed minimum-investment thresholds for Enabling or Transitional activities (as a share of total assets under management, AUM), all respondents stated that they had set no such thresholds. This suggests that the question remains at the frontier of current practice, even for the most ESG-committed Asset Managers.

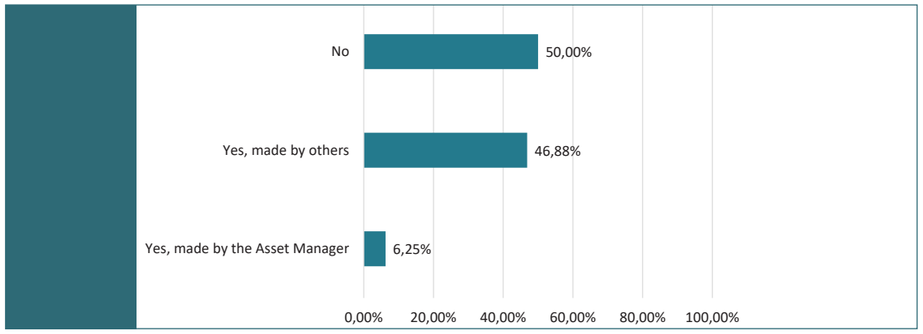
Asked about their actual AUM, as of 31 March 2024, it shows that 15.63% of respondents had Enabling activities representing between 1% and 25% of their total AUM, while 14.06% had Transitional activities in the same range. Notably, one particularly committed Asset Manager (1.56% of the sample) reported Transitional activities accounting for between 51% and 75% of its AUM.

TRANSPARENT EET

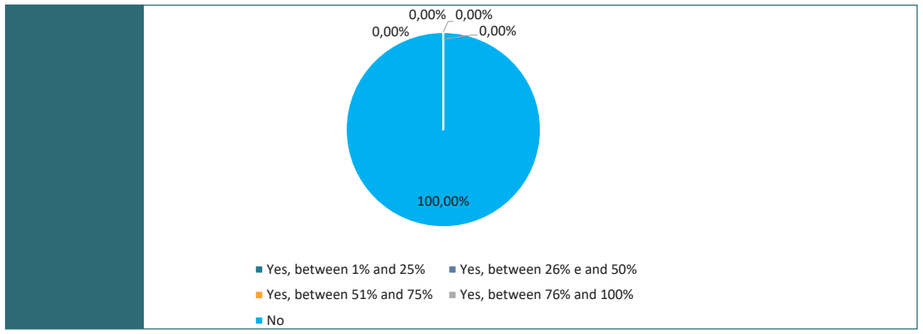
Finally, when asked whether they disclose, within the European ESG Template (EET), the percentage of investments in Enabling and Transitional activities for each of their EU funds, 48.44% did so for Enabling activities, with 18.75% making their EET publicly available. For Transitional activities, 46.87% provided the data in the EET, again with 18.75% sharing it publicly.

The data of the 2025 edition of the assessment will be available after November 2025.

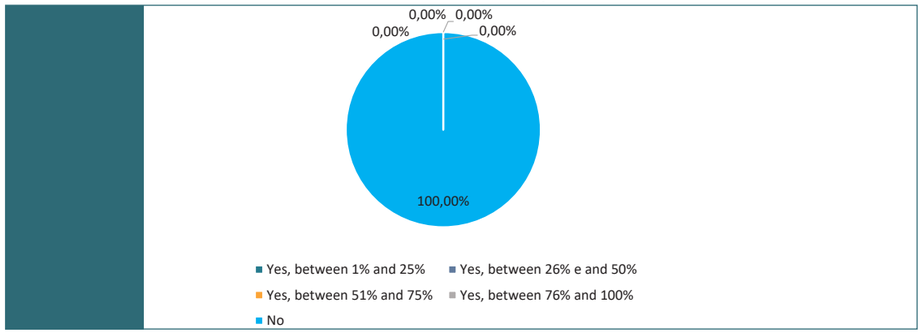
Did the Asset Manager attend any events/working tables with a focus on the Just Transition during 2023?



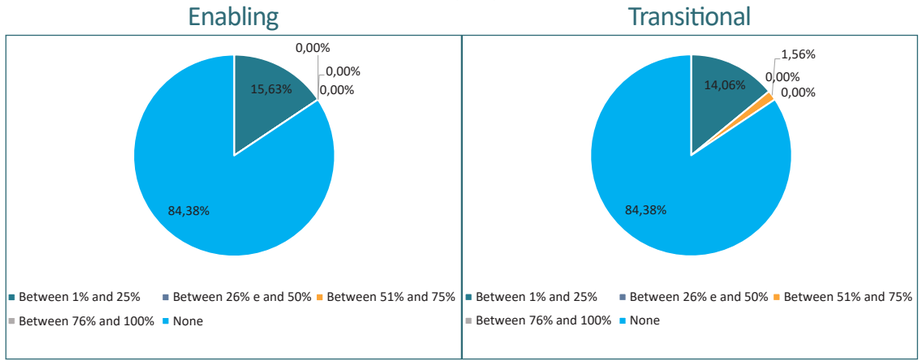
Did the Asset Manager decide an Enabling activities minimum-investment threshold compared to the whole assets under management (not only specific to the sustainable asset)?



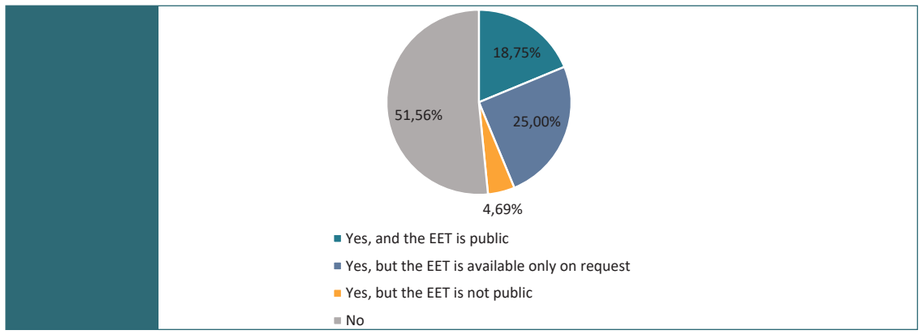
Did the Asset Manager decide a Transitional activities minimum-investment threshold compared to the whole assets under management (not only specific to the sustainable asset)?



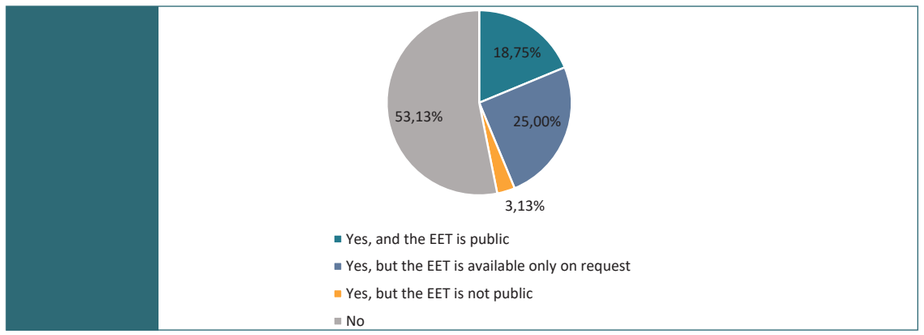
In respect to all the assets under management internationally, indicate the percentages of investments classifiable as Enabling and as Transitional activities, as for 03/31/2024



Does the Asset Manager explicit the percentage of investments in Enabling activities of each of its UE funds in the EET (European ESG Template)?



Does the Asset Manager explicit the percentage of investments in Transitional activities of each of its UE funds in the EET (European ESG Template)?



WHY ESG DEBT WILL KEEP POWERING THE ENERGY TRANSITION

According to a recent study by Bloomberg NEF, global energy transition investments exceeded USD 2.1 trillion in 2024, reflecting an 11% increase from the previous year. While this marks a significant milestone, it also represents a slowdown from the 25%+ annual growth rates seen in prior years. The key question remains: is this level of investment sufficient?

Various reports indicate that capital flows must double or even quadruple by 2030 to prevent critical climate tipping points. Beyond that, sustained capital inflows will be essential to achieving a low-carbon economy.

A TWO-SPEED TRANSITION IS EMERGING

A two-speed transition is becoming increasingly apparent. Most investments continue to flow into mature technologies such as electrified transport, renewable energy, and power grids, while emerging solutions – including hydrogen, clean shipping, and carbon capture and storage – have attracted only 7% of total investments.

The most cited barriers to scaling these emerging technologies are technological complexity and economic viability, both of which will likely require targeted public policy incentives to overcome. Without stronger policy support, these newer technologies may struggle to attract the level of capital needed to scale effectively.

WHO IS FUNDING THE ENERGY TRANSITION?

A significant portion of energy transition investments has been financed through ESG debt markets, with green bonds serving as the flagship category of sustainable finance. These instruments have been crucial in directing capital toward climate-focused projects, but why are they considered essential for achieving a low-carbon economy?

A purpose-driven market with significant growth potential

Green and ESG bonds are specifically designed to finance projects with environmental and sustainability benefits, allowing investors to align their capital with measurable impact. While annual issuance in 2024 has already exceeded USD 1 trillion, there is considerable room for expansion, especially given that the global fixed income market exceeds USD 15 trillion.

With the substantial investment required for the energy transition, both mature and emerging technologies can qualify for green bond financing. Mature sectors, in particular, are well-suited for bond financing due to their predictable cash flows, making them attractive to investors with low-risk appetites and/or long investment horizons.

No significant performance trade-off

There is currently no statistically significant difference in secondary market performance between green bonds and traditional bonds. While sectoral and credit quality biases exist at the index level, actively managed portfolios can effectively overcome and benefit from these challenges.

A recent Barclays study confirmed that investors view the green bond market as high quality but noted that the willingness to pay a premium remains limited to a few basis points – a relatively small margin, particularly in higher interest rate environments. As the market continues to expand, further growth and diversification are expected to enhance its resilience and attractiveness.

THE RISE OF GREENHUSHING

Will policy push issuers and investors away?

While some concerns exist that regulatory shifts could deter issuers and investors from the ESG debt market, we remain confident that it will continue to thrive. Although headline risks around climate investment have increased, the underlying economics remain solid, ensuring that capital will continue to flow.

Financial markets may struggle to price climate risks on a daily basis, and novel climate technologies might require public support to scale. However, this should not slow down the energy transition, nor should it prevent fixed-income markets from playing a central role in funding the shift at a market-based cost of capital.

We have observed a growing reluctance among issuers to publicly disclose their climate initiatives. This trend, known as “greenhushing,” refers to a scenario where companies remain committed to climate action but are less vocal about their efforts.

