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DELHI CHAPTER

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CONTENTS

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2023 IIM Distinguished Contributor Award

Dr. Ramen Datta, Executive Committee Member of IIM Delhi Chapter, has received the **2023 IIM "Distinguished Contributor Award".** This Award was conferred to him at Bhubaneswar during the IIM-ATM Annual Event on 23rd November 2023. This Award was bestowed to him in recognition of his significant contributions and commendable efforts made by him towards promotion of IIM activities over the last 40 years.

Dr. Ramen Datta graduated from B.E. College, Shibpore in 1978 and obtained his Ph.D. in Materials Science from IIT Delhi in 1982. He joined RDCIS, SAIL, Ranchi in 1982 and contributed immensely to steel research in the areas related to product development, process innovation and application engineering. After his superannuation from SAIL in 2016 as GM I/C (Steel & Refractory), Dr. Datta is serving as a Consultant to the Steel Research and Technology Mission of India (SRTMI) under the aegis of Ministry of Steel, Govt. of India.

Dr. Datta made significant contributions towards the development of a wide variety of special steels, which are commercially produced in large tonnages and are extensively used today for diverse applications in engineering, infrastructure, defense, linepipe and auto segments. He has also made outstanding contributions in application engineering and weldability evaluation of special steels. Due to his efforts, "Safe Welding Packages" were designed and developed for the benefit of the end-users. Besides publishing more than 110 papers in national and international journals of repute, he has 25 patents to his credit.

Dr. Datta, over the last 40 years, has contributed to IIM in different capacities. He has served as an Editor of Trans IIM during 2000-03. He served as Secretary of Ferrous Division and Joint Secretary of IIM during 2007-10. Dr Datta played a vital role in organizing the NMD/ATM at Kolkata and Coimbatore in 2009 and 2015 respectively. Besides, he served as Secretary of IIM Bokaro Chapter during 2009-11 and IIM Delhi Chapter during 2021-23. Dr. Datta played a key role in organizing MMMM 2022 Conference and Exhibition in 2022, a flagship event of IIM Delhi Chapter.

He is a Life Fellow of the IIM and Member of Editorial Board of *Steel Technology*. He is also a recipient of the prestigious "Metallurgist of the Year Award", conferred by the Govt. of India, O.P. Jindal Gold Medal by IIM, and Metallurgy and Material Science Gold Medal, SAIL Gold Medal and Visvesvaraya Gold Medal by The Institution of Engineers (India).

Our Congratulations to Dr. Ramen Datta.

HyIron to Start Producing 15,000t of Green Iron a Year

The Oshivela project, in Namibia, developed by start-up *HyIron*, which received €13m ($13.87m) funding from Germany's federal government, is due to start producing 15,000 tonnes of green iron a year from the end of 2024. The developer plans to ramp annual production up to one million tonnes, drawing from 18MW of wind power capacity and 140MW of solar, although an exact timeline for this scale up is unclear. For now, the plant will use 20MW of solar PV, with electrolysis on-site.

HyIron is considering exporting the green iron produced at Oshivela to German steelworks, which could reduce emissions from the vast quantities of coking coal, currently used in fuel blast furnaces.

The developer has already commissioned a pilot direct iron reduction plant in Lingen, Germany earlier this year, which would process Namibian ore.

Located in the south of the African continent, Namibia has often been singled out for its potential to produce green hydrogen at low cost due to strong wind and solar resources, as well as vast tracts of greenfield land for large project development.

This project could be a sign that rather than try to integrate hydrogen-based DRI into Europe's traditional steelworks and depend on imported volumes of H_2 - already considered difficult to transport over long distances - these industries may reconfigure the value chain to import green iron produced close to where renewable hydrogen production will be cheapest, before processing it into steel.

