CITY OF LONDON

Investment Opportunities in Decarbonising Indian Industrial Supply Chains

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Foreword

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Governments are radically reappraising their aspirations to strengthen commitment to climate action. The UK has taken bold steps towards a low-carbon economy through its Net Zero Strategy which will help achieve the goal of reaching net zero emissions by 2050. India too, has set bold climate targets and is moving with pace and vigour.

However, these government plans and the promise of the transition will only come to fruition if it is backstopped by investment. That is the reason we support CFLI India, an initiative led by Bloomberg, Macquarie Group, and Tata Group.

Financial markets have a critical role to play in driving deployment at scale and lowering the costs of the next generation of clean technologies. Here in London, we have seen this dynamic play out in real time with the explosive growth of the UK offshore wind capacity financed on the back of a rapidly falling cost curve. India too, has ridden the same wave with renewables growing by a factor of five over the past decade.

However, the road ahead will require large volumes of capital, which must be channelled into decarbonising major sectors shared by the Indian and UK economies: from energy, to mobility, and significant industrial processes such as auto manufacturing and steel production.

A key barrier facing each of these sectors is securing a supply of critical minerals. This is a challenge I believe the UK and India are uniquely placed to tackle. Indian corporates are manufacturing powerhouses and are taking ambitious strides towards net zero. With deep capital markets and significant metals trading infrastructure, the UK's financial and professional services ecosystem is already exploring solutions.

It is in the interests of partnership and in response to a common challenge that we commissioned this analysis. I hope it provides a common framework for commercial cooperation between Indian and UK firms. It is an important stepping stone in our vision for strong two-way capital flow between India and the UK.

The City of London Corporation has long been committed to supporting sustainable economic growth in India. We are delighted to collaborate with Cybele Capital Partners for this research and would like to thank them for their valuable inputs.

Executive summary

India today

The progress of industrialisation since the 1950s has been key to the economic development in India. The heavy industry sector has significantly supported the socio-economic growth and urbanisation in the country, allowing India to become one of the fastest growing economies in the world. This has, however, caused a surge in energy demand. The industrial sector is now the second largest energy consuming sector in India.[1]

India is the third largest single country carbon emitter in the world behind the USA and China and accounts for some 7% of global emissions today increasing to 13% by 2040. However per capita emissions remain low. Indian carbon emissions are directly linked to rising GDP per capita. A growing population and increasing affluence is leading to increasing levels of carbon emissions. Clearly India is a significant participant in the global effort to decarbonise.

Indian power generation is the single largest contributor to India's carbon emissions. Over 60% of Indian power generation is derived from coal leaving significant room to reduce emissions by moving to more sustainable forms of power generation.

Mobility is another key driver of emissions. Ownership of cars, motor cycles and scooters has grown from 55 million in 2001 to over 296 million today. This growth will continue at over 20% per annum for the foreseeable future.

The road forward

India has an ambitious agenda to reform its industrial sector and transition to a low carbon economy. This includes an initial commitment to reducing its carbon footprint by up to 35% by 2030, achieve approximately 40% cumulative installed power generation capacity from non-fossil fuel energy and create an additional carbon sink of 2.5-3 billion tonnes of carbon dioxide equivalent through additional forest and tree cover.

A significant element of this will be achieved by increasing the share of renewable energy in India and encouraging the move to electric vehicles. Government standards on emissions and fuel efficiency is driving a move to electric mobility with the majority of new vehicle sales being electric by 2040.

Indian power generation will increase by more than 3 times by 2040 but this growth will be driven primarily by renewables which will account for 40% of energy generation by 2040.

Indian corporates, particularly a coalition of leading engineering companies including companies from the hard to abate sectors of cement and aluminium have committed to decarbonisation pathways. These corporates have stated that energy substitution is only a part of the required pathway and significant modification in traditional industrial processes is required. This includes the use of hydrogen in traditional industrial processes where it can completely replace fossil fuels.

The steel sector is a particular area of focus. India has the world's second largest metallurgical industry and steel production is the single largest industrial contributor to emissions given the high degree of energy used in the steel making process. Changes in the production process from blast furnaces to electric arc furnaces will reduce both energy intensity as well as total emissions. The Indian steel industry emits around 242 Mt of greenhouse gases, however the

[1] *https://energy.economictimes.indiatimes.com/news/power/opinion-why-industrial-decarbonization-is-an-opportunity-for-india-to-fight-climate-change/82052996*

shift towards hydrogen energy will decrease these emissions by 8%. A further step forward is the use of hydrogen as a reducing agent. Hydrogen based steel making is expected to be feasible by 2040 and will become an appreciable part of the Indian steel making industry by 2050.

The path toward electrification raises supply chain and security issues for India. Electrification requires significant quantities of critical minerals including copper, nickel, zinc, cobalt, lithium and rare earths. For example India's usage of key minerals in 2030 versus projected usage and global production is set out below:

- India's lithium use will increase from 1,000 tonnes per annum to 109,000 tonnes vs global production today 82,000 tonnes per annum
- Cobalt from 1,200 tonnes to 165,000 tonnes vs global production of 142,000 tonnes per annum
- Nickel from 61,300 tonnes to 1,4 million tonnes vs global production of 2.5 million tonnes per annum

This means that India's requirement of certain key minerals in 2030 will be a disproportionate share of today's global production. Energy storage (batteries), charging infrastructure, hydrogen infrastructure and electricity generation infrastructure are all made of critical minerals. At the best of times these commodities trade sparsely on a "spot" basis and will increasingly become the subject of long term contracts.

India is a large producer of bulk minerals such as coal, bauxite and iron ore but relies largely on imports for critical minerals such a cobalt, lithium, nickel, copper and rare earths.

The scale of minerals required in the low carbon future of electrification will require an increase in mineral supply of several multiples from today's global production. Supply and security of critical minerals is a pivotal part of decarbonization.

Given that most of the world is increasingly focusing on the security of supply for these minerals traditional integrated supply chains will come under increasing pressure producing investment opportunities.

Investment opportunities

It is clear that the success of the low carbon transition in India and globally hinges on the coherence and development of critical mineral supply chains. Leading corporates and financial institutions are already acting in response to these challenges.

There are five key trends emerging which we expect to accelerate over the course of the next decade:

1. Pricing Differentials: Extraction, processing and transportation of minerals is an energy intensive activity and there will be premium pricing for energy efficient minerals. Similar demand-driven pricing differentials are already emerging in the rapidly growing green bond market.

2. Mineral Offtake Agreements: In pursuit of security of mineral supplies, industrial producers will seek medium- and long-term offtake agreements with mineral producers. Financial innovation will be a pre-requisite to smoothing pricing and volatility of supply.

