BlackRock

The brown to green transition

October 2023

MKTGM0424E/M-3501661-1/10

A material revolution in the energy landscape

Earlier this year, BlackRock identified five 'mega forces' that are creating investment opportunities for our clients. These structural trends – like the rise of artificial intelligence and changing demographics - are re-shaping economies and portfolios now and long-term.

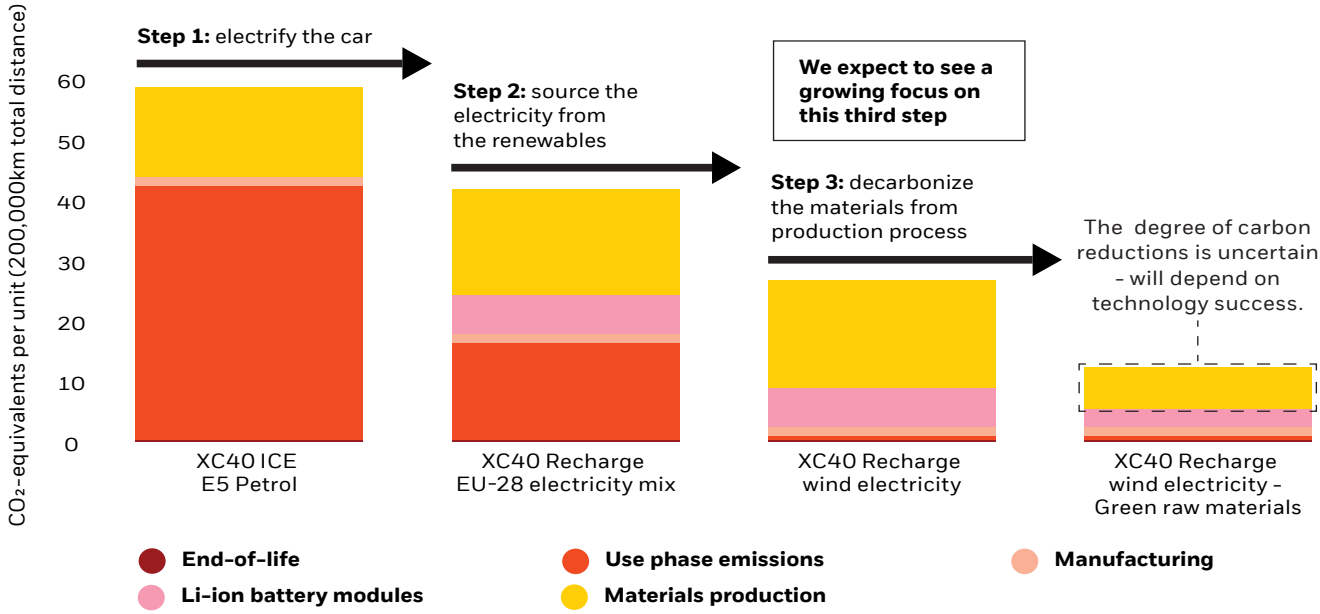
The most capital-intensive of these mega forces is the transition to a low-carbon economy - requiring a substantial reallocation of resources as supply chains, production processes, and energy systems are reviewed.

The global shift to reliable, low-emission energy is an opportunity that spans many asset classes and regions. While there are many aspects of the transition, we see one of the most important elements being the changeover from an energy system reliant on fossil fuels, to one based on metals and materials.

Metals and materials are essential building blocks for low-carbon technologies. However, if the companies that produce these materials don't also actively work to reduce their own carbon footprints, the problem of emissions could merely shift from the point of consumption to production.

It's time for us to look at this monumental shift from a 'brown' economy based on fossil fuels to a 'green' system reliant on materials.

Exhibit 1: Lifecycle carbon emissions associated with driving under various scenarios



Source: Volvo and BlackRock, June 2021. The reduction in lifecycle emissions from decarbonizing the materials production process is estimated. The actual carbon emissions could differ from the estimated emissions presented.