While this decline in transparency is not ideal, we believe that discreet, yet effective capital deployment is preferable to high-profile pledges with little meaningful follow-through. However, this shift also means that investors will need to conduct deeper financial analysis and engage more actively to identify the true and credible “green gems” in the market.

Despite slowing investment growth and increased policy uncertainty, ESG debt markets remain a fundamental pillar of climate finance. Green bonds continue to demonstrate strong market credibility, and while issuers may adopt a lower-profile approach, the capital needed for the energy transition is still flowing. Investors who take a proactive approach, looking beyond headlines and engaging directly with companies, will be best positioned to capitalise on the next phase of the transition.

Ronald Van Steenweghen
Fixed Income Fund manager DPAM

HOW EUROPEAN BANKS ARE SUPERCHARGING THE ENERGY TRANSITION

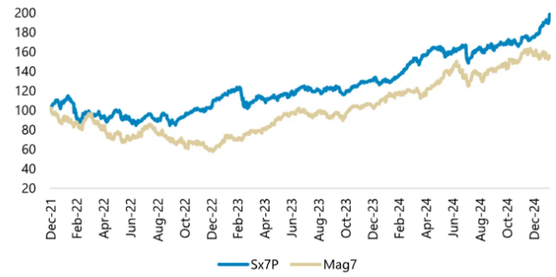
We previously highlighted the conundrum of European value stocks, particularly banks, trading near their lowest valuations despite boasting their strongest fundamentals in over two decades. Despite continued outperformance, there remains significant potential for a valuation catch-up as investors reassess banks’ strategic role in the energy transition. Over past few years, European value stocks have re-emerged as a compelling investment opportunity, with financials leading the charge. Beyond their strong performance, banks

are essential enablers of Europe's energy transition, leveraging their financial strength to mobilise capital for sustainable initiatives. The sector surged by 26% in 2024, marking its best performance since 2021. Over the past three years (2022-2024), the value investing style in Europe has demonstrated significant outperformance, reinforcing its appeal to investors. Meanwhile, European banks have experienced even longer-term outperformance, benefiting from various tailwinds. The Banks Index has more than doubled in value since early 2022, outpacing the approximately 90% return of the "Magnificent Seven" U.S. tech giants over the same period. Interestingly, the strong Q2 2025 earnings season has reinforced the outperformance trend, driven by continued muted loan loss provisions alongside robust lending and deposit growth.. Despite these gains, European banks remain relatively attractively valued, with one of the lowest price-to-earnings ratios among European sectors and a total cash return yield approaching 10%.

As a cherry on the cake, the results of the German elections, the possible French elections later this year and a potential ceasefire in Ukraine could drive a surge in lending demand. These developments make European value stocks, particularly financials, an essential component of a well-balanced investment portfolio.

Banks stand out due to their large balance sheets, which serve as a critical lever for both economic growth and the financing of Europe's energy transition. As public sector resources face increasing fiscal constraints, private financial institutions are playing a central role in mobilising capital for sustainable investments. By supporting banks with strong green financing strategies, shareholders are not only positioning themselves for solid returns but also ensuring that capital is effectively allocated to drive the transition to a low-carbon economy.

EU banks have outperformed MAG7 in recent years



Source: Jefferies, Factset - In Total Return*

source: Jefferies, Factset, 2025

Looking into 2025, several key drivers have been a source of upside to 2025 profit outlook for the sector:

1. Interest rates: rather than collapsing as pessimists feared, central bank rates in Europe have declined gradually and deliberately, providing relief to banks' revenue outlook. At the same time, the steepening of the European yield curve has supported banks' net interest income outlook, mitigating the negative impact to net interest margin from declining rates.

2. The recovery of lending and deposit volume growth: across most geographies, lending volumes are picking up, as the confidence of economic agents increases, a trend likely to continue, supported among other by the new German coalition's fiscal plans

3. Capital efficiency: after years of exclusively prioritising allocation of capital towards cash return to shareholders, with the sector valuation multiple now no more on the lows, an increasing number of banks are redeploying capital towards value creating M&A transactions (think of Santander's sale of its profitable Polish business at a fair price to fund the Sabadell UK acquisition).

Despite the bounce in valuation multiples from the lows, European banks remain relatively undervalued relative to historical levels and their U.S. counterparts. This presents an opportunity for investors seeking exposure to financials with strong earnings momentum and a key role in financing Europe's long-term growth initiatives.

Beyond financial performance, European banks are at the forefront of sustainable finance, delivering attractive returns for investors while also funding projects that benefit businesses, policymakers, and society by accelerating the transition to a low-carbon economy. Their ability to deploy capital at scale is essential for addressing Europe's green transition needs. With government budgets constrained, banks' lending capacity is crucial for financing renewable energy projects, green infrastructure, and sustainable innovation.

BNP Paribas exemplifies how financial institutions can build a competitive advantage through sustainability. The bank has developed a comprehensive Green Bond Framework to mobilise capital markets for energy transition solutions. It integrates Environmental, Social, and Governance (ESG) criteria into its financing and investment decisions, aligning with global climate objectives and responding to growing investor demand for sustainable investments. In 2021, BNP Paribas was the world's second-largest green bond player, acting as a joint bookrunner for EUR 22 billion in green bonds. This highlights how European banks are driving sustainability.

While banks are pivotal in financing the energy transition, they must operate within a framework of proper governance. Investors have a vital role in ensuring that financial institutions maintain a commitment to responsible lending and long-term sustainability goals.

Active engagement is necessary to:

- Monitor banks' alignment with net-zero commitments.
- Ensure transparency in green finance allocations.
- Advocate for policies that balance profitability with sustainable impact.

This oversight is particularly important in the current political climate, where shifts in government policies, such as populist movements reminiscent of former U.S. President Donald Trump's withdrawal from the Paris Agreement, could impact long-term climate strategies. Investors must remain engaged to sustain the momentum of Europe's green transition, ensuring that banks continue to play their essential role without deviating from ESG commitments.

The European banking sector presents a compelling opportunity for investors seeking exposure to value stocks with strong financial and strategic sustainability potential. Banks are benefiting not only from macroeconomic tailwinds, such as rising interest rates and operational efficiencies, but also from their role as key facilitators of Europe's energy transition.

For investors, allocating capital to European financials offers a dual advantage: exposure to a sector with strong earnings growth and reasonable valuations, while simultaneously fostering sustainability by financing the transition to a low-carbon economy. However, ensuring that banks remain committed to responsible lending and green finance requires active investor engagement. By monitoring governance and sustainability initiatives, shareholders can play a decisive role in aligning financial performance with long-term climate objectives.

To maximise their role in both financial growth and the energy transition, banks must maintain strong governance. Investors can play a critical role in holding banks accountable, ensuring that their lending practices balance profitability with long-term sustainability goals that benefit all stakeholders, shareholders, businesses, policymakers, and communities alike.

As European banks continue to evolve as both economic drivers and sustainability enablers, now is the time for investors to take notice. The opportunity remains ripe for both financial returns and for shaping a more sustainable future through strategic investment.

Laurent Van Tuyckom
Fund manager DPAM

THE GLOBAL ENERGY BALANCING ACT

by Pgim

Global energy conditions remain mercurial amid policy shifts in the U.S., U.K. and Europe. Growing demand, driven by digitalisation, electrification and urbanisation, highlights the need for cleaner solutions while making net-zero goals harder to achieve. Bolstering renewable energy resources is critical, but facilitating the progress needed for long-term success requires a more comprehensive approach. Experts from Jennison Associates discuss the megatrend in detail, including pragmatic ideas for reducing carbon and expanding investment opportunities beyond traditional decarbonisation targets.

How the changing energy landscape is driving the need to prioritise decarbonisation

The global energy landscape is transforming, driven by rising power demands, rapid technological advancements (e.g. artificial intelligence and soaring data centre needs), and a shift toward cleaner energy solutions. Geopolitical dynamics and energy security concerns are pushing nations to prioritise reliability, sustainability and independence. In this context, decarbonisation and strategic energy planning are critical to addressing environmental and security challenges. The transition to renewable energy sources like wind, solar and hydropower is accelerating to meet growing energy needs while cutting emissions. Governments and businesses are heavily investing in energy storage, grid modernisation, and efficiency technologies to ensure a sustainable and reliable energy supply. Policies promoting carbon neutrality, alongside innovations like electric vehicles and digital energy management tools, are advancing decarbonisation. Yet, renewables face challenges such as intermittent energy generation and insufficient infrastructure. As a result, traditional energy sources such as natural gas and nuclear power remain vital for stability and complementing renewables. Energy security concerns are driving nations to diversify imports and boost domestic renewable production to reduce reliance on volatile global markets. In 2024, global investments in energy transition technologies exceeded $2 trillion, an 11% increase from the previous year. This underscores the growing urgency among governments and businesses to adopt sustainable energy solutions. As the transition progresses, the combined influence of innovation, infrastructure and policy will define the future of global energy systems.

The impacts on decarbonisation efforts

The current macroeconomic landscape presents both challenges and opportunities for decarbonisation. Lower interest rates make borrowing cheaper, supporting new energy projects. However, rising inflation, recession risks, and policy uncertainty keep companies cautious about spending. Despite these challenges, the energy transition continues driving major investments from corporations, supported by strong cash flows

ALIGNING DECARBONISATION AMBITIONS WITH REALITY

DIVERSE DEMAND DRIVERS

SHIFTS IN SUPPLY MIX

across most sectors. Political changes add complexity, as shifts in climate policies, taxes and regulations could either speed up or slow down progress. Deregulation and tax cuts might boost corporate spending but could hinder progress in climate-focused industries, highlighting the balance among policy, economics, and energy goals. Interestingly, policy shifts could benefit traditional energy and natural gas companies, reshaping the competitive landscape. As companies navigate these uncertainties, the interplay among policy, economics and decarbonisation will shape the future of energy investment.

Key investment themes for 2025 and beyond

We are in the midst of a major global energy crisis. Upended by global supply issues that have led to rising energy costs at a time of soaring demand is creating energy deficits around the world and driving an increased need for sustainable solutions. We see several pivotal investment themes emerging driven by shifting market dynamics, technological advancements, and evolving consumer behavior. These themes are centred around demand, supply and enabling factors shaping opportunities across industries and influencing where capital is being allocated for maximum impact.

The world's energy needs are growing rapidly due to several interconnected factors. Surging demand is putting unprecedented pressure on current energy systems and highlighting the urgent need for cleaner, more sustainable solutions.