3. Supply Growth: The supply of critical minerals will need to expand significantly. Due to capital intensity, development timetables, and innovation in extraction and processing methodologies, long term partnerships and access to finance will become a priority.

4. Capital Markets Scrutiny: Increasing attention by capital makets firms for corporate and transaction-level compliance with standards as a requirement to access capital.

5. Innovation Partnerships: Key transition technologies dependent on critical minerals - including batteries, battery recycling, hydrogen electrolysers, and hydrogen-based steel-making – need to undergo further standardisation and optimisation. Current technologies alone will be difficult to meet future demands. Large-scale demonstrators and innovation partnerships aiming at resource efficiency will be increasingly prioritised.

India's industrial expertise and rapidly growing demand for critical minerals has natural complementarity with the UK's deep financial markets, mining and metals expertise and technology innovations. There is a clear opportunity for India and the UK to partner to overcome the critical minerals bottleneck which could pose a significant barrier in the global race to zero.

Trends in Minerals Development	Partnership Opportunities
Pricing Differentials	1. Indian corporates to adopt LME standards on responsible mineral sourcing which allows for differential pricing of critical minerals. 2. UK financial institutions to consider pricing impact 3. LME and mineral producers to undertake further research to refine methodologies for ethically sourced minerals.
Offtake Agreements	4. Develop standard frameworks for aligning offtake agreements with key ESG metrics. 5. UK government to explore capacity for technical assistance programmes and export finance to accelerate adoption of mineral offtake agreements. 6. Support development of long-term investment and partnership agreements between producers, traders and end users of critical minerals.
Supply Growth	7. Profile financial innovation aligned to expanding ethical supply, such as metal royalty and streaming companies for battery metals. 8. Support India-UK corporate partnerships aimed at critical mineral exploration, extraction and processing.
Capital Markets Scrutiny	9. Support Indian corporates to raise labelled sustainable capital from international investors.
Innovation Partnerships	10. Explore joint India-UK research partnerships with regards to battery chemistry, recycling, and energy storage. 11. Support UK – India technology innovation partnerships to provide solutions for green industrial metals production. 12. UK financial institutions to explore financing major transition demonstrator projects with major Indian corporates, such as new gigafactories and green hydrogen production sites.

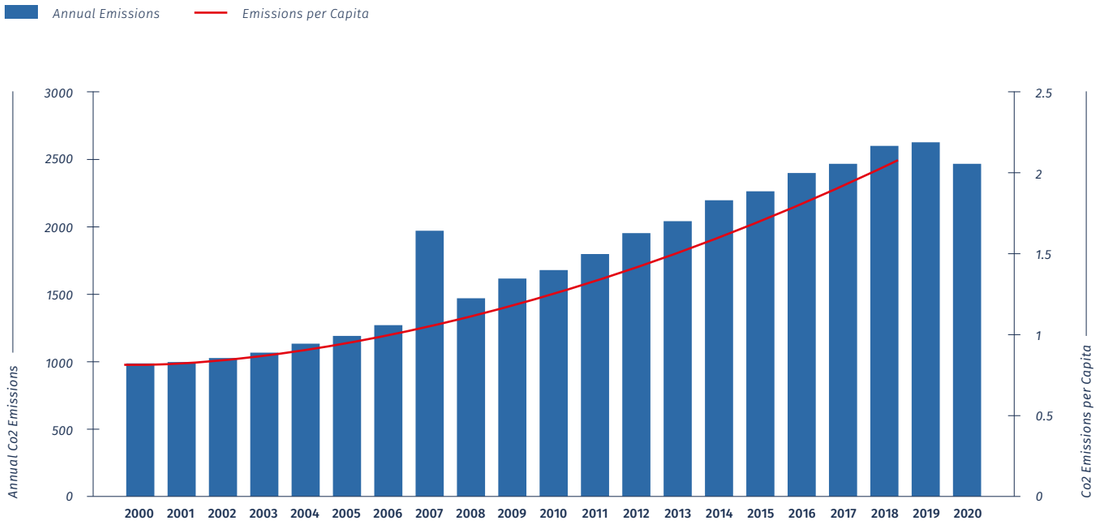
Contents

Table of Figures

01. The situation today

India is the third largest single country carbon emitter in the world behind the United States and China and accounts for 7% of global emissions. Carbon emissions are estimated to increase to 13% of the global total by 2040. However per capita emissions remain low. A growing population and growing affluence means steadily increasing level of carbon emissions.

Figure 1: Annual Co2 Emissions and Co2 Emissions per Capita
(Source: Global Carbon Budget, 2020)



Indian carbon emissions/ per capita is directly related to income levels. The wealthy (defined by a daily spend of more than $1.9/ day) in India generate nearly seven times the carbon emissions compared to poor people (who spend less than $1.9/day). The mean carbon footprint of every Indian was estimated at 0.56 tonne per year – 0.19 tonne per capita among the poor and 1.32 tonne among the wealthy.

Clearly the growing affluence of India and the growing population makes India a crucial participant in the global effort to decarbonise.

The Indian government has launched an ambitious decarbonisation strategy. Under the Paris climate agreement, India has pledged to reduce its carbon footprint by 33-35% from 2005 levels by 2030. India aims to produce 40% of its power from non-fossil fuel sources by 2030.

In addition, India's decarbonisation is linked to two structural programmes. Firstly a "Make In India" programme to position India as a global manufacturing hub and secondly Aatmanirbhar Bharat (self-reliant India) that will fast track modern infrastructure development which increase's the Indian investment opportunity.

Carbon emissions by sector

The Indian economy is driven by services which account for 53% of GDP whilst industry accounts for 29% and agriculture accounts for 8%. India's economic growth has been driven by the service sector whilst the manufacturing sector has had far lower growth rates.

The Make in India and Aatmanirbhar Bharat programmes aim to increase the manufacturing sector's share of GDP but focuses on key downstream industries including automotive, renewables, electronics and defence.