MKTGM0424E/M-3501661-2/10

Financial and investment implications

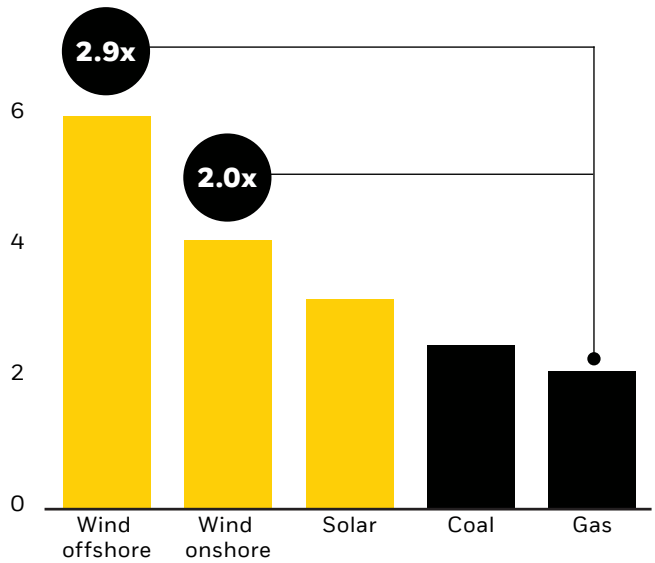
The demand for metals and materials in the coming years is poised to surpass all prior estimates. Consider copper, the linchpin of power grids, or the rare earth elements critical for wind turbines. As the global transition to low-carbon technologies accelerates—possibly faster than market projections—this surge in demand could be highly underestimated.

An interesting consequence of this demand is its impact on material prices and company earnings. Supply limitations coupled with surging demand could result in unanticipated increases in materials prices. Investors could stand to benefit by focusing on companies that navigate their carbon transition well, as they are likely to command higher valuation multiples than those that struggle with the transition. Meanwhile, companies already leading in low-emission materials may enjoy robust business model advantages.

When we look at the investment universe, we can organize it into three categories:

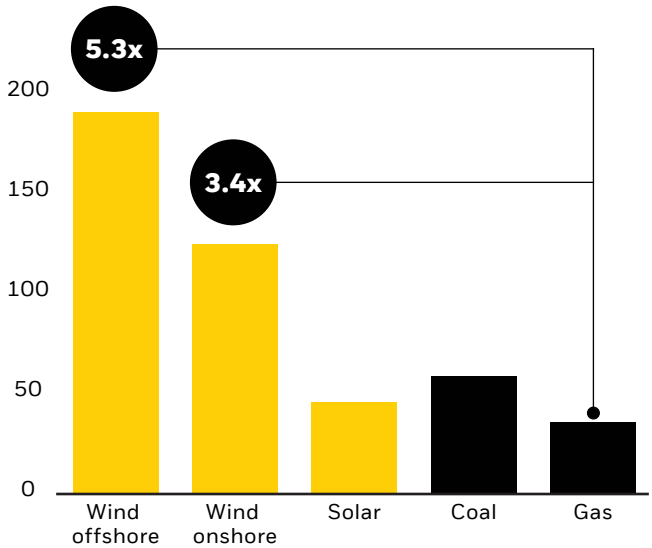
1. **Emissions reducers:** Materials companies with plans to lower their emissions intensity over time.
2. **Enablers:** Companies supplying crucial materials or technologies that help materials companies reduce emissions.
3. **'Green' Leaders:** Those that are ahead of their peers in producing materials with lower emissions.

Exhibit 2: Copper required per unit of power capacity
Tonnes per megawatt



Source: BHP analysis, August 2023.

Exhibit 3: Steel required per unit of power capacity
Tonnes per megawatt



Source: BHP analysis, Hatch, ArcelorMittal, August 2023.

MKTGM0424E/M-3501661-3/10

The supply side: will it keep up?

In theory, the availability of metals and materials like copper, lithium, nickel, graphite, and cobalt should be more than sufficient to meet global demand—these resources are generally in abundant supply.[1] However, the true scarcity exists not in the raw materials themselves but in high-quality, cost-effective undeveloped projects. Specifically, we're talking about projects where the material in question constitutes a high proportion of the ore being mined, indicating both quality and potential profitability.