Urbanisation: population growth and economic development are fueling urbanisation at an accelerated pace. As industries expand and new technologies emerge, demand for reliable and efficient energy continues to rise. While grid expansions over the past decade have significantly reduced energy poverty, nearly 10% of the global population still lacks access to electricity. Though progress is being made, current efforts fall short of meeting the Sustainable Development Goal 7 (SDG7) target of achieving universal access to affordable, reliable and modern energy by 2030.

Digitalisation: the rapid adoption of AI and other advanced technologies is reshaping the global economy, but it comes at a cost: immense computing power requirements. AI systems and data centres demand uninterrupted energy supply, accentuating the importance of grid modernisation and resilience. In the U.S. alone, there is an estimated 15GW energy deficit, underscoring the need for a diversified, multi-faceted approach to energy production. The accelerating growth of digital systems adds a layer of complexity to the challenge of meeting rising energy demands sustainably.

Electrification: the shift to electrification is a key driver of rising energy demand. From electric vehicles transforming transportation to the electrification of heating, the growing reliance on electricity is straining power grids. This trend is fuelled by global efforts to cut carbon emissions, boost energy efficiency, and move away from fossil fuels. Meeting this demand sustainably will require major investments in renewable energy, storage and infrastructure upgrades.

Transitioning to renewable energy is vital for a sustainable future, but several challenges hinder its widespread adoption. A key issue is the intermittent nature of renewables like solar and wind due to their propensity for reduced output during unfavorable conditions. This is worsened by storage limitations that can't yet handle high demand. Addressing these issues often requires advanced technologies and systems to stabilise capacity, which can degrade efficiency. Another major barrier is the high upfront cost of renewable infrastructure, such as solar panels or wind farms. This is especially challenging for lower-income nations, making large-scale adoption difficult. While renewables are expected to dominate the energy mix in the future, current limitations highlight the need to rely on traditional and transitional fuels as we move toward full sustainability.

Factors driving the renewed interest in nuclear energy

The AI race is speeding up, and tech giants are scrambling to secure reliable power

for their growing computational needs. As AI demands enormous energy, traditional energy markets remain constrained, while renewables face scalability and reliability challenges. This has pushed companies such as Amazon and Microsoft to explore nuclear energy as a key solution. Nuclear energy offers a strong case for powering the AI revolution. Unlike fossil fuels, it produces zero carbon emissions during operation, aligning with corporate climate goals and government regulations. It also provides consistent, reliable energy, unlike solar and wind, which depend on weather. Recognising this potential, companies are investing billions into revitalising nuclear plants and nextgeneration technologies. Small modular reactors (SMRs) and government incentives are addressing past challenges such as high costs, safety risks, and waste management. These smaller, cost-effective reactors come with enhanced safety features. Supportive policies and favourable market conditions are driving investments to modernise nuclear infrastructure and integrate SMRs into power grids.

INNOVATIVE ENABLERS

As the global focus on sustainability and carbon reduction intensifies, companies across industries are stepping up with innovative solutions to reduce emissions and promote energy efficiency. To mention an example, one standout leader in this push is Trane Technologies. This company specialises in temperature-controlled transport, HVAC, and smart thermostat systems for both commercial and residential applications. The company is actively reimagining supply chains to deliver energy-efficient products that help customers lower their carbon footprints. Trane has set an ambitious goal of reducing one gigaton of carbon emissions from its customers' footprints by 2030. Impressively, in 2024, 40% of the company's revenue was classified as "clean," driven by efforts to replace outdated, inefficient refrigerants and decrease downstream emissions. Trane's strong sales growth outlook is fuelled by rising demand for its energy-efficient heating, ventilation and air-conditioning (HVAC) solutions, as businesses and consumers increasingly prioritise sustainability. By integrating circularity into its supply chain, Trane is reducing waste, further enhancing its role as a leader in the shift toward a greener, more energy-conscious future.

HOLISTIC, EVOLVING STRATEGY

The journey to decarbonisation began with ambitious goals of rapidly transitioning to a low-carbon economy, powered by wind and solar energy. Early successes with these technologies fueled optimism for achieving global climate targets quickly. However, the transition has proven more complex and slower than expected due to infrastructure challenges, policy hurdles, and the need for significant investments. Fossil fuels still dominate the global energy mix, highlighting the scale of the challenge. While coal use has declined, natural gas has grown as a cleaner alternative and key bridge fuel during the transition. This reflects the gradual pace of the energy shift as renewables scale up to meet demand. In addition to wind and solar, emerging technologies like carbon capture and hydrogen are beginning to address critical gaps. While still in early stages, these innovations are expected to grow and become commercially viable as markets develop. Looking ahead, these technologies will drive the next phase of decarbonisation, offering investors balanced, long-term growth opportunities in the push toward a low-carbon future.

The importance of a holistic view to decarbonization

Decarbonisation is a multi-trillion-dollar effort that goes far beyond electric vehicles and renewables. While many focus narrowly on reducing operational emissions, Jennison emphasises the need to consider avoided emissions and overlooked solutions, such as carbon capture, hydrogen, and grid upgrades. These sectors provide untapped opportunities for investors as they play critical roles in making industries and supply chains more sustainable. By adopting a broader view, investors can access a richer and more diverse array of growth opportunities. We believe it's important to start with the broadest opportunity set and analyse return potential from the bottom up to optimise alpha potential.

The energy transition is a multi-decade evolution requiring a holistic "all-of-the-above" approach. This means combining immediate pathways to decarbonisation, like renewables and energy efficiency, with transitional elements such as natural gas and nuclear energy that bridge the gap between old and new energy systems. Companies that blend innovation with operational scale, including those in sectors like copper and manufacturing, will lead this transformation.

Neil Brown, CFA, Managing Director Portfolio Manager Global Natural Resources
Bobby Edemeka, Managing Director Portfolio Manager Infrastructure/Utilities
Jay Saunders, Managing Director Portfolio Manager Global Natural Resources and Portfolio Manager of the PGIM Jennison Carbon Solutions Fund

ENERGY TRANSITION INFRASTRUCTURE: THREE KEY AREAS OF OPPORTUNITY

by Schroders

Why we believe mid-market platforms, data centre hyperscalers and other renewable power demand drivers, and emerging technologies such as green hydrogen will be valuable additions to energy transition infrastructure portfolios.

NAVIGATING THE ENERGY TRANSITION

Energy transition investments play a key role in the broader infrastructure landscape, with renewable energy alone accounting for between 50% and 60% of all completed transactions consistently since 2018, and in aggregate half of total infrastructure deal volume over the past 15 years. Global investment in energy transition infrastructure has been increasing exponentially over the past five years, reaching €2 trillion in 2024. And the demand for capital to support the drive to a low-carbon global economy is only growing, with $28 trillion of investment implied over the next three decades under current government policies worldwide – and a need to invest more than double that to meet the target of reaching net zero by 2050 (see charts).

All of this speaks to a vast investment need and a very broad and deep universe. This then begs the question; where within this universe might an investor concentrate their capital in order to most effectively capture the performance and portfolio resilience potential of the global energy transition?

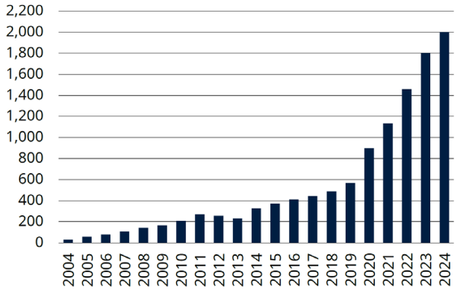
Evolution, not revolution

From a top-down perspective, we see the investment need across the energy transition continuing to translate to a wide range of investment opportunities that can meet the needs of investors across the full spectrum of risk-return appetite. These include everything from core renewable energy assets that have become a fixture of the infrastructure investment and energy provision landscape, to the growing array of emerging adjacent and climate technologies.

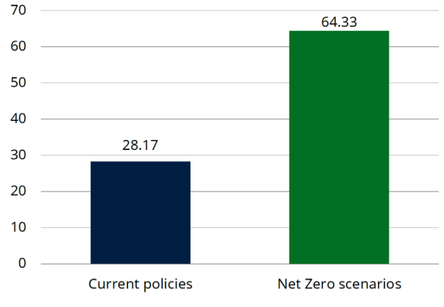
This also speaks to a landscape that is constantly evolving. While the direction of travel is generally accepted, the path to realise the global energy transition is likely to be anything but a straight line. Navigating that path – and identifying and then executing on the opportunities it creates – will require specialist skills, understanding and expertise. Our belief and experience is that this specialism will both help to manage risks and, importantly, drive potential portfolio outperformance.

As we move into the next phase of the energy transition, there are several emerging areas that we believe offer compelling access points to maximise the future return opportunities across this dynamic and rapidly-evolving sector.

Global annual investment in energy transition infrastructure over the last 20 years ($ billions)



Global energy investment and spending 2024 to 2050, current policies and NZS ($ trillions)



Sources: BloombergNEF, Energy Transition Investment Trends 2025, and BloombergNEF, 2024.

SCALING FOR GROWTH: FOCUS ON LOWER AND MID-MARKET PLATFORMS

In this paper we bring together the views of three of our segment leaders across Schroders Greencoat to highlight these three complementary and specialist opportunities around which we have especially high conviction within energy transition infrastructure, a sector in which we are a recognised pioneer and on which have maintained a dedicated focus for over 15 years. These are:

1) Lower and mid-market developer and platform investments that suffer from a shortage of growth capital, and which can be scaled through both organic expansion and strategic acquisitions.

2) Driving market growth of green hydrogen to support the development of this key fuel, as well as of nascent derived technologies.

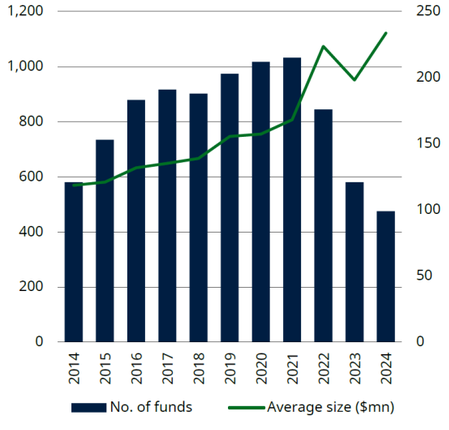
3) Leveraging broader energy transition and power expertise to enable and grow new renewable energy demand drivers, including for example data centre hyperscalers.

One of the key trends we have observed over the longer term across the infrastructure market is one of increasing scale. Put simply, over a prolonged period there have been more funds raising capital for infrastructure – and, at the same time, a smaller number of the largest funds have been getting larger.

A decade ago in 2014, 121 infrastructure funds raised a collective $64 billion, equating to an average fund size of $569 million, according to data from Preqin. In contrast, in each of the three years between 2020 and 2022 more than 200 funds were raised.