Figure 2: Co2 Emissions by Sector in India, 2006-2016
(Source: CAIT Climate Data Explorer)

Indian power generation

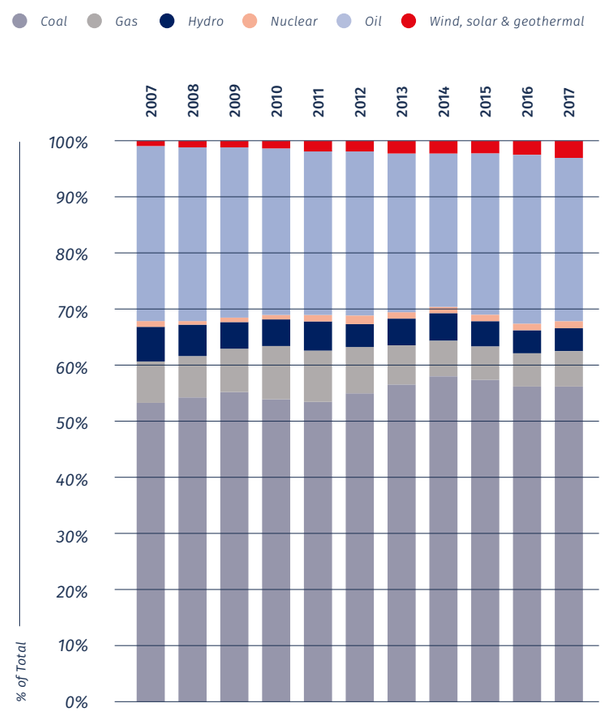
Indian power generation has historically relied on coal generation. Over 60% of Indian power generation is derived from coal. Fossil fuels including lignite, gas and diesel accounts for 8.30%, nuclear for 1.70%, hydro and renewables for 12% and wind and solar for 25%

Indian power consumption is increasing rapidly in direct proportion to increasing affluence attracting significant investment into Indian power generation and transmission.

The Indian government has placed an increasing emphasis on energy security as a strategic need. Coal based power generation has strategic advantages for India given the abundance of coal within India.

Renewable energy is rapidly emerging as a key component within India's energy generation capability but carries a strategic penalty as India is heavily dependent on imports for renewable infrastructure. For instance solar energy infrastructure is overwhelmingly sourced from Chinese manufacturers as domestic manufacturers are not cost competitive. This dependence on Chinese manufacturers is viewed as a strategic weakness in energy policy planning.

Figure 3: Power Generation from different sources in India, 2007-2017
(Source: The Carbon Brief Profile: India, 2019)

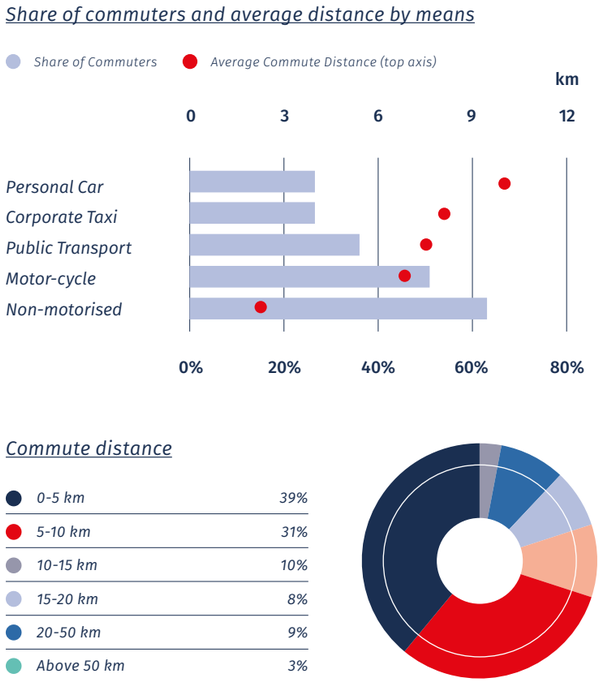


Mobility

The last three decades have transformed mobility in India. The rapid growth in almost all types of transport infrastructure since the 1990's has fuelled economic growth, which in turn has led to a continual increase in demand for mobility for both passengers and goods. The number of cars on the road in India has grown from 55 million in 2001 to over 296 million today.

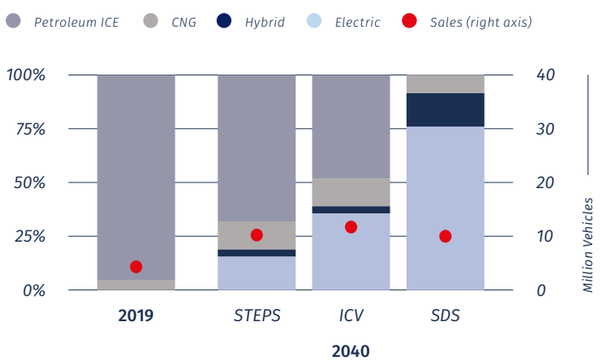
However a significant proportion of journeys are still by non-motorised forms of transport which means that vehicle numbers will continue to grow.

Figure 4: How urban Indians travel, 2019
(Source: The Council on Energy, Environment and Water (CEEW), 2019)



The Indian car market will continue to grow at a rate above 20% per annum. However government environmental policy based on emission standards and fuel efficiency is driving a change away from fossil fuel powered vehicles toward electric vehicles.

Figure 5: Passenger car sales scenario, 2019-2040[2]
(Source: IEA India Energy Outlook, 2021)



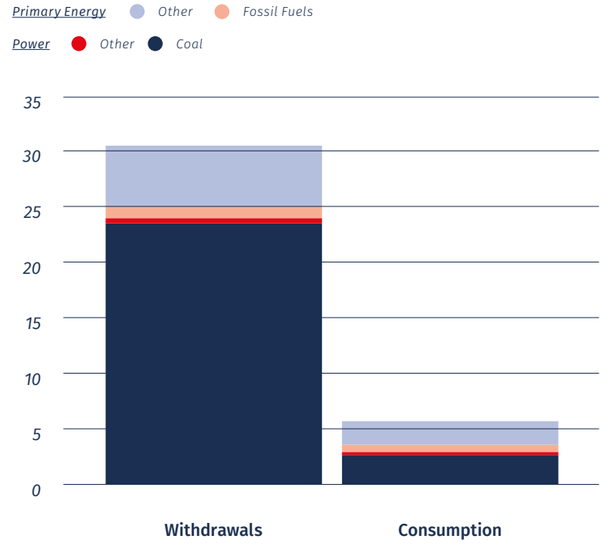
[2] *The* **Stated Policies Scenario** *(STEPS) provides a balanced assessment of the direction in which India's energy system is heading, based on today's policy settings; The* **India Vision Case** *(IVC) is based on a rapid resolution of today's public health crisis and a more complete realisation of India's stated energy policy objectives, accompanied by a faster pace of economic growth than in the STEPS; The* **Sustainable Development Scenario** *(SDS) explores how India could mobilise an additional surge in clean energy investment to produce an early peak and rapid subsequent decline in emissions, consistent with a longer-term drive to net zero, while accelerating progress towards a range of other sustainable development goals.*

Water consumption

Water usage by fossil fuel based power generation also has an environmental footprint. With just 4% of the world's water resources but 18% of its population, India counts as one of the world's most water-stressed countries. Today the energy sector withdraws roughly 30 bcm of water and consumes almost 6 bcm. Coal-fired power generation accounts for 80% of the water withdrawals made by energy sector.