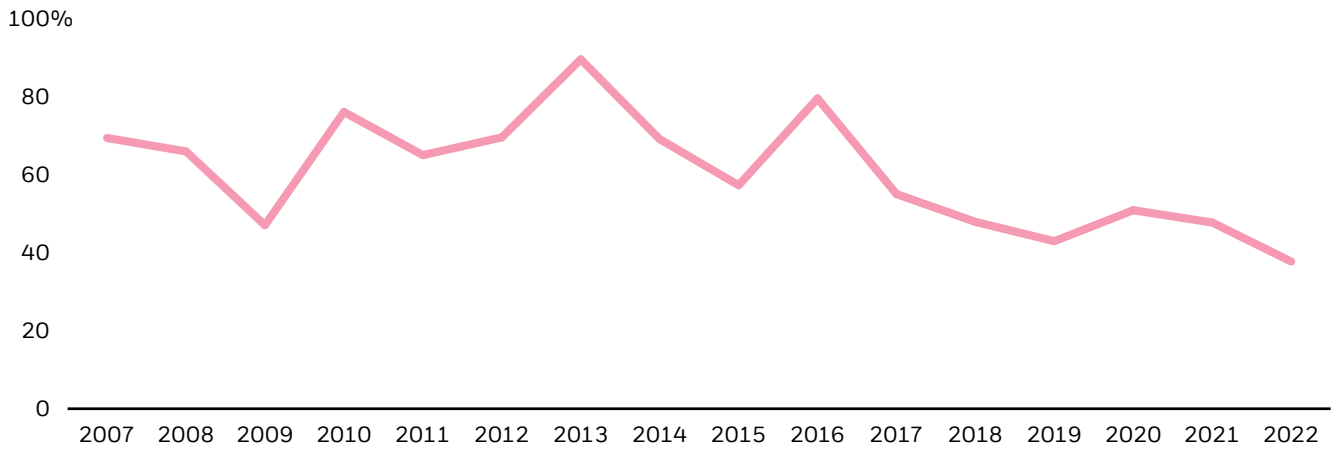
The imbalance between supply and demand is not just hypothetical; several metals, including copper, are already forecasted to face medium-to-long-term deficits.[2] This means that, in the foreseeable future, demand for these metals is likely to exceed what can be supplied, a concern that extends to some rare earth elements as well.

When it comes to financial investment, the gap between what needs to be invested and what has actually been committed is staggering. According to the International Energy Agency (IEA), the cumulative capital expenditure required for critical minerals is expected to reach between US$360-450 billion by 2050. Astonishingly, over 60% of this estimated investment is earmarked for copper alone.[3]

The copper industry faces a significant investment gap that needs to be addressed by the end of this decade to sustain supply. Current commitments for new projects fall far short of the investment levels required to meet projected demand.

In summary, while the materials may be abundant, the financial and developmental gaps in bringing them to market are substantial. These imbalances pose both challenges and opportunities for stakeholders in the metals and materials sectors.

Exhibit 4: Capex of the top 50 miners: spending as a proportion of EBITDA (Earnings before interest, taxes, depreciation and amortisation) was the lowest in decades in 2022



Source: BHP analysis, January 2023.

1 Source: Bloomberg, 2023.
2 Source:Goldman Sachs, Supply and Demand Forecast, 7 October 2023.
3 Source: International Energy Agency, September 2023.

Decarbonizing the materials sector

Companies in the materials sector face an urgent need to take decisive action in reducing their carbon footprints. The IEA also found that the materials sector alone contributed to over 17% of the 36.8 billion tons of global greenhouse gas emissions in CO2 equivalent as of 2022. In our view, this share is expected to grow if deliberate action isn't taken, particularly as the low-carbon transition increases the demand for metals and materials.

The steel industry stands out as a significant contributor within this sector. To combat this, steel companies can adopt a three-stage approach to decarbonization**:**

Stage 1.

Optimizing the 'Brown' facility

The first phase focuses on what can be done here and now, without requiring substantial financial outlay. In countries like India, China, and Vietnam, companies are already pulling the low-cost levers available to them. They're switching to renewable power sources, recycling energy-rich gases, and investing in higher-quality raw materials. Technological innovation supports these efforts, with advancements in energy optimization technologies such as waste heat recovery and smart process control, as well as better utilization of quality raw materials.

Stage 2.

Transitioning from 'Brown' to 'Khaki'

The next step involves making a transition, albeit a partial one. In this stage, companies take their existing facilities and retrofit them with transitional, low-carbon technologies. These aren't complete solutions but they're substantial steps in the right direction. For instance, companies are starting to use low-carbon fuels like LNG, biomass, and even hydrogen injection in their existing boilers and furnaces. Meanwhile, carbon capture utilization and storage retrofits offer 'end-of-pipe' solutions that catch emissions before they enter the atmosphere. Countries like China, Japan, the U.S., and South Korea are leading the charge in this transitional phase.