Aggregate fundraising has dropped materially since 2023. This has been a challenging period for capital raising across private markets more broadly amid a rising interest rate environment. However, the size of the biggest funds continued to grow, with the largest raising upwards of $25 billion[1], meaning despite the smaller number of funds being raised, average fund size reached a new record $1.12 billion in 2024 (see chart).

Number of infrastructure funds raised and average fund size globally, 2014–2024



Source: Schroders Greencoat, Preqin, February 2025.

The 'missing middle'

One of the key consequences of this trend is the obvious reality that larger funds must, in turn, seek out larger deals in which to deploy their investors' capital.

This plays into another widely-observed dynamic in energy transition infrastructure in particular that some have referred to as the 'missing middle'[2]. This describes the dual trends of more capital from larger infrastructure funds flowing into low-risk, very large-scale, operational renewables assets; while at the same time capital from venture funds is flowing into start-up climate technology companies at the other end of the risk and scale spectrum.

In between are mid-market energy transition infrastructure opportunities that lack the scale to command the attention of mega-funds.

Schroders Greencoat has been playing this theme for some time.

Mid-market platform opportunities

A compelling way to take advantage of this dynamic is investing in earlier-stage and lower or mid-market assets as 'platform' investments. These opportunities range from developers of renewable energy with the potential to expand from a domestic to regional or global footprint, to developers of adjacent energy transition technologies with potential to ramp up projects aggressively.

Investment 'success' is achieved through scaling the platform, through both organic expansion developing and building new assets, as well as strategic bolt-on acquisitions of other operational assets. The end game is a wide array of exit options, ranging from a sale to larger infrastructure funds for which these platforms have reached a viable scale, to strategic purchases by global energy companies, or public listing.

Identifying premium via earlier-stage investments and platform growth

Green hydrogen

- Platform investment targeting the development of 500MW green hydrogen
- Mature green hydrogen projects, among first projects under UK CFD, totalling 55MW beginning construction in late 2024

EV infrastructure

- Platform investment to develop ultra-fast charging stations in the Netherlands – targeting 1,000 stations by 2030
- Charging stations across the Netherlands, France, UK, Belgium, Germany, Switzerland and Denmark

Solar and battery

- Partnership with a leading solar and battery developer targeting >400MW net capacity
- Acquiring earlier stage solar and battery storage assets; now focused on creating a platform arrangement

District heating

- Largest single platform of district heating assets in the UK; 12 existing networks with 433 MWth heat capacity
- Acquired platform with pipeline; finance new projects and decarbonise existing networks

Wind developer

- Platform acquisition of an Italian developer and operator of renewable energy
- Active in Italy, France and Spain with 1.4GW pipeline
- Initial €50m growth capital and co-development of solar and wind projects

Source: Schroders Greencoat, 2024. Projects have been selected as the types of transactions the strategy would focus on. Projects shown are for illustrative purposes and may not be reflective of the actual investments held in the portfolio. There is no guarantee similar investments will be available in the future.

In terms of the specific characteristics we look for, we favour businesses with some operational assets to deliver baseline income, and with a proven track record in single or multiple markets of not only development, but also construction and operations.

Given development often exposes investments to technology or geography risks, we also believe diversification is important in a portfolio. In our experience this is best achieved through partnerships with technology or geography-specific specialists, leading to a development strategy being best employed by an energy transition specialist with the relationships and broad energy market understanding needed to be successful.

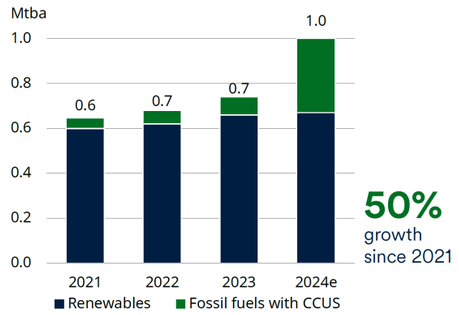
For investors, a relative lack of competition for dealflow – in fact, many deals in this space are negotiated on a bilateral basis with segment specialists – should support comparatively attractive transaction economics and robust underwritten returns.

Green shoots have begun to appear in the market for green hydrogen – that is, hydrogen that is produced from water using renewable energy-powered electrolysis – in particular driven by increasing government support and targeted regulatory initiatives around the world.

The International Energy Agency (IEA) estimates that low-emissions hydrogen production has risen by than 50% since 2021, with all of that growth attributable to renewables-powered green hydrogen. Meanwhile, installed electrolyser capacity to produce green hydrogen was expected to reach 5.2GW last year, a 9x increase from 2021 and a threefold increase year on year (see charts).

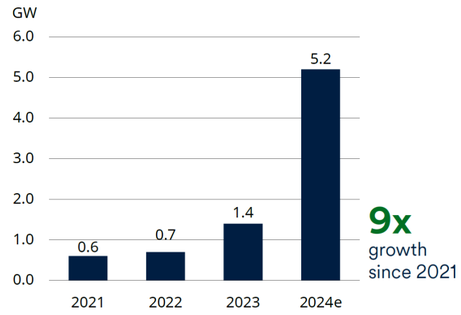
FUELS OF THE FUTURE: ENABLING DECARBONISATION OF HARD-TO-ABATE SECTORS

Low-emissions hydrogen



50% growth since 2021

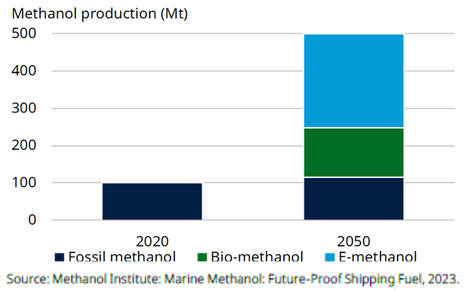
Electroyser installed capacity



9x growth since 2021

Source: International Energy Agency, October 2024.

Forecasted methanol market by production pathway, million tonnes



Source: Methanol Institute: Marine Methanol: Future-Proof Shipping Fuel, 2023.

A wide range of government financial support has been committed globally over the past year, with around $25 billion in subsidies and other funding announced to support projects in the UK, across Europe – and even in the US, relating to projects to deliver hydrogen projects at three of the largest ports in California.

Of course, the green hydrogen market has had a previous 'false dawn' at the turn of the decade, when investment boomed on the back of excitement of the potential for this no-emissions fuel but actual projects experienced delays or failed to materialise, which ultimately undermined investor confidence.

The difference this time around is that the specialist investors active in this space, and the governments that are now delivering promised support, are much more focused on actual end use-cases. This means projects are being linked more directly to specific demand, which is expected to grow as the energy transition gathers pace.

Linking projects to demand

Among those use cases is the deployment of hydrogen to support the decarbonisation of key industrial sectors, which otherwise have hard-to-abate carbon emissions.

An example is the use of green hydrogen as an input to chemical processes and refineries, particularly when that is displacing grey hydrogen (produced from fossil fuels such as natural gas) where it's used today, such as in fertiliser production, or where it is a new pathway to producing an existing product, such as in the direct reduced iron process for steelmaking.

There are important regulatory imperatives here, too. For example, in Europe the third Renewable Energy Directive (RED III) includes a binding target for 42.5% of the hydrogen used in industry (mainly refineries) to be produced from renewable sources by 2030, with this requirement increasing to 60% by 2035.

Refineries, which are the largest industrial users of hydrogen, are thus in a hurry to use clean hydrogen and have made the biggest final investment decisions (FID) on projects to date. For example, BP, Shell, TotalEnergies and EWE reached FID in 2024 on major green hydrogen projects accounting for more than 1,000MW of capacity.

Green hydrogen is also deployed in industry through derived, synthetic e-fuels that are produced by combining hydrogen with biomass or recycled carbon molecules. These include e-ammonia, which is used as a fuel for shipping and in fertiliser production, or e-diesel, used in heavy road transportation. But the e-fuel with the greatest early momentum is e-methanol, which is also used as a fuel for shipping and as an input in the plastics and chemicals sectors.

The methanol market is expected to grow significantly from the current c.100 million tonnes p.a. in 2020 to around 500 million tonnes p.a. in 2050, with three-quarters of future production being met by e-methanol and bio-methanol, which is produced from green hydrogen and biomass. The installed capacity for renewable methanol is expected to grow rapidly (see charts) – and prices for these fuels are currently around double that of fossil fuel-derived methanol.

Investment need – and opportunity

Overall, to achieve the necessary expansion in the clean hydrogen market and meet global net zero targets, an estimated additional investment of roughly $150 billion will be required through 2030. Capital is needed to support the expansion of production capacity, as well as into projects that enable its end uses, such as those outlined above in hard-toabate industrial sectors, and so unlock the fuel's full decarbonisation potential.

This creates significant opportunities for specialist investors. Notably, expansion in green

hydrogen will also support demand for renewable energy capacity more broadly, given the symbiotic relationship between renewable generation and green hydrogen production. So, it is a good time to be invested across the energy transition spectrum.

While much of the discussion around the energy transition initially focused on how to expand renewable energy generation, the equally important next step in the journey is enabling demand drivers that will utilise the green electrons generated from renewable sources. Specifically, this relates to supporting and expanding new energy transition technologies that are driving the electrification of various sectors across the economy.

Key examples include:

- The heating of homes and businesses through heat pumps and district heating networks;

- Electrification of transport though electric vehicles requiring charging infrastructure;

- Delivering powered land for data centres hyperscalers; and

- Building out new grid infrastructure to facilitate the transmission of green electrons, such as interconnectors, transmission and distribution networks.

Taking the example of heat pumps and district heating networks, the market for these solutions is expected to grow by more than 15% per year by 2030. Even faster expansion, and investment, will be required in future to meet targets implied within current net zero assumptions. In fact, to reach current policy targets by 2040 requires annualised investment of $54 billion until 2030, increasing to $128 billion thereafter.

Elsewhere, data centres are an already rapidly expanding sector that is driving huge growth in energy demand – and billions of dollars are being invested in new hyperscale data centre capacity globally to meet voracious and growing appetite for data. Most notably, the 'Magnificent Seven' – the large technology groups that now dominate the S&P 500 – have committed as much as $325 billion[3] to build new artificial intelligence infrastructure, including new data centres, in 2025.

The International Energy Agency (IEA) estimates that the share of global electricity demand coming from data centres is predicted to double from 2022 levels by 2026, equivalent to Germany's entire power needs.

Importantly, the relationship between data centres and energy grids, and renewable energy in particular, will not simply be a one-way street. We believe that the data centre sector will play a more engaged role with renewable energy assets in the future, through more co-location of data centres with renewable assets, as well as using data centre energy assets as a way to support local grid networks.