Changing India's power generation mix will significantly improve India's water shortages.

Figure 6: Water use in India's energy sector by fuel and power generation type, 2019
(Source: IEA India Energy Outlook, 2021)



02. Implications of India's Decarbonisation Pathways

The Indian government's stated decarbonisation pathway has also been supported by Indian industry. The Indian CEO Forum For Climate Change which comprises 24 of India's largest corporate groups including Reliance, Adani, Tata, Vedanta and ITC have all declared their support for the government's decarbonisation strategy. These corporates have undertaken voluntary commitments to reduce emissions through energy usage efficiency and technology advancements.

The key pathways of sustainable mobility, energy transition and technology change in difficult to abate industries are being driven by the Indian private sector.

Sustainable mobility

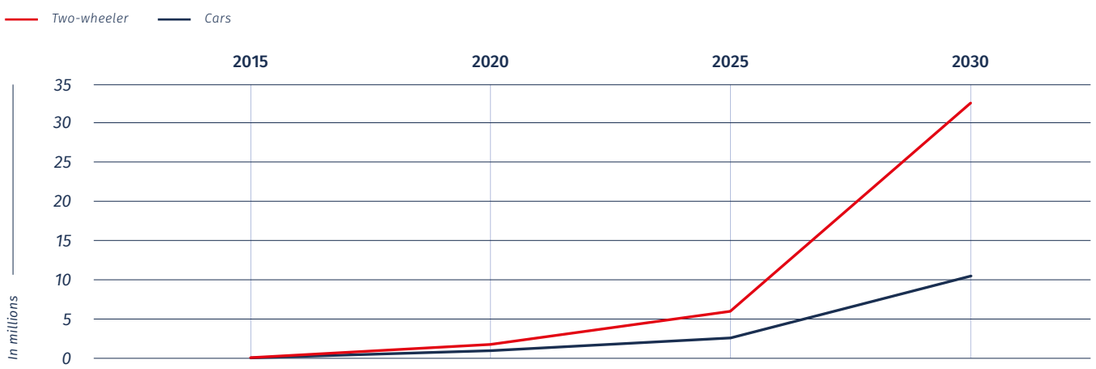
The Indian automotive industry is the fifth largest in the world and is slated to be the third largest by 2030. Federal policy makers are developing a mobility option that "Shared, Connected and Electric" and have projected an ambitious target of achieving 100% electrification by 2030.

Increasingly stringent emission standards and fuel efficiency requirements are accelerating the move towards sustainable mobility.

According to an independent study by CEEW Centre for Energy Finance, the EV market in India will be worth US$206 billion opportunity by 2030 if India maintains steady progress to meet its ambitious 2030 target. This will require a cumulative investment of over US$180 billion in vehicle production and charging infrastructure.

The implications for investors are clear – Indian corporates will rapidly scale production capabilities in batteries, electric vehicles (two-wheelers, cars, buses), and chargers. In parallel, considerable development will be needed in to reinforce local energy grids, and deploy storage, charging and rapid charging infrastructure.

Figure 7: Projected EV Sales in India by 2030
(Source: Berkeley National Laboratory, 2017)



Energy transition

India is moving away from traditional fossil fuel based electricity generation. Electricity generation will increase by more than 3x by 2040 but this growth in generation will be driven primarily by solar energy and other renewables.

Coal and other fossil fuels will be an rapidly diminishing part of the electricity generation mix. An important factor in facilitating this change will be the construction of an energy storage and charging infrastructure.

Once more, the implication for investors are clear. Indian corporates will rapidly scale their production capabilities in key technologies including solar PV and grid-scale storage solutions

Figure 8: Change in fuel supply and installed electricity capacity by scenario, 2019-2040
(Source: IEA India Energy Outlook, 2021)

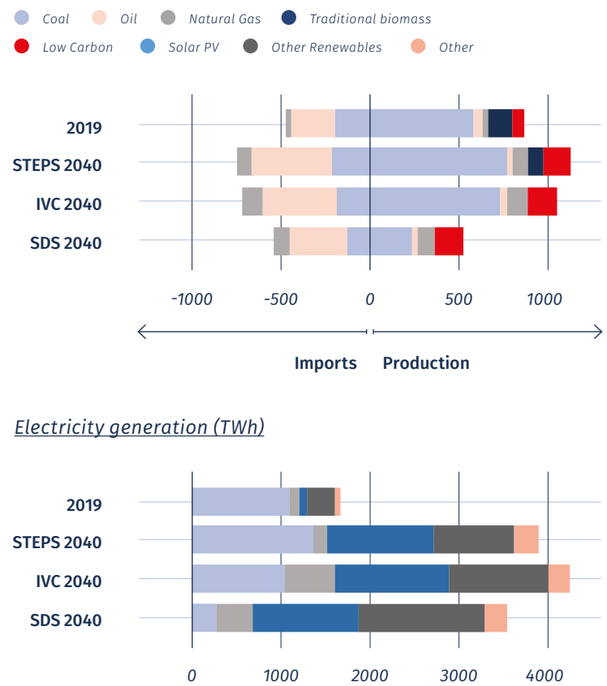
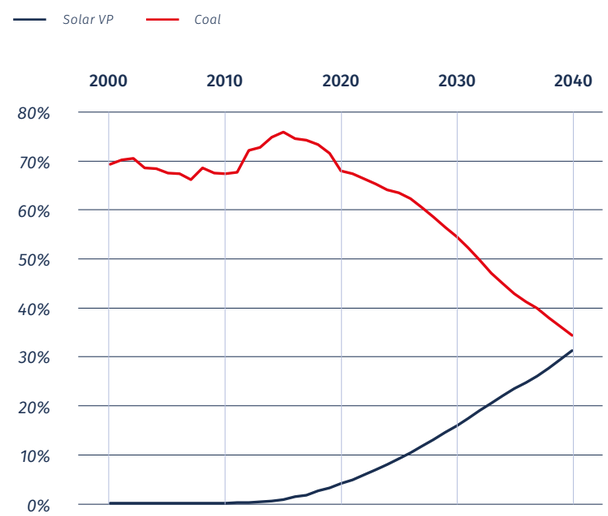


Figure 9: Changes in share of power generation in India in the Stated policies Scenario, 2010-2040
(Source: IEA India Energy Outlook, 2021)



Difficult to abate industries

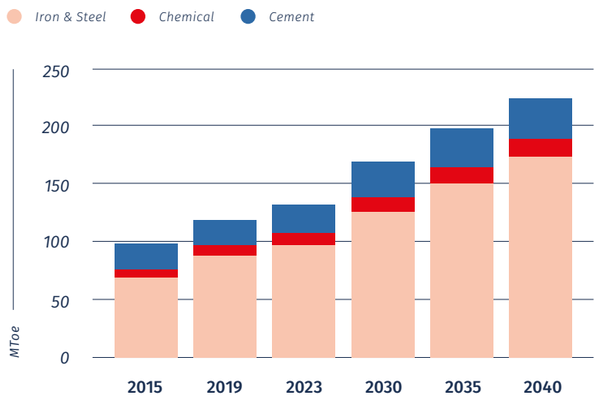
Certain crucial sectors of the economy remain difficult to abate carbon emissions. In particular cement, iron and steel, non ferrous metals and chemicals

Emissions from these “hard-to-abate” industries are notoriously difficult to reduce because, in addition to emissions associated with energy use, a significant portion of industrial emissions come from the process itself.