Stage 3.

Achieving a 'Green' end-state

The third and final stage calls for a wholesale transformation: companies completely replacing their existing capital stock with low-or-zero emissions alternatives. This is no small feat and requires significant investment and technological innovation. Here, we see countries like Germany, Sweden, and the Netherlands leading the way by exploring zero-emission hydrogen-based solutions and direct electrification methods that extend from ore electrolysis in steel production to electric marine propulsion in the maritime sector. Moreover, advanced bioenergy solutions like sustainable aviation fuels are emerging as viable 'green' alternatives.

Materials contribute to the global emissions problem on a conservative estimate, over 17%* of total global emissions.[4]

But they are also a critical part of the solution.

We can't have wind turbines, solar panels or electric vehicles without materials to build them.

4 Source: BlackRock, October 2023. * International Energy Agency, based on 2022 global emissions.

MKTGM0424E/M-3501661-5/10

Emerging trends in ‘green’ transition across industries

The transformation toward sustainability is creating ripple effects across various sectors, signaling where we might be headed. In the utilities sector, companies pivoting away from fossil fuels toward renewables have seen an uptick in their valuation multiples, suggesting a positive trajectory that could be mirrored in higher-carbon sectors like European steel. The latter is gradually transitioning from traditional blast furnaces to more eco-friendly steelmaking methods, which may allow them to command premium prices for lower-emission steel.

Meanwhile, the copper industry faces a paradox: while well-positioned to benefit from the low-carbon transition, it grapples with aging mines and a lack of new projects, even amid record copper prices. This raises questions about how the sector will meet the growing global demand, likely leading to higher prices and strong earnings potential for the most efficient producers. Lastly, battery recycling is emerging as a vital industry, especially as the first generation of electric vehicles starts to age. Regulatory support, coupled with growing supply pressure, makes this an area ripe for growth. Existing players in this space are well-positioned to seize these emerging opportunities, indicating a bright future for sustainable practices across industries.

MKTGM0424E/M-3501661-6/10

The role of government policy in accelerating the transition to ‘green’ energy

In the quest for a sustainable future, the role of government cannot be overlooked. Governments have the power to both incentivize and enforce the transition from ‘brown,’ or carbon-intensive, technologies to ‘green,’ or sustainable, technologies. They can do this through a blend of policy, funding, and regulation that spurs investment in lower carbon technologies.

When it comes to government intervention, there are two primary ‘sticks,’ or punitive measures at their disposal. The first is pricing greenhouse gas emissions through mechanisms like carbon taxes. By making it more expensive to emit carbon, companies are economically compelled to reduce their emissions or switch to greener technologies. The second is directly regulating activities that produce emissions, such as the banning of Internal Combustion Engine vehicles.

But it’s not all about punitive measures; there are also ‘carrots,’ or incentives, that governments can offer. These incentives can be incredibly varied, ranging from tax credits and direct subsidies to producers and consumers, to accelerated permitting for sustainable projects and concessional lending for technology demonstration projects.

In some sectors, a blend of both punitive measures and incentives may be necessary. Take the power sector as an example: there’s a dual objective of rapidly expanding renewable energy sources while simultaneously winding down fossil fuel-based power generation. In such cases, a balanced mixture of ‘sticks’ and ‘carrots’ may become vital to nudging the sector toward sustainability.

The choice between ‘sticks’ and ‘carrots’ often depends on the objective. If the goal is to attract new investments, such as building a battery gigafactory or opening a new copper mine, then incentives like tax credits are usually the most effective approach. On the other hand, if the focus is on improving the emissions profiles of existing projects or hastening their closure and replacement with greener alternatives, then punitive measures like carbon taxes may be more appropriate.

Through a well-calibrated mix of penalties and incentives, governments can encourage new investments in ‘green’ technologies while ensuring that existing projects either improve their environmental performance or make way for more sustainable alternatives.