Specifically, we believe that data centre storage assets will work to support the grid when there is a shortage of clean power, while being able to store excess renewable electricity in times of increased generation. Increasingly, it will be important to understand not just the data centre market but to also understand the energy markets, including grids and generation assets.

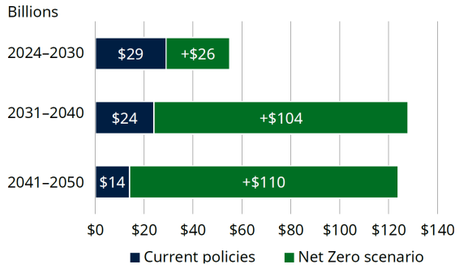
Energy demand vs. decarbonisation

This growth in power demand is coming at a time when there is fresh scrutiny on the role of renewable energy in the power mix, especially in the US under Trump 2.0.

The first thing to note here is that this build out of solutions is happening globally – even in direct relation to the data centres being funded by big US tech companies, but

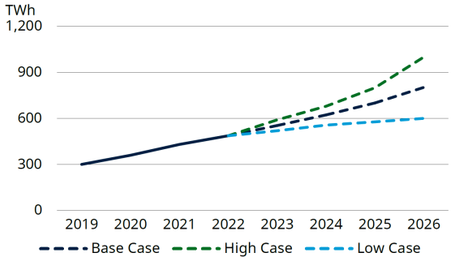
POWERING DEMAND: CATALYSING THE ELECTRIFICATION OF THE ECONOMY

Required global annualised heat investment, 2024–2050

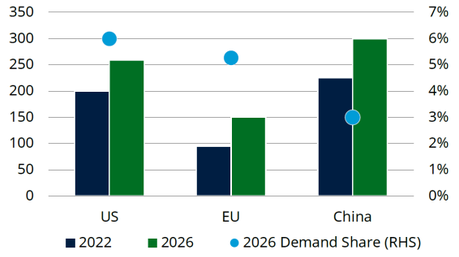


Source: BloombergNEF, 2024.

Global electricity demand for data centres, AI and cryptocurrencies



Datacentre IT electricity consumption and share projections



Sources: IEA, JLL, Schroders Capital, June 2024.

which are located in every region around the world. Across many jurisdictions, there is a continuing – and growing – need to link data centre build out with renewable energy to power them, to reduce pressure on wider energy grids or the drag effect on future net zero targets.

More broadly, renewable energy generation such as wind, solar and battery storage is in many places now extremely cost competitive with traditional energy and so, utility providers, even in the US, will continue to rely on these sources to meet growing demand.

Finally, there is the fundamental reality that companies are not likely to abandon their commitment to all their stakeholders – employees, customers, and shareholders in the US and abroad – to make their operations sustainable. This is especially the case for technology companies, since many of their users are among younger generations for whom climate issues are a more pressing priority.

From commitment to reality

Investment opportunities for energy transition infrastructure providers lie in direct investments in the assets and technologies themselves, sourcing and providing powered land for data centres hyperscalers, as well as in leveraging the demand for power to underpin the value of existing renewable energy assets. As an example of the latter in practice, in April 2024 data centre operator Keppel DC REIT signed a 10-year power purchase agreement (PPA) covering the entire output of the Ballybane wind farm in County Cork, Ireland.

But understanding that there is a huge need for investment – and so opportunities to gain exposure to the expansion of – these power demand technologies, as well as in the renewable energy and storage technologies needed to power them, is one thing; being able to deliver on the promise to grow them is another. As noted above, getting new developments off the ground often means being able to directly provide and guarantee renewable energy to power them.

Success in these sub-sectors is therefore about more than just recognising the need for capital. Investors also need to be able to directly connect sites, often through co-location, with renewable power. They also need to navigate jurisdictional complexities to secure fast access to power grids, effectively utilise power storage solutions to ensure consistency of power, and negotiate PPAs to provide cost certainty, to name but a few attributes.

In short, specialism is key. This is where we believe we are well positioned, with the ability to leverage our decade-and-a-half of experience in owning, operating and developing renewable energy assets globally, as well as strong relationships both with developers and regulators, and deep expertise across the broader energy transition.

[1] *https://www.ft.com/content/766b702e-acdf-4e71-ab9e-664e30611e83.*
[2] *https://www.infrastructureinvestor.com/is-the-missing-middle-missing-common-ground/.*
[3] *https://finance.yahoo.com/news/big-tech-set-to-invest-325-billion-this-year-as-hefty-ai-bills-come-under-scrutiny-182329236.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZnQuY29tLw&guce_referrer_sig=AQAAAElflUU1hrsL6Kvdpvux mQjvWsPuIU1QK25fLCTH7uq69DXRUj2rm5kzVA3nUmNpdKM8raDHwfDxjsgFfBDiL95Y5JegpSlxnxkrzHaKulbQa8iqXUyD7_lXplmmkThjNwMKMZZEFrd77IrQtpGdWmumU8Ypw0qpNeIJDWMwMSjh.*
[4] *https://www.datacenterdynamics.com/en/news/keppel-dc-reit-signs-wind-energy-ppa-with-greencoat-renewables-in-ireland/.*

Minal Patel, Partner, Global Head of Infrastructure
Lee Moscovitch, Partner
James Samworth, Partner
Paul O'Donnell, Partner

CRITICAL MINERALS: THE BASIS FOR THE ENERGY TRANSITION

The global market for critical minerals is growing rapidly, driven largely by the introduction of new technologies to generate clean and renewable energy. Examples include solar power, wind power and batteries for electric vehicles (EVs).

This development means that the underlying minerals are becoming more important - both in terms of decarbonising the economy and for those countries that do not have their own resources. It is not surprising that the International Energy Agency's (IEA) forecasts[1] suggest that demand for these minerals, which are crucial for the transition to a more sustainable economy, could rise sharply.

This is also important from the perspective of sustainable investing. Therefore, the challenge for investors, companies and governments is likely to be to reconcile supply with this growing demand. Furthermore, it will be important to diversify geographically and ensure the environmentally responsible mining of these minerals.

This can be seen in the example of copper (see Section 3), which is of paramount importance in the decarbonisation of the economy.

The topic of critical minerals at a glance

The shift towards renewable energy, electrification and a circular economy is directly linked to the demand for critical minerals. As this transition accelerates, the market for critical minerals also experiences signi ficant growth. The following drivers are having an impact:

- The unprecedented expansion of markets for critical minerals is driven by the widespread adoption of clean energy technologies and electrification. These include solar power, onshore and offshore wind power and EV batteries.

- Secondary supply, including recycling, already plays an important role for some critical minerals. This secondary supply is likely to increase further due to supply bottlenecks, sustainability efforts and rising demand from industry. This will also support the transition to a circular economy.

- The availability of critical minerals is likely to have a significant influence on the pace of the energy transition. The supply dynamics of these minerals are expected to play a key role in how quickly and cost-ef ficiently the global economy can switch to renewable energy sources.

- States are actively striving to expand their commodity sources. This are doing so, for example, through a number of legislative measures such as the European Union's (EU) Critical Minerals Act. These measures aim to reduce dependence on individual sources and at the same time increase security of supply.

- It is crucial to analyse the capacity of future resources to meet the rapid increase in demand due to climate action initiatives. While some critical minerals, such as copper, present difficulties in this respect, others, such as lithium, are more readily available. In summary, we believe that critical minerals are a key factor in the energy transition. In the spirit of sustainability, responsible mining is important to counteract negative social and environmental impacts. Comprehensive ESG integration in the investment process can address these concerns.

1 CRITICAL MINERALS AS THE BASIS FOR THE ENERGY TRANSITION.

The decarbonisation of the economy aims to bring about the transition from "brown" fossil fuels to "green" renewable energy sources such as sun, wind, water and geothermal heat. The aim is to reduce greenhouse gas emissions and slow down climate change. Also pursued by governments, this transition relies on critical minerals, as they provide the basis for low-emission technologies and products.

At the same time, pressure on these resources is also increasing elsewhere. This is due to growing prosperity and economic growth, the advancement of digital technologies and increasing demand from developing countries.

The demand for these minerals used varies depending on the technology. Lithium, nickel, cobalt, manganese and graphite, for example, are crucial for battery performance. Rare earths are used for the construction of permanent magnets in wind turbines and electric motors.

And for the power grids large amounts of aluminium and copper are required, the latter being the cornerstone of all technologies related to electricity (see focus on copper, Section 3). A selection of the most important minerals for the energy transition is shown in the chart below:

Figure 1: Use of critical minerals for the energy transition.

	Copper	Aluminium	Nickel	Zinc	Manganese	Tin	Lithium	Cobalt	Graphite	Rare earths	Silicon	Silver	Platinum-group metals	Steel	Chromium
Electric vehicles (EVs)															
Electrical networks (e.g. wiring, cables)	●	●				●						○			
Electric motors (e.g. wiring, magnets)	●					○				●		○			
EV batteries	●	●	●	○	●	●	●	●	●	●		○			
Autonomous vehicles (e.g. sensors, circuits, semiconductors)	○					●					●				
On-board computers (e.g. semiconductors)						●					●				
Vehicles (e.g. battery and engine housings, castings)		●			●									●	
Power generation															
Offshore wind power	●	○	○	●	○					●		○		●	●
Onshore wind power	●	○	○	●	○					●		○		●	●
Solar power (photovoltaic, PV)	●	●	○	○		●					●	●		○	
Concentrated solar power (CSP)	○	●	○	●		●					●			○	●
Water power	○	○	○	●											●
Biomass	●	○	○	●										○	○
Geothermal energy	○	○	●	○										○	●
Nuclear energy	○	○	○	○										●	●
Hydrogen/natural gas	●	○	●							●			●	●	
Energy infrastructure															
Charging infrastructure (e.g. charging connections, power cabling, transformers)	●	●		●		●						○		●	
Grid infrastructure and electrical components	●			●		○						○		●	
Energy transmission and lines	●	●		●		●						○		●	
Energy storage systems (ESSs)	●	●	●	○	●	●	●	●	●	●		○			
Further information															
Share of clean technologies in total demand by 2023/24	30%	15–20%	15–20%	5–10%	5–10%	5–10%	60%	30–40%	30–40%	20–25%	30–35%	20–25%	20–30%	5–10%	10–15%
Share of clean technologies in total demand by 2030E	40–45%	40–50%	40–50%	20–25%	20–25%	15–20%	80–90%	50–60%	60–65%	35–42%	60–70%	30–40%	30–35%	10–15%	20–25%
Share of secondary supply in total demand by 2023/24	30–33% (Recycling: 17–18%)	23–31%	33–34% (Recycling: 1–2%)	12–14%	<1%	15%	3%	10–11%	5–7%	20–25%	10–15%	15–17%	42–47% (Recycling: 18%)	28–29%	10–15%
Share of secondary supply in total demand by 2030E	32–36% (Recycling: 18–19%)	26–37%	37% (Recycling: 2–4%)	13–14%	2–3%	22%	5–10%	12–15%	10–15%	25–30%	20–25%	17–25%	49–53% (Recycling: 19%)	35–38%	15–20%
Major mining countries	Chile DRC Peru	Australia China Guinea	Indonesia Philippines New Caledonia	China Peru Australia	South Africa Gabon Australia	China Indonesia Myanmar	Australia China Chile	DRC Indonesia Russia	China Mozambique Madagascar	China Myanmar Australia	China USA Brazil	Mexico China Peru	South Africa Russia Zimbabwe	Australia Brazil China	South Africa Kazakhstan Turkey
Main refining countries	China	China	Indonesia	China	China	China	China	China	China	China	China	China	South Africa	China	China