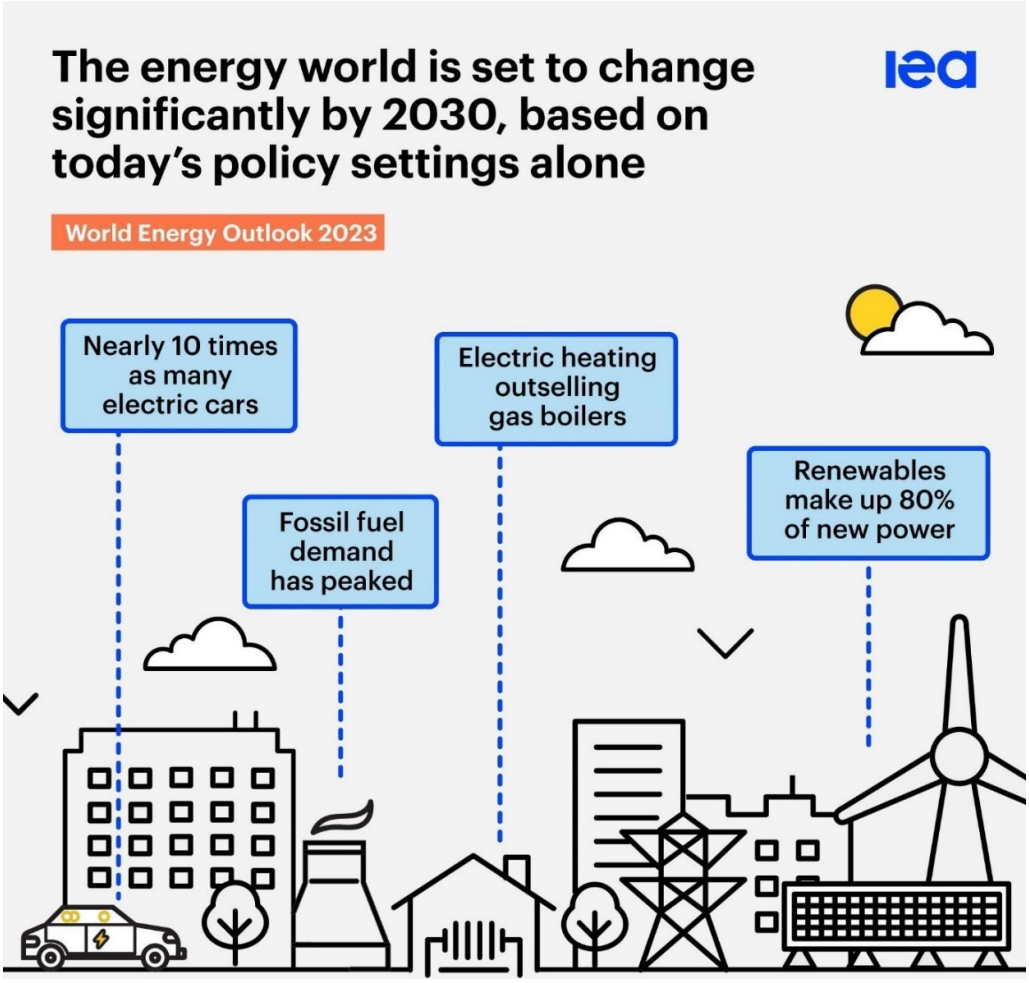
Source: Accelerate Hydrogen Newsletter; 9.11.23

What Will Our Energy System Look Like in 2023

IEA is projecting that global demand for oil, coal and natural gas is set to peak this decade based on today's policy settings alone, according to World Energy Outlook 2023, the Agency's flagship report, which was released on 24 October.

The transition to clean energy is happening worldwide and it's unstoppable. It's not a question of 'if', it's just a matter of 'how soon'. And with the inflection point for fossil fuels demand in sight, the global energy system is expected to look very different by 2030