MKTGM0424E/M-3501661-7/10

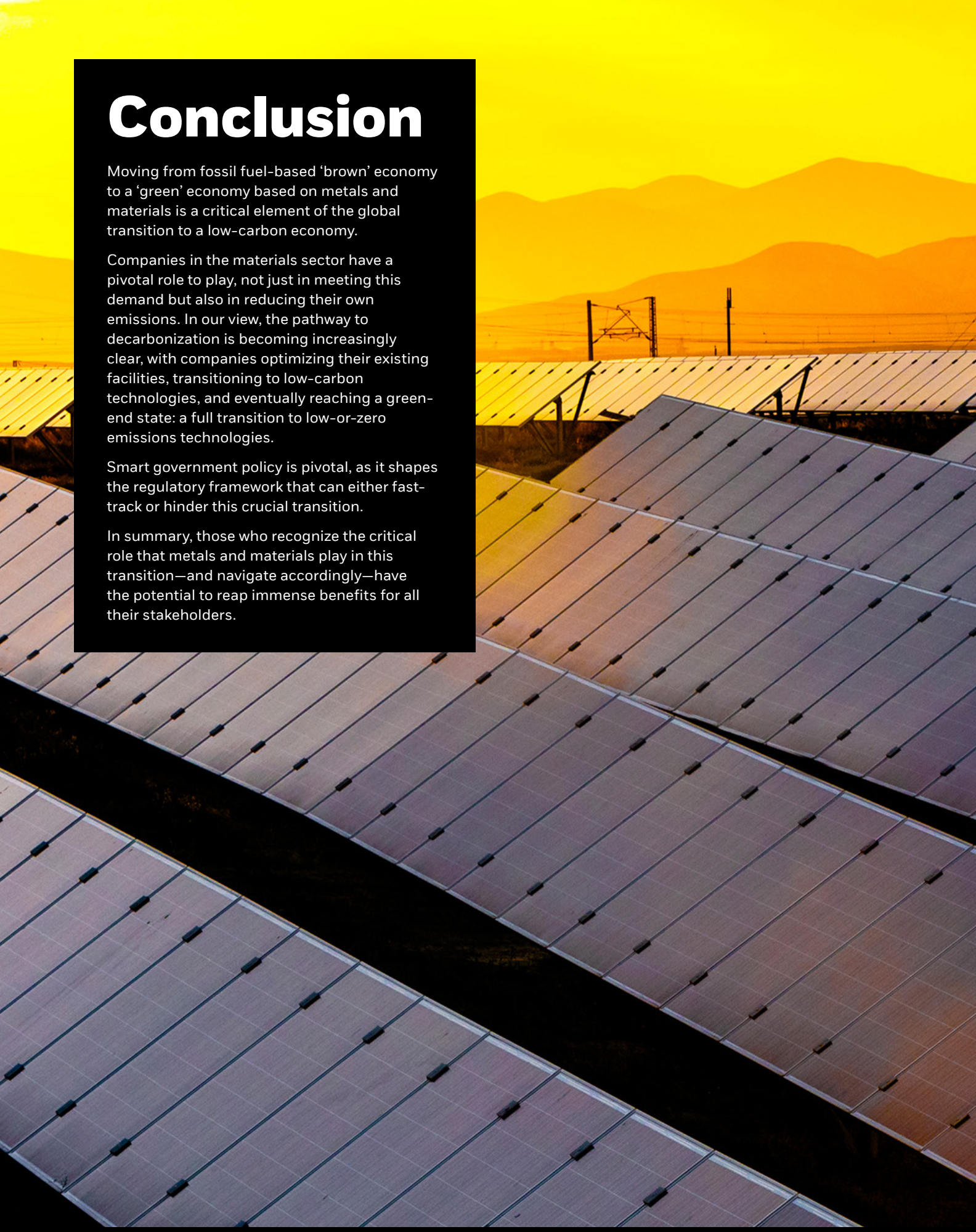
Conclusion

Moving from fossil fuel-based 'brown' economy to a 'green' economy based on metals and materials is a critical element of the global transition to a low-carbon economy.

Companies in the materials sector have a pivotal role to play, not just in meeting this demand but also in reducing their own emissions. In our view, the pathway to decarbonization is becoming increasingly clear, with companies optimizing their existing facilities, transitioning to low-carbon technologies, and eventually reaching a green-end state: a full transition to low-or-zero emissions technologies.