Three scenarios in the fight against climate change

The IEA's forecasts are sobering. For example, the available amount of minerals required for clean energy technologies, such as copper, nickel, graphite, lithium, manganese and cobalt, would have to more than double in order to implement the Stated Policies Scenario (STEPS) or Announced Pledges Scenario (APS) expected in the fight against climate change. The STEPS scenario aims to give a sense of the prevailing direction of development in energy systems, based on a detailed review of the current political landscape. APS assumes that governments will fully or partially deliver on the promises made today. Here, the IEA forecasts a moderate increase in global temperature by 1.7°C by the year 2100.

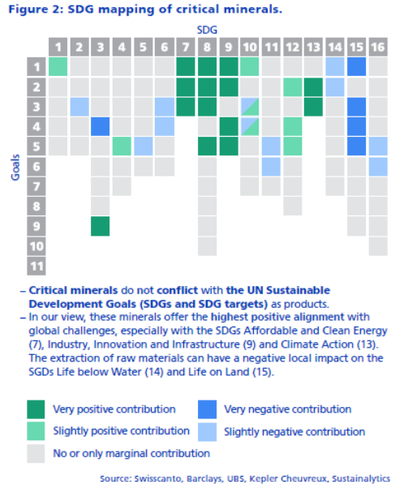
Achieving the Net Zero Emissions (NZE) target by 2030 – the IEA's most ambitious scenario – would even require tripling critical minerals. Measured against global economic growth, this may not seem particularly astronomical at first glance. However, it would mean that demand for these minerals would increase by around 12-19% each year until 2030. This surge in demand is likely to intensify global competition for resources and possibly lead to a shift where dependence on critical minerals reaches the degree of oil today.

The transition from fossil fuels to clean energy sources will likely depend heavily on critical minerals. As a result, these minerals also play a key role in achieving the Sustainable Development Goals (SDGs) set by the United Nations.

For example, critical minerals are expected to be crucial to address global challenges such as the transition from fossil to renewable energy or to accomplish electri fication and industrial innovation. They can also promote clean energy, economic growth and job creation. As a result, critical minerals contribute to achieving several SDGs and the assigned targets (see Figure 2). However, if their local extraction and processing is not done responsibly, critical minerals may cause a variety of problems. In mining, for example, there is a danger of pollution and disruption to ecosystems. Waste, excavation and polluted seepage water, as well as deforestation, deserti fication, loss of biological productivity and abandoned sites frustrate progress towards some SDGs.

2 DECISIVE CONTRIBUTION TO THE SDGS.

Figure 2: SDG mapping of critical minerals.



– **Critical minerals** do not **conflict** with **the UN Sustainable Development Goals (SDGs and SDG targets)** as products.
– In our view, these minerals offer the **highest positive alignment** with global challenges, especially with the SDGs Affordable and Clean Energy (7), Industry, Innovation and Infrastructure (9) and Climate Action (13). The extraction of raw materials can have a negative local impact on the SGDs Life below Water (14) and Life on Land (15).

Source: Swisscanto, Barclays, UBS, Kepler Cheuvreux, Sustainalytics

Figure 3: Positive contributions to SDGs predominate.

– Critical minerals are the **backbone** of the **energy transition** and enable the transition to **renewable energy** (e.g. wind and solar), electric vehicles and **infrastructure** (e.g. grids, transmission and charging).
– **These minerals** enable **optimal alignment** with global challenges, especially with SDGs in the following areas: Affordable and Clean Energy (7), Industry, Innovation and Infrastructure (9), and Climate Action (13).
– However, **local mining activities** may have a **negative** impact on SDGs for Life below Water (14) and Life on Land (15).

Source: Swisscanto, IEA

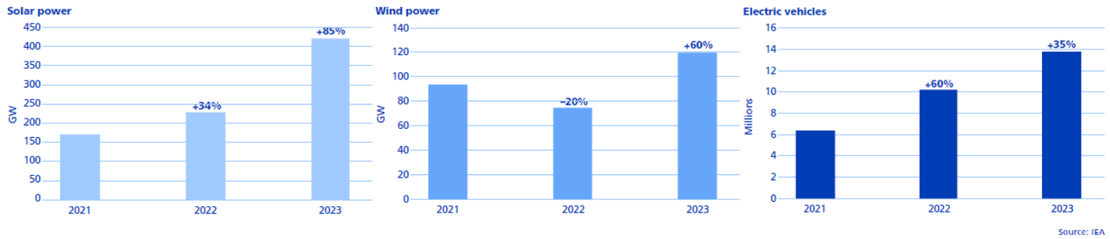
As the comparison (see Figure 3) shows, the positive contributions generally outweigh the negative impacts. All things considered, critical minerals are able to support the SDGs. In our view, SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure) and SDG 13 (Climate Action) are actually closely aligned. On the other hand, local mining can be detrimental to SDG 14 (Life below Water) and SDG 15 (Life on Land). Where quantitative criteria are in alignment, a holistic ESG integration is always conducted at company level. Only companies that demonstrate a positive approach to environmental, social and governance aspects are selected.

3 THE INVESTMENT THEME AND ITS MAIN DRIVERS.

3.1 The vision of a net zero world depends on critical minerals

The rapid adoption of new technologies for the production of clean and renewable energy – such as solar power, onshore and offshore wind power – is leading to unprecedented demand for critical minerals, according to the IEA. For example, in 2023, the use of clean energy technologies reached an unprecedented level with annual growth of 85% in photovoltaics, 60% in wind turbines and 35% in EVs. Western developed countries and China continue to lead the way in the use of renewable energy, while most developing countries are still lagging behind.

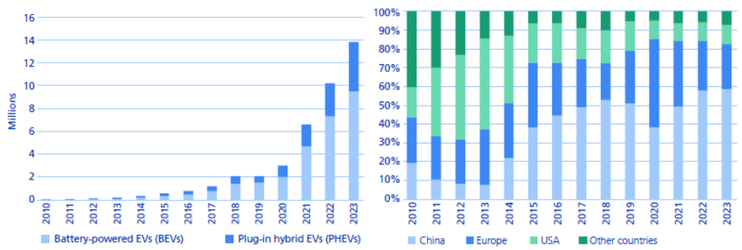
Figure 4: Annual capacity expansion for clean energy technologies (in gigawatts, GW).



Source: IEA

The EV industry has also experienced enormous growth over the last five years. Sales already reached almost 14 million units worldwide in 2023. This represents growth of 35% compared to the previous year. Also in 2023, the share of EV sales in total automotive sales climbed to 18%. Five years earlier, the EV share was just 2%. China, Europe and the USA accounted for around 95% of total sales, with China still proving to be the most important sales market (approx. 60%).

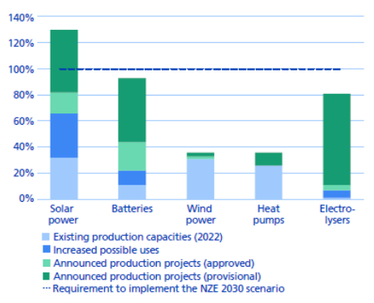
Figure 5: Worldwide EV sales (in units).



Source: IEA

The IEA, on the other hand, notes that the current and announced production capacities for PV and EV batteries are sufficient to meet the expected demand by 2030 even under the ambitious NZE scenario. At the same time, the market is tending to anticipate the STEPS or APS scenarios. However, there is a significant NZE capacity shortfall for heat pumps and wind turbines.

Figure 6: Where there are potential capacity shortfalls according to the NZE scenario.



Source: IEA

3.2 "Clean" alternatives require more critical minerals.

Demand for these minerals will increase rapidly in all scenarios forecast by the IEA. As can be seen, photovoltaic systems, wind farms and electric vehicles generally require more critical minerals than competing products powered by fossil fuels.

For example, the construction of a typical electric vehicle requires six times more critical minerals than a conventional one, and 13 times more of these materials are used than in a gas power plant of comparable size. It is no coincidence that the average quantity of critical minerals required for a new unit of power generation capacity has increased by 50% since 2010.

The figure on the right shows that copper is the essential ingredient used in many of these applications applications (see also Figure 1 above), and particularly in power grids, renewables and EVs. In second place are materials that are used directly in batteries, such as graphite, nickel, manganese, cobalt and lithium. In turn, manganese, nickel and zinc are used to produce alloys for renewable energies such as photovoltaics and wind power, while silicon is the most important semiconductor material for solar cells and wafers. The magnets in electric vehicle engines and wind turbines are mainly made of neodymium, an important rare earth metal (REE).

Although the increased demand may not seem excessive at first glance, the demand for these materials is likely to increase significantly between 2023 and 2030. For example, according to the STEPS and APS scenarios, the supply of copper would have to increase by 8 to 10% annually by 2030 in order to meet the material demand for clean energy technologies. However, in the past, copper production has only increased by around 2 to 3% annually, in line with global growth in gross domestic product (GDP).

3.3 Availability of critical minerals sets the pace of the energy transition

The pace and costs of the energy transition will depend heavily on the availability of critical minerals in the future. The way in which these resources are supplied is also likely to determine the success of this paradigm shift.

The historical price behaviour of these minerals shows that they are highly volatile and subject to cycles. Shortterm supply problems can lead to record prices, while high prices in turn have a normalising effect. This is because they allow unprofitable mines to suddenly generate a return again. This creates incentives to better exploit existing mines or commission new ones. As a result, the supply increases. As soon as this exceeds demand, prices fall. Although the reality of these price fluctuations is far more nuanced, supply and demand are the main factors in the pricing of minerals.