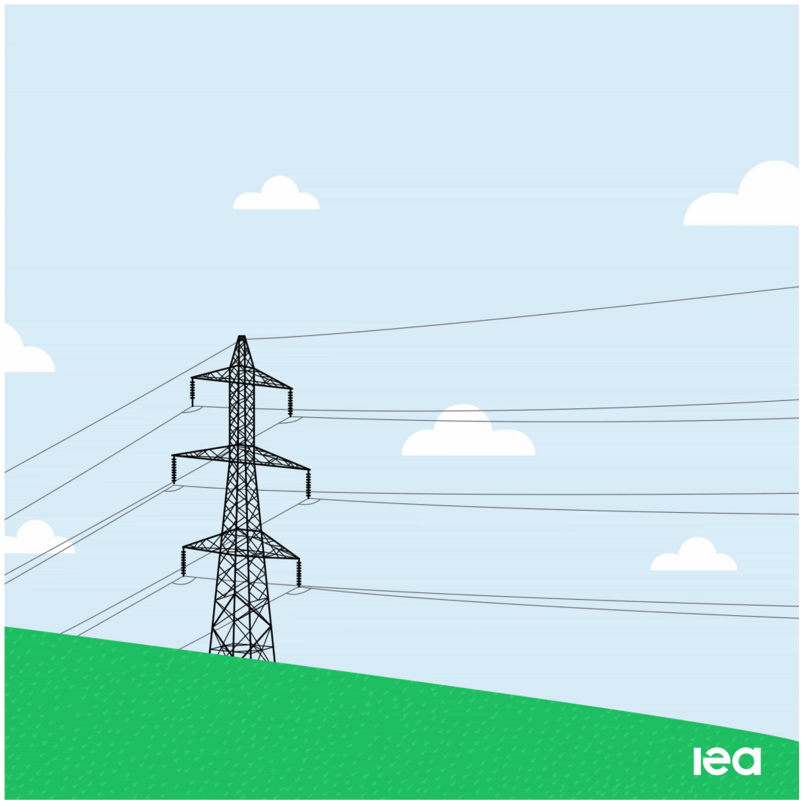
But as things stand, demand for fossil fuels is set to remain far too high to keep within reach the Paris Agreement goal of limiting the rise in average global temperatures to 1.5 °C. This risks not only worsening climate impacts after a year of record-breaking heat, but also undermining the security of the energy system, which was built for a cooler world with less extreme weather events.



One key area where more development and increased investment are needed is electricity networks. **Grids** have formed the backbone of electricity systems for more than a century, delivering power to homes, factories, offices and hospitals – and their importance is only set to rise as electricity's role in energy systems increases.

The first ever global study on grids, *Electricity Grids and Secure Energy Transitions*, in October 23 showed that to meet national climate targets and support energy security, the world must add or replace 80 million km of grids by 2040, equal to all grids globally today, to meet national climate targets and support energy security. In addition, grid investment needs to nearly double by 2030 to over USD 600 billion per year. However, emerging and developing economies,

excluding China, have seen a concerning decline in grid investment in recent years, despite robust electricity demand growth and energy access needs.



Cross-border power trade in Southeast Asia

Grids are not just a domestic issue. The Asia-Pacific region is key to the global clean energy transition and cross-border power system connectivity is an important facilitator, as it enables the integration of higher shares of renewable energy, reduces energy costs, and increases energy security.

In Southeast Asia, rising attention and importance are given to the topic due to the renewal of the ASEAN Power Grid Memorandum of Understanding (APG-MOU), and the expectations to accelerate the implementation of decarbonisation policies.

Reliable data is crucial for energy transitions

To achieve a net-zero energy system by mid-century and limit global warming to 1.5°C, there's an urgent need to increase renewable capacity and improve energy efficiency. However, it is expected that the planned increase in renewable

capacity by 2030 shall fall short of our climate goals, particularly in advanced economies and China. Large energy consumers, such as businesses, have a key role to play in filling this gap, but a key challenge they're facing, particularly in emerging economies, is the lack of reliable data. Quality data, and access to it, is crucial to support clean energy strategies, measure progress and report associated emissions reductions.

While data availability has improved, the growing complexity of the energy system still poses challenges. Data transparency, integration and protection are essential to address these issues.

To ensure efficient power system operation, policymakers should prioritise data governance to define data ownership, access, and security in collaboration with industry. Leveraging power system data for improved efficiency and making investments in digitalization self-sustaining requires policymakers to create mechanisms for capturing its value. Robust reporting standards should be in place, ensuring data quality, location, and clean energy attributes are effectively recorded, reducing the reporting burden. Promoting safe third-party access while protecting private information and fostering cross-border collaboration with common principles can lead to more cost-effective, mass-market data solutions.

Source: IEA's Clean Energy Transitions Newsletter - November 2023

MENA Poised to Become a Leading Green Iron and Steel Hub

The Middle East and North Africa (MENA) region is well equipped to produce cheap green hydrogen due to its excellent solar resources, but exports look inefficient and expensive.

MENA should instead prioritise using green hydrogen domestically to become a global leader in the emerging green iron trade, where it already enjoys a significant advantage due to its established use of direct reduced iron (DRI) technology.

As the global steel sector decarbonises, the MENA region is well placed geographically to supply the key and emerging markets for green iron and steel. But global green iron competition is already growing.

Middle East and North Africa (MENA) region could become a world leader in truly green steel and the newly emerging green iron trade.

Using its plentiful solar energy resources to produce green hydrogen for direct reduced iron (DRI)-based steelmaking, the region is perfectly placed