All these industries use high levels of electricity and given that most of Indian power generation is coal derived there is a high degree of interdependence. Much of the abatement for these industries requires a change in production methodology.

India has the worlds second largest metallurgical industry and steel production is the largest single contributor to emissions given the high degree of energy usage in the steel making process.

Figure 10: Industrial Energy Consumption in the Stated Policies Scenario, 2015-2040
(Source: IEA Air Quality and Climate Policy Integration in India,2021)

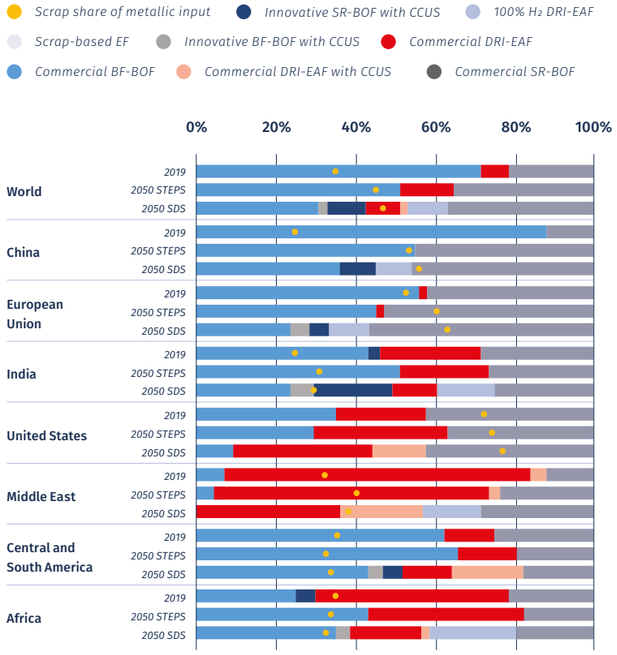


Changes in the production process for steel making will contribute to a reduction in emissions. Firstly changes to electricity generation, natural gas pricing support and production methodologies will all need to play their part in reducing emissions from. Secondly the move from blast furnaces to electric arc furnaces reduces both energy intensity as well as total emissions.

In order to reach more demanding carbon reduction targets the use of hydrogen as a reducing agent is very important. Electric arc furnaces produce lower quality steel and it is necessary to incorporate metallic feedstock to maintain steel quality. In addition there will be continuing usage of blast furnaces to make virgin high quality steel.

Hydrogen based steel making is expected to be feasible by 2040. This will allow the complete elimination of the use of fossil fuels as a reducing agent. The tables below show hydrogen based steel making becoming an appreciable part of the Indian steel making industry by 2050.

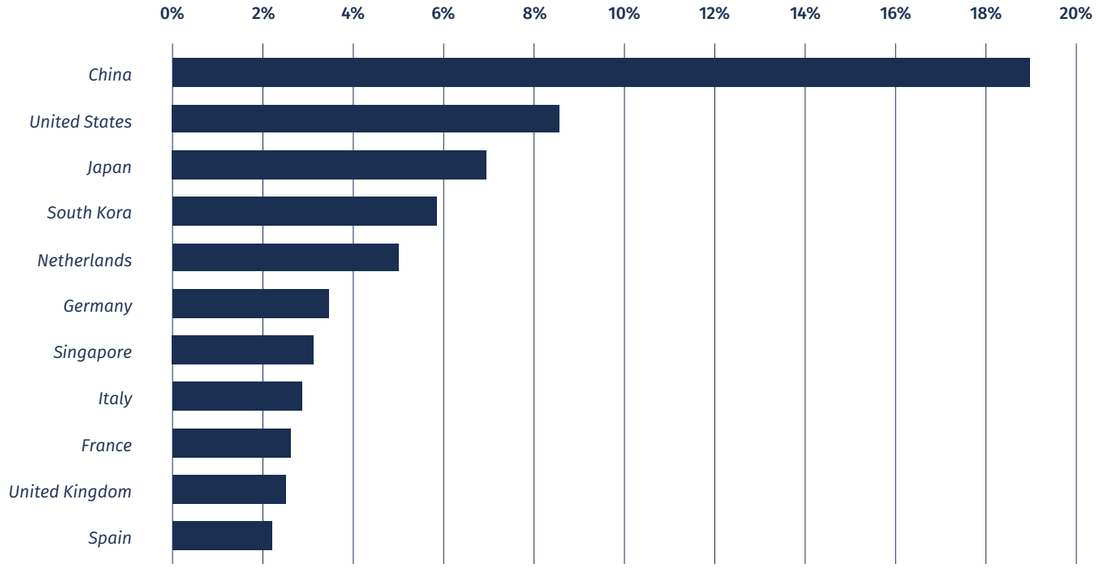
Figure 11: Crude steel production by process route and scenario in major steel-producing regions
(Source: IEA Iron and Steel Technology Roadmap, 2020)



03. The value chain today

Critical minerals are an essential part of decarbonisation. India has limited reserves of minerals and depends heavily on imports. These minerals have limited availability on the “spot” market and require long term supply agreements and partnerships. With the exception of iron ore, coal, manganese and to a certain extent zinc, India is a significant importer of critical minerals.