Smart government policy is pivotal, as it shapes the regulatory framework that can either fast-track or hinder this crucial transition.

In summary, those who recognize the critical role that metals and materials play in this transition—and navigate accordingly—have the potential to reap immense benefits for all their stakeholders.



MKTGM0424E/M-3501661-8/10

Risk Warnings

Capital at risk. The value of investments and the income from them can fall as well as rise and are not guaranteed. Investors may not get back the amount originally invested.

Past performance is not a reliable indicator of current or future results and should not be the sole factor of consideration when selecting a product or strategy.

Changes in the rates of exchange between currencies may cause the value of investments to diminish or increase. Fluctuation may be particularly marked in the case of a higher volatility fund and the value of an investment may fall suddenly and substantially. Levels and basis of taxation may change from time to time.

This material is intended for information purposes only, and does not constitute investment advice, a recommendation or an offer orsolicitation to purchase or sell any securities, funds or strategies to any person in any jurisdiction in which an offer, solicitation,purchase or sale would be unlawful under the securities laws of such jurisdiction. The opinions expressed are subject to changewithout notice. Reliance upon information in this material is at the sole discretion of the reader. Investing involves risks.

Any research in this document has been procured and may have been acted on by BlackRock for its own purpose. The results of such research are being made available only incidentally. The views expressed do not constitute investment or any other advice and are subject to change. They do not necessarily reflect the views of any company in the BlackRock Group or any part thereof and no assurances are made as to their accuracy.

Important Information

In the UK and Non-European Economic Area (EEA) countries: this is issued by BlackRock Investment Management (UK) Limited, authorised and regulated by the Financial Conduct Authority. Registered office: 12 Throgmorton Avenue, London, EC2N 2DL. Tel: + 44 (0)20 7743 3000. Registered in England and Wales No. 02020394. For your protection telephone calls are usually recorded. Please refer to the Financial Conduct Authority website for a list of authorised activities conducted by BlackRock.

In the European Economic Area (EEA): this is issued by BlackRock (Netherlands) B.V., authorised and regulated by the Netherlands Authority for the Financial Markets. Registered office Amstelplein 1, 1096 HA, Amsterdam, Tel: 020 – 549 5200, Tel: 31-20-549-5200. Trade Register No. 17068311 For your protection telephone calls are usually recorded.

For investors in South Africa
Please be advised that BlackRock Investment Management (UK) Limited is an authorised Financial Services provider with the South African Financial Services Conduct Authority, FSP No. 43288.

For investors in Switzerland
This document is marketing material.

In the **U.S.** and **Canada**, this material is intended for public distribution.

In Latin America: No securities regulator has confirmed the accuracy of any information contained herein. The provision ofinvestment management and investment advisory services is a regulated activity in Mexico thus is subject to strict rules. For moreinformation on the Investment Advisory Services offered by BlackRock Mexico please refer to the Investment Services Guide availableat www.blackrock.com/mx

In Singapore, this is issued by BlackRock (Singapore) Limited (Co. registration no. 200010143N). This advertisement or publicationhas not been reviewed by the Monetary Authority of Singapore.

In Hong Kong, this material is issued by BlackRock Asset Management North Asia Limited and has not been reviewed by theSecurities and Futures Commission of Hong Kong.

In South Korea, this is issued by BlackRock Investment Management (Korea) Limited. For information or educational purposes only,not for reuse, redistribution, or any commercial activity, and does not constitute investment advice or an offer or solicitation topurchase or sells in any securities or any investment strategies.

In Taiwan, independently operated by BlackRock Investment Management (Taiwan) Limited. Address: 28F., No. 100, Songren Rd., XinyiDist., Taipei City 110, Taiwan. Tel: (02)23261600.

In Australia, issued by BlackRock Investment Management (Australia) Limited ABN 13 006 165 975 AFSL 230 523 (BIMAL). Thematerial provides general information only and does not take into account your individual objectives, financial situation, needs or circumstances.

In China, this material is provided for informational or educational purposes in People's Republic of China ("PRC", for such purposes, excluding Hong Kong, Macau and Taiwan) only and does not constitute a solicitation of any securities or BlackRock funds.

This document is for information purposes only and does not constitute an offer or invitation to anyone to invest in any BlackRock funds and has not been prepared in connection with any such offer.

BELM-1990-OCT23-Global

BlackRock®