Projections for scenarios up to 2035 may seem distant, and they are certainly not set in stone. But what about supply and demand today and in 2035?

According to the IEA, it is very likely that the metals copper, lithium and nickel will be undersupplied in all three scenarios by 2035. In contrast, there seems to be a slightly greater balance between supply and demand for rare earth metals and graphite. The above three metals are considered to be undersupplied in the NZE scenario.

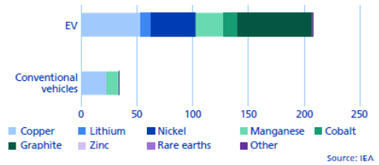
The only metal currently traded in deficit is copper. The remaining metals have either a slight or a high surplus.

At first glance, this indicates limited potential. But it is important to remember that commodities move in cycles. In other words: lower prices usually trigger a supply reaction that drives prices up again.

Focus on copper

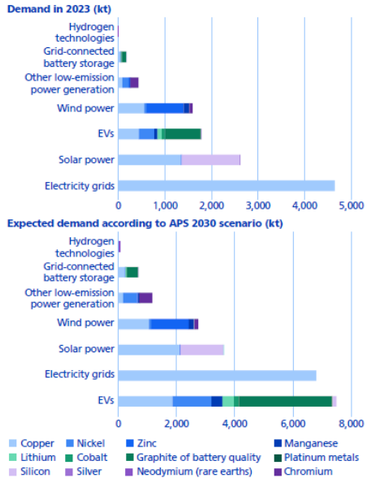
According to the IEA's scenarios, the market expects a worsening shortage of copper.

Figure 7: Consumption of critical raw materials in EV construction compared to conventional vehicles (in kg).



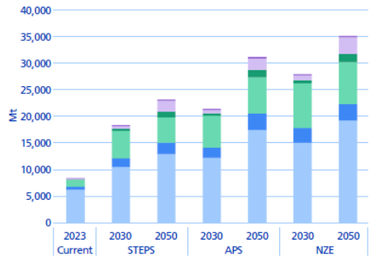
Source: IEA

Figure 8: Use of critical minerals for clean energy technologies (in kt).



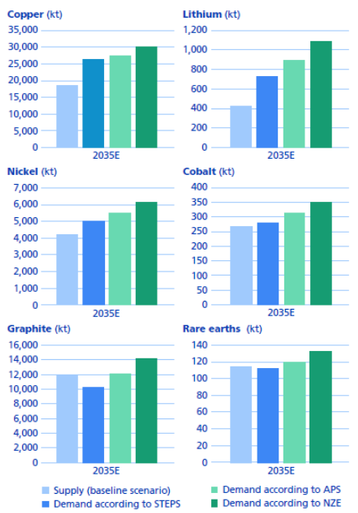
Source: IEA; note: this includes a subset of minerals, but excludes aluminium and steel.

Figure 9: Demand for critical minerals for clean energy technologies according to IEA scenarios (in mt).



Source: IEA; note: this includes a subset of minerals, but excludes aluminium and steel.

Figure 10: Equilibrium of supply and demand by 2035 (in kilotonnes, kt).



Source: IEA; note: the IEA does not create scenarios for aluminium.

It is interesting to note that the market is currently pricing in a scenario that is more in line with STEPS than NZE. This suggests that market participants tend to expect global temperatures to rise by 2°C by 2050. However, it is also conceivable that the market strongly underestimates the probability of achieving the 1.5°C target according to the NZE scenario.

Figure 11: The equilibrium for copper.

Sources: Swisscanto, IEA and various brokers; note: unit in kilotonnes (1,000 metric tonnes).

Regardless of the IEA's scenarios, copper is expected to move towards structural deficit. The following drivers are expected here in the short and long term:

- Structural lack of investment (long-term effect): Exploration activity has declined significantly over the last 10 years. It usually takes about 10 to 15 years from initial discovery to extraction. There are only a few profitable projects; most new major projects are not expected to start until the 2030s.

- Decreasing content (long-term effect): The average content of copper ore has decreased significantly since the last century. Nowadays, the average is below 1%. The consequences are clear: lower contents require higher input costs to extract the same amount of copper.

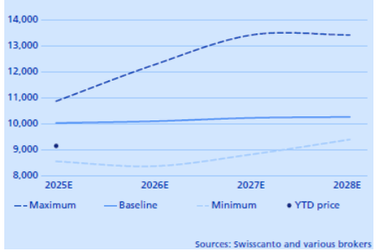
- Strong demand as a result of the energy transition (long-term effect): The transition to clean and renewable energy is driving demand for copper. EVs require three times as much copper as vehicles with combustion engines. Energy infrastructure, transmission, grid capacity and solar cells also contribute to this demand.

- Supply interruptions (short-term effect): In regions with high copper deposits such as Latin America and Central Africa, some states are not particularly stable in political or economic terms. Supply interruptions are therefore not uncommon. Examples include strikes in Peru and Chile or the closure of the largest copper mine in Panama in 2023.

- Low visible stock levels (short-term effect): For example, inventories for 2025 are developing similarly to 2022. In the first quarter, they were characterised by an increase in demand due to replenishments, which is particularly common in China. However, compared to the last five years, stock levels are still lower than before the coronavirus pandemic.

- Speculation (short-term effect): In January 2025, for example, speculators significantly increased their positions compared to the previous month, resulting in the largest monthly net increase since January 2022. Short-term demand for copper remains robust, mainly due to stable infrastructure projects in China. In addition, demand is supported by a reduced production forecast from mining companies and a very tense contract market.

Figure 12: Price forecast for copper (in USD per metric tonne).



Sources: Swisscanto and various brokers

3.4 Closing the loop: the important role of secondary supply and recycling.

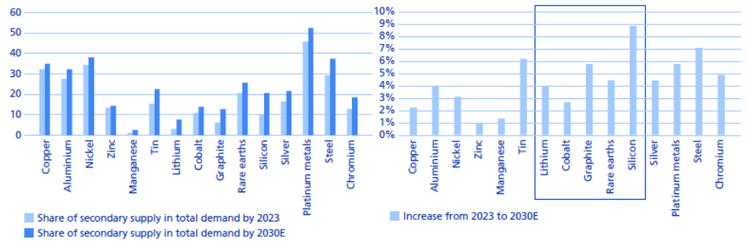
The secondary supply of critical minerals is expected to increase due to supply bottlenecks, sustainability efforts and rising industrial demand. The following terms are required to understand the topic of secondary supply[2]:

- Secondary material is a broad term for materials that have previously been used in one or more products and are returned to the supply chain. These materials can come from various sources: such as from production waste, by-products or recycled material from end-of-life products or applications. The secondary materials are collected and processed in the production of new products. This helps to reduce the need for newly extracted primary material.

- Recycled material is understood as a subset of secondary material; this refers to those substances that are collected, processed and converted into new materials. Typically, they go through a recycling process that includes sorting, cleaning and reprocessing. The quality of recycled materials can sometimes be lower than that of primary materials. However, technological advances have continued to improve the quality of recycled materials.

The secondary supply of copper, for example, is currently relatively high, but is only expected to increase slightly by 2030 due to its use in durable products such as electrical networks and buildings. However, an increase is expected when the first major wave of EVs reaches the end of its life cycle; from this point onwards, secondary supply becomes crucial as growth in primary supply is limited (see above: focus on copper). Similar mechanisms apply to the EV base materials lithium, cobalt, graphite, rare earths and silicon.

Figure 13: Share of secondary supply and expected increase.



Sources: Swisscanto, IEA, UBS, BofA, DB, GS, CRU

For aluminium, secondary supply could increase more as the industry strives to reduce its CO2 footprint due to high energy consumption in primary production. The secondary supply of nickel is expected to increase due to battery recycling. The secondary supply of zinc remains low and only minimal changes are expected, despite some recycling of steel dust. Manganese, on the other hand, is hardly reused due to the abundance of primary resources, making recycling economically impractical. In contrast, increased recycling efforts are being made to meet demand for the currently relatively scarce metal tin, the most important material for soldering.

The secondary supply of silver is expected to increase due to its high value and scarcity. Despite their scarcity, the secondary supply of platinum metals will probably only increase slightly due to the di fficult demand situation. The secondary supply of steel could increase sharply due to the proliferation of EAF/DRI processes, particularly in Europe and Asia, whereas the USA already has high EAF penetration. The relatively high secondary supply of chromium is due to its signi ficant use in stainless steel production, where significant recycling efforts are also undertaken.

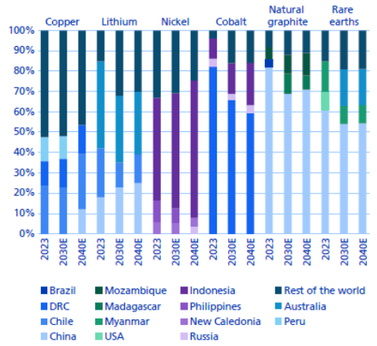
3.5 Problematic resource dependence on a few countries.

Geographical constraints have a significant impact on commodity procurement, as resources are often concentrated in few regions. This limits importing countries' ability to diversify their supply chains. The distribution of commodity deposits varies by commodity, with some resources being more geographically diversified than others. For example, at first glance, copper extraction is relatively widely scattered across the globe. However, a closer look shows that Chile alone accounts for more than 20% of supply.

In contrast, nickel and cobalt are much less distributed geographically. Indonesia supplies around 50% of the world's nickel, while the Democratic Republic of the Congo (DRC) produces around 60% of the world's cobalt supply. Similarly, natural graphite and rare earths are highly concentrated, with China controlling 80% of natural graphite and 60% of rare earth production.

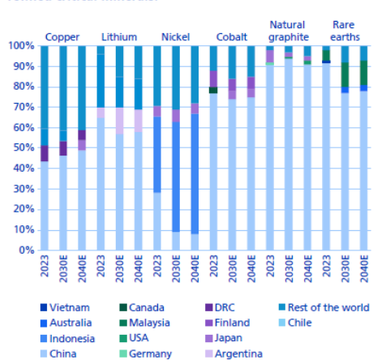
This concentration of supply creates vulnerabilities in global supply chains, making them vulnerable to geopolitical and economic disruptions. As a result, strategic planning and international cooperation are essential from the perspective of the stakeholders involved in order to manage the inherent risks and ensure stable supply.

Figure 14: Geographical distribution of the production of mined critical minerals.



Source: IEA

Figure 15: Geographical distribution of the production of refined critical minerals.



Source: IEA

On the processing side, concentration is even more pronounced, with China dominating the global landscape (see Figure 15). In an effort to gain strategic access to minerals, the People's Republic has aggressively invested in upstream and downstream facilities in Africa and Latin America.