Figure 12: Indian import of minerals by country of origin, 2019
(Source: The Observatory of Economic Complexity (OEC), 2019)



Indian import of minerals

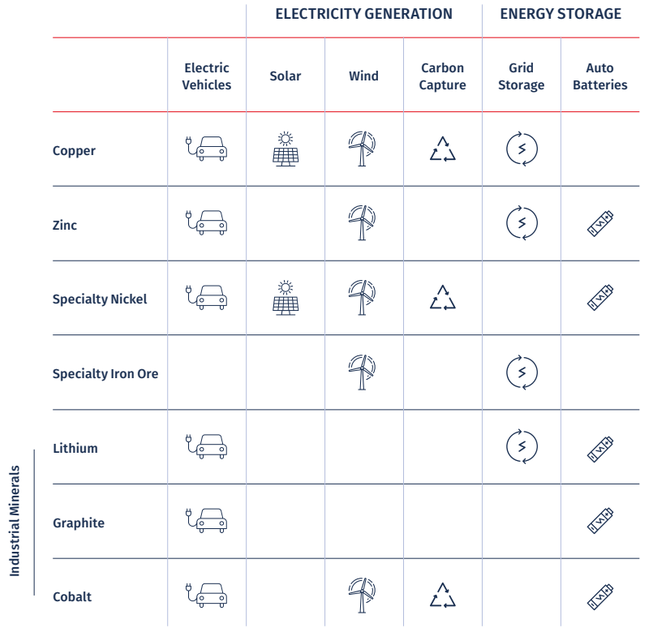
Commodities	2018-19	2019-20	2020-21
Bulk Minerals	*36,969,698*	*39,862,159*	*29,796,224*
Copper ores and conc.	*823,937*	*821,555*	*415,136*
Tin ores and conc.	*6*	*-*	*2*
Zinc ores and conc.	*1,422*	*101*	*804*
Gold	*983*	*720*	*651*

(Note: Quantities displayed in Tonnes)

Decarbonisation requires India to significantly increase the import of minerals. These minerals are of interest to most countries across the world who are all seeking to uses the very same supply networks to provide the raw material necessary for decarbonisation. It is difficult at this stage to identify the carbon emissions attached to the actual production and consumption of these minerals.

In addition there are significant energy and water costs attached to the extraction and processing of each of these minerals. Identifying and quantifying these costs will require further detailed work.

Figure 13: Minerals required for clean energy technologies
(Source: IEA, The Role of Critical Minerals in Clean Energy, 2021)



Projected raw material requirements

Primary metals

Indian mobility and energy storage will drive an explosion in demand for battery storage and battery manufacturing capacity. It is anticipated that by 2030 India will require at least 375GWh of EV battery storage and 92GWh of grid storage.

This leads to a sharp rise in in demand for primary metals including cobalt, lithium, nickel, manganese, graphite and copper.

Both primary and recycled metal processes generate emissions in their own right and pose the same ESG concerns that all heavy industry activities do. It is important that emissions are measured across the value chain including raw material sourcing in order for emissions numbers to have any accuracy.

Figure 14: Growth to 2040 by sector
(Source: IEA, The Role of Critical Minerals in Clean Energy, 2021)

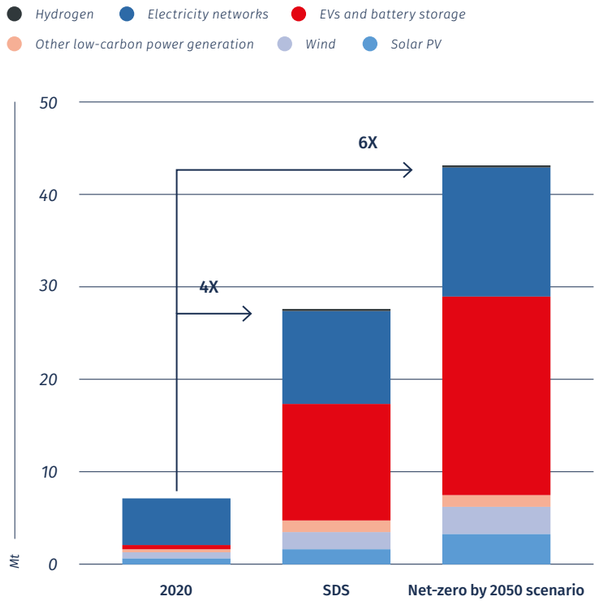
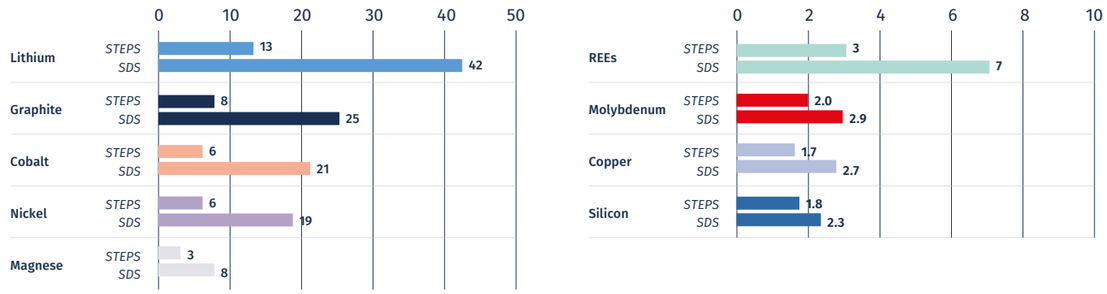


Figure 15: Growth in demand for selected minerals from clean energy technologies in 2040 relative to 2020 levels
(Source: IEA, The Role of Critical Minerals in Clean Energy, 2021)



Recycled metals

Recycling industrial metals and end products such as batteries present an opportunity to bridge the gap between the increased metal usage intensity posed by electrification and the supply constraints around primary metal.

The two most topical recycling subjects are 1) the recycling of scrap steel in Electric Arc Furnaces and 2) the recycling of batteries.

Electric Arc Furnaces have a key role to play in reducing emissions in a hard to abate sector by moving steel production towards scrap recycling. Constraining factors are the shortage of scrap steel and the need to bolster scrap quality with the addition of primary metallic feedstock (such as direct reduced iron).

Globally only 9% of spent batteries are recycled. This means most batteries end up in landfill and represent a loss of valuable metals. The large quantity of batteries and other metal rich products which are discarded represent a valuable resource which is currently under-utilised.

There remain significant issues with recycling materials. Current recycling methods such as pyrometallurgical procession have environmental and emission issues attached to them.

Ethical standards

Ethical standards for mineral procurement cover responsible sourcing, low carbon production, innovative extractive and processing technology and development of recycling opportunities.

The London Metals Exchange (LME) responsible sourcing standards on mineral procurement provide an excellent framework for evaluating the procurement and use of critical minerals for a sustainable future.[3] Passporting of minerals and transparency of sourcing will lead to differential pricing and financing of minerals which comply with these standards.

[3] *https://www.lme.com/en/Company/Responsibility/Responsible-sourcing*

Sources of future material requirements

Development timelines

Minerals and metal supply chain sources pose significant challenges to decarbonisation timelines. The current mining operations in the world do not have the capacity to supply the increased metal usage intensity electrification requires.

New mine development takes many years. It is not unusual for identification of a new geologic deposit to take decades. Following that the process of understanding the deposit, designing and building a mine can take as long as 15 years. In addition most deposits prove to be uneconomic which means that most early stage mining projects end in failure.

Recycling existing minerals provides a limited answer as the intensification of demand means that there simply is not enough metal available to recycle in order to meet increased metal usage.

Extraction methodologies

It is important to realise that much mineral extraction requires processes which are energy, water and chemical intensive. There has been limited work done to date in measuring the impact of the increased use in the processes.

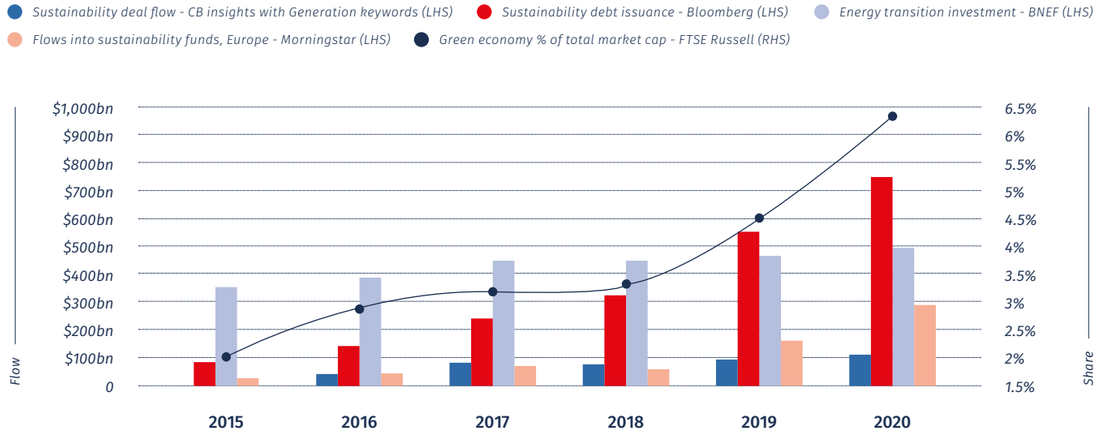
Environmental impact trade offs

The building blocks of decarbonisation involve significant natural resource and energy usage. The trade offs involved in moving carbon emissions to other parts of the supply chain are often not understood and have not been analysed in the depth required. It will be critical to ensure the decisions behind decarbonisation recognise and evaluate these conflicting trade offs.

04. Finance

Capital markets have undergone a revolution since the signing of the Paris Agreement in 2015. Over this time, sustainability-aligned debt issuance including green bonds has grown by over nine times; in Europe flows into sustainability-aligned fund products has grown by x10. This trend is only accelerating. Almost 300 financial institutions have joined the Glasgow Financial Alliance for Net Zero. Asset managers representing $43 trillion and asset owners representing $9.3 trillion in assets under management have committed to net zero by 2050 or earlier.

Figure 16: Trends in sustainability-related finance, 2015-2020
(Source: CB Insights; Bloomberg; BNEF; Reuters; FTSE Russell; Generation)



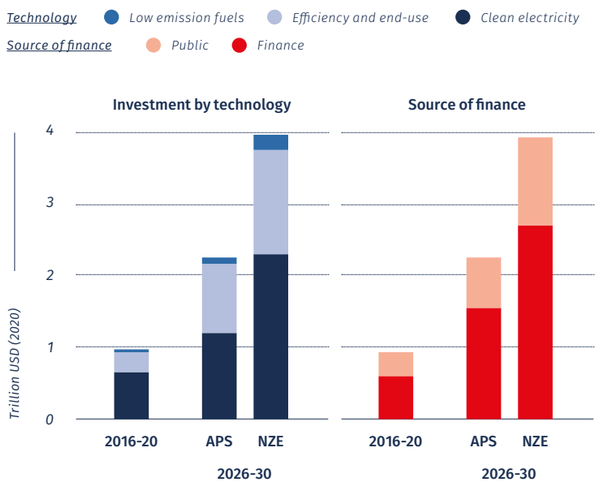
This reorientation of capital has driven a voracious appetite for green and transition projects globally. Throughout 2021, green bond issuances have been consistently oversubscribed. According to the Climate Bonds Initiative, a third of corporate green bonds issued in H1 2021 achieved a 'greenium' – a lower cost relative to a vanilla bond.[4] Indian corporates have been less active on global markets - London Stock Exchange, the largest rupee denominated Masala bond centre globally, currently hosts 43 masala bonds - and have only issued a small number of green bonds.[5] Although none have yet achieved a 'greenium', recent issuance including from the industrial sector have been oversubscribed.

In parallel, investors are rapidly developing sophisticated capabilities with which they assess the transition across different sectors. For example, widely-used the Transition Pathway Initiative has recently announced it will expand its coverage from 400 to 10,000 corporates.[6] There are strong reasons to believe that the hard coding of sustainability preferences into investment mandates will continue to directly impacting Indian firms. This will offer downside as well as upside. For example, AXA and NN Investment Partners both excluded State Bank of India green bonds from their investment portfolios at the end of 2020 over exposure to coal.[7]

[4] *https://www.climatebonds.net/files/reports/cbi_pricing_h1_2021_03b.pdf*
[5] *FICCI & City of London Corporation, 2021, "Drivers of Sustainable Finance in India"*
[6] *https://www.transitionpathwayinitiative.org/publications/89.pdf?type=Publication*
[7] *https://www.environmental-finance.com/content/news/nnip-joins-axa-im-in-ditching-state-bank-of-india-green-bonds.html*

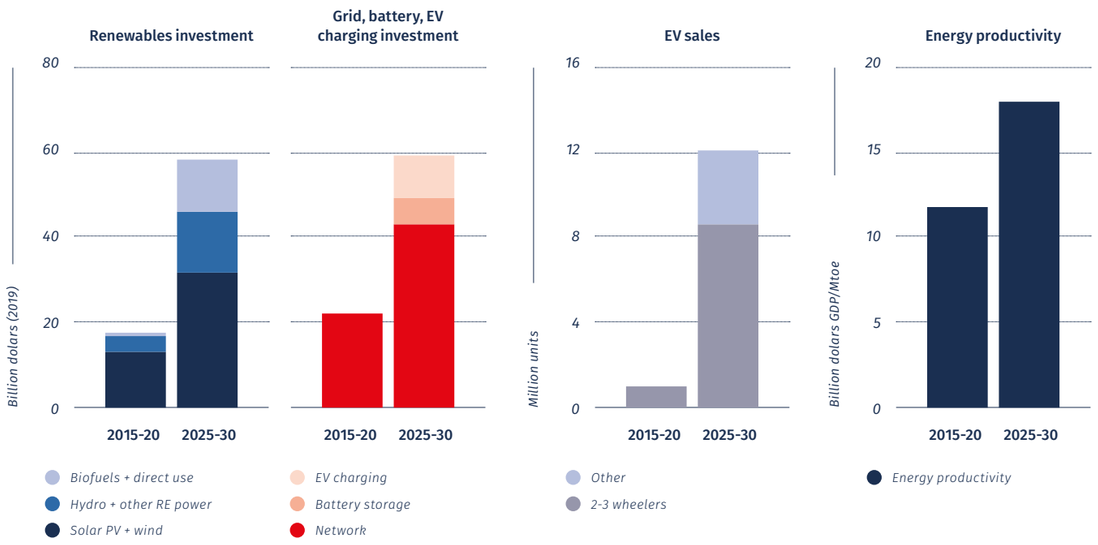
Despite the growth of sustainable finance, increased investor sophistication, and emerging evidence of pricing differentials, capital mobilised to date remains small when compared against need. As the IEA's World Energy Outlook 2021 makes clear, green investment must grow by x2-4 times to realise decarbonisation goals.