According to the IEA, Chinese companies invested around USD 4.3 billion in the acquisition of lithium deposits between 2018 and 2021, twice as much as US, Australian and Canadian companies combined. This makes China not only the world's largest consumer of many minerals, but also the leading refinery operator.

The need for a sustainable and secure supply of critical minerals has driven governments around the world to act. Notable initiatives include the EU's Critical Raw Materials Act (CRM), the USA's Inflation Reduction Act (IRA), Australia's Critical Minerals Strategy and Canada's Critical Minerals Strategy.

On the other hand, some countries have imposed restrictions on the import and export of these raw materials. For example, resource-rich countries such as Indonesia, Namibia and Zimbabwe have banned the export of unprocessed mineral ore. These restrictions aim to promote value creation in the respective country and to control resource management.

4 CRITICAL MINERALS – ALSO INTERESTING FROM AN INVESTOR'S PERSPECTIVE.

Investing in companies operating in the critical minerals sector, for example through investment funds, can be interesting for the following reasons, especially in times of supply constraints:

- Strong demand growth: As clean energy technologies are promoted globally, the demand for critical minerals grows. This creates significant growth potential for investments in sectors that mine, refine and supply these materials.

- Supply bottlenecks: Supply deficits can drive up prices for these minerals. Limited supply due to geopolitical tensions, new environmental protection regulations or technical challenges in mining and processing can lead to higher raw material prices. This benefits the holders of these assets.

- Hedging against inflation: Critical minerals can be used as a hedge against inflation. In times of high inflation, the value of tangible assets tends to rise, which can protect the real value of capital.

- Sovereign support and regulation: Many governments support the transition to clean and renewable energy sources through subsidies and regulations. The mining and processing industries can also benefit from these policies.

- Trend towards more sustainability: Increasing investor interest in sustainable and responsible investments can have a positive impact on the price of materials that are crucial for renewable energy.

- Diversification: Investments in critical minerals can contribute to portfolio diversification. As their performance is often determined by factors other than those of traditional equity and bond markets, they can reduce the total risk of the portfolio.

- Geopolitical importance: Critical minerals have are of paramount strategic importance.

If investments are in line with important national and geopolitical interests, this can provide additional stability to the investment.

Positive case study: Ivanhoe Mines
Ivanhoe Mines is a Canadian mining company focused on the exploration, mining and production of copper and a variety of other minerals. As of March 2025, the company has reached a market capitalisation of around USD 13.3 billion. Net profit in 2024 was USD 229 million (USD 513 consensus estimate for 2025E) and annual copper production was 437 kilotonnes (kt) in 2024 (consensus estimate for 2025E: 564 kt).

The mining regions are primarily located in Africa. The company's most important projects include the Kamoa-Kakula copper complex in the Democratic Republic of the Congo (DRC). It is known as one of the fastest growing and highest-quality copper mines in the world. In addition, there is the Platreef project in South Africa, an important source of platinum-grade metals (PGMs) and nickel. The Kipushi project, which is currently in the start-up phase, is another important zinc mine in the DRC.

Quality of resources: The company's Kamoa-Kakula copper complex is known for its high-quality deposits. With an impressive copper content of around 5.5% (the global average is below 1%), it is one of the world's highest-quality large copper mines. The expected lifespan of the mine is over 40 years. The company also prioritises exploration, with ongoing projects at Makoko and Kiala in the DRC.

These expansions underline the company's robust growth option that should make Ivanhoe Mines one of the world's leading copper producers both in the near term and in the coming decades.

Quality of the company: Ivanhoe Mines is a positive example of comparatively high company quality in the mining sector, characterised by strong management led by founder Robert Friedland. The company's balance sheet is robust and has a low debt ratio. Ivanhoe Mines has consistently achieved increasing margins over the years, which also underlines its operational efficiency. Due to the high growth potential, high resource quality and favourable sales forecasts for copper, the return on investment capital (ROIC) profile looks very favourable.

The company is also well-positioned in the growth trend triggered by the global energy transition and leads the sector's cost curve thanks to comparatively high-quality and cost-effective operations. All of this strengthens Ivanhoe Mines' competitive advantage and opens up excellent prospects for the company's future in the mining industry.

- We assess the company's ESG performance using our own SDG and ESG assessment framework, consult with external providers and conduct regular discussions with the obsolete management itself. This engagement includes virtual and physical meetings as well as on-site visits, which are particularly valuable from an investor perspective. Based on our assessment, we conclude that Ivanhoe Mines is pursuing sustainable mining practices to supply key metals for the global energy transition.

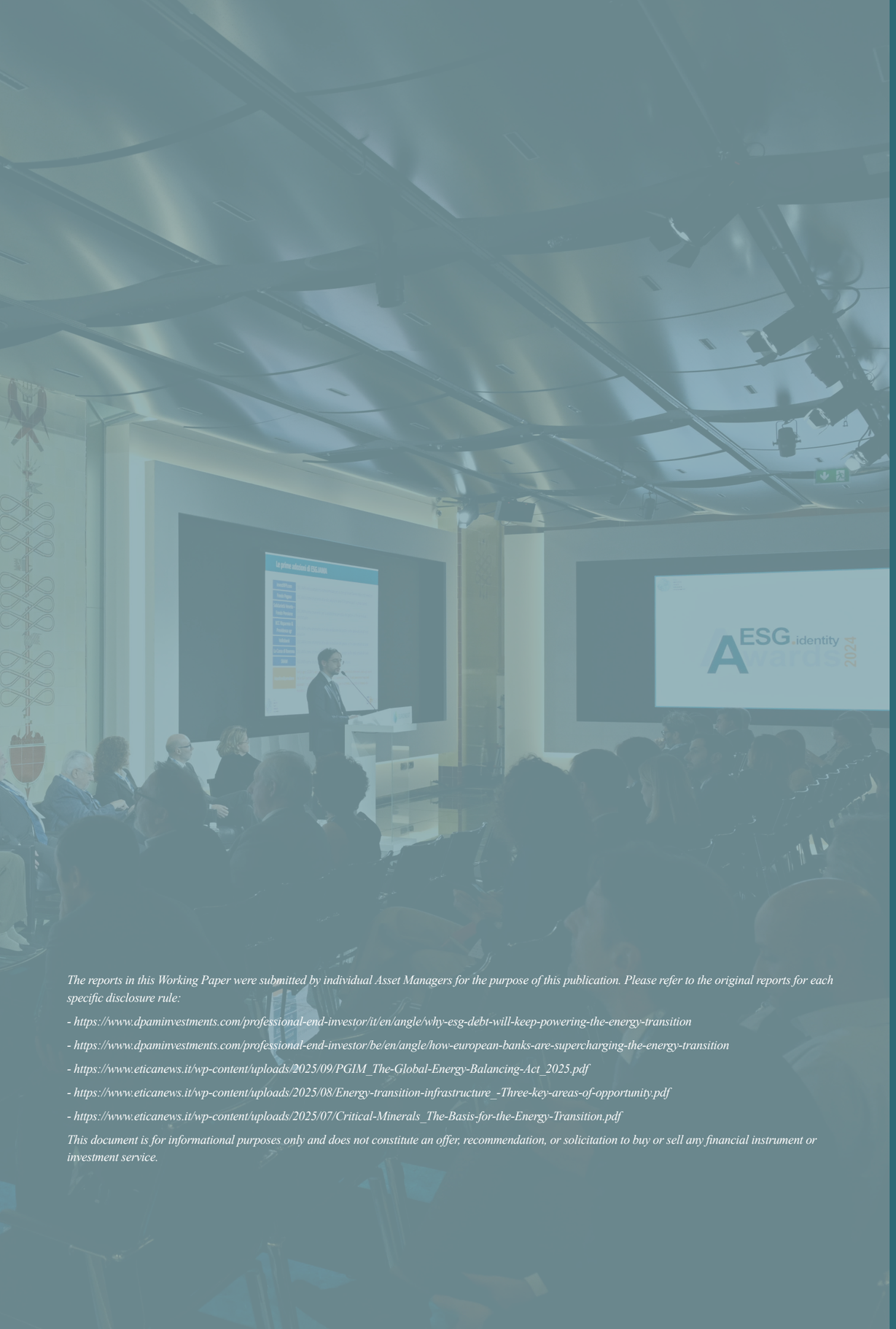
SUMMARY

The decarbonisation of the economy depends heavily on renewable energy sources such as sun, wind, water and geothermal energy. Consequently, minerals that serve as the basis for clean energy technologies are of crucial importance. This applies in particular to the supply of critical minerals such as lithium, nickel, cobalt, copper and rare earths. These minerals are the foundation for technologies that drive the energy transition; EVs, wind turbines and solar cells all rely on them. Consequently, as clean energy technologies become more widespread, demand for critical minerals is expected to rise substantially.

From an investor's perspective, investments in critical minerals or in companies that extract or process them can offer various opportunities. In our opinion, these include comparatively high growth potential, inflation protection opportunities and portfolio diversification. The strategic importance of these minerals is now recognised worldwide, and many governments are implementing measures to ensure sustainable and stable supply. Against this backdrop, investors have the opportunity for rising price trends, which could result from supply deficits and the growing need for sustainable energy solutions, which is also politically driven.

[1]*Global Critical Minerals Outlook 2024, IEA https://www.iea.org/reports/global-critical-minerals-outlook-2024 (Download: 11.2.2025).*
[2]*Secondary supply = production waste + by-products + recycled material from end-of-life products or applications.*

Dominik Ladner, Dr Gerhard Wagner and Rocchino Contangelo



The reports in this Working Paper were submitted by individual Asset Managers for the purpose of this publication. Please refer to the original reports for each specific disclosure rule:

- https://www.dpaminvestments.com/professional-end-investor/it/en/angle/why-esg-debt-will-keep-powering-the-energy-transition

- https://www.dpaminvestments.com/professional-end-investor/be/en/angle/how-european-banks-are-supercharging-the-energy-transition

- https://www.eticanews.it/wp-content/uploads/2025/09/PGIM_The-Global-Energy-Balancing-Act_2025.pdf

- https://www.eticanews.it/wp-content/uploads/2025/08/Energy-transition-infrastructure_-Three-key-areas-of-opportunity.pdf

- https://www.eticanews.it/wp-content/uploads/2025/07/Critical-Minerals_The-Basis-for-the-Energy-Transition.pdf

This document is for informational purposes only and does not constitute an offer, recommendation, or solicitation to buy or sell any financial instrument or investment service.

THANKS TO:

DPAM

PGIM

SCHRODERS

SWISSCANTO

ETGroup
THE ESG KNOWLEDGE COMPANY

ESG. IDENTITY ASSET MANAGER ASSESSMENT