Figure 17: Scale of global investment by IEA decarbonisation scenario
(Source: IEA)



A similar trend is evident for India, where investment projections under the IEA's Sustainable Development Scenario call for a tripling of investment in renewables, grid, batteries, and charging infrastructure. Moreover, it is clear that the bulk of this investment must come from the private sector.

Figure 18: Investment required for India under IEA SDS Scenario
(Source: IEA)



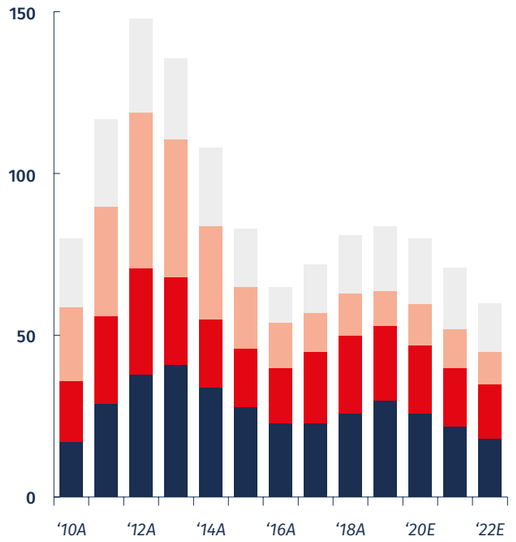
The UK is a natural partner for Indian corporates as they seek to raise sustainable capital. The UK is widely recognised as the leading financial centre for green finance.[8] Almost half the £9.4tn managed by UK-based asset managers integrates ESG factors.[9] London's banking industry is well-positioned to provide expertise on structuring projects, with many banks having already build sophisticated sustainable finance capabilities in London. The specialty London Market is in a unique position to insure infrastructure-associated projects for its global reach and deep reserves of capital.

There are already significant India-UK partnerships accelerating investment into the energy transition[10], sustainable mobility[11], and industrials[12]. This reflects a rising interest in Indian green projects from global investors. Recent interest also includes TPG Rise Climate investing in a new venture by Tata Motors focused on electric vehicles and charging infrastructure[13]; and Actis announcing just under 15% of their expected $6bn Actis Energy 5 fund would be allocated to Indian opportunities.[14] But to date, these partnerships and investments have focused on downstream infrastructure.

In comparison, there has been a significant shortage of financing available to raw material producers. The significant overcapacity in the natural resources sector following the last commodity boom led to declining investment levels in the natural resources sector and an emphasis by large mining companies on deleveraging their balance sheets rather than developing new mines.

The natural resources sector has struggled to access equity and debt financing. In addition, financial institutions have struggled to differentiate between natural resource firms based on their application of the most appropriate ESG standards. The highly technical nature of the industry, long project development lead times spanning multiple commodity cycles and multiple jurisdictions has made it hard for financial institutions to differentiate between actual and perceived risk.

Figure 19: Global mining CAPEX spend (US$bn)
(Source: S&P Global Market Intelligence)



[8] *https://www.longfinance.net/publications/long-finance-reports/global-green-finance-index-8/*
[9] *https://www.theia.org/sites/default/files/2021-09/IMS%20report%202021.pdf*
[10] *Green Investment Group, Thomas Lloyd, EverSource.*
[11] *bp Ventures, CDC Group.*
[12] *Standard Chartered, Macquarie, HSBC.*
[13] *https://therisefund.com/news/tata-motors-raise-1-bn-its-passenger-electric-vehicle-business-valuation-91-bn-tpg-rise*
[14] *https://www.act.is/media-centre/press-releases/actis-reaches-final-close-on-actis-energy-5-with-us-6-billion-of-investable-capital/*

05. Investment opportunities

There are significant opportunities across all parts of the value chain from sourcing and processing critical minerals, offtake agreements between mineral producers and end users and technology.

India is increasingly focussed on strategic vertical integration to provide security of supply for the raw materials and technology necessary for all aspects of electrification including generation, transmission and storage. The critical raw materials which will be in increasingly short supply include copper, lithium, nickel, cobalt, zinc and rare earths.

Investment opportunities in particular include:

- Pricing Differentials: Developing a market for commodities which differentiates between critical minerals based on ESG metrics. The existing LME rules on responsible sourcing provide an excellent standard to build on. Extraction, processing and transportation of minerals is an energy intensive activity and there will be premium pricing for energy efficient minerals. For example aluminium produced using hydropower is priced at a premium to aluminium produced using more carbon heavy energy. Further research on developing the framework for ethically sourced minerals and differential pricing between minerals sourced from different processes.
- Mineral Offtake Agreements: Industrial end users dependent on critical minerals require security of supply but do not wish to directly invest in the complex and highly specialised world of mining. Offtake contracts between specialist finance companies, miners and end users are becoming increasingly popular. The London market is well positioned to develop these transactions and route capital towards offtake agreements. Government support programmes such as export finance to support offtake partnerships
- Supply Growth: The UK has a well-developed mining industry with significant experience in mineral exploration and processing. India will seek to invest in these capabilities as it seeks to use technology to further enhance its critical mineral sourcing
- Capital Markets Scrutiny: Develop standard frameworks for aligning offtake with ESG metrics
- Innovation Partnerships: The UK holds a strong cleantech sector that is set for explosive growth, which will be driven by global cleantech exports. Partnering these innovations with Indian institutions for commercial and technical cooperation can help accelerate solutions for green industrial metal production and mineral extraction and processes. There is a need to identify participants in battery and storage technology research, along with the areas of investment within battery chemistry and recycling. Battery technology is a key driver of critical mineral usage. The chemistry of batteries is evolving rapidly and standards are still being developed. Investments in developing more efficient battery technology will continue to be attractive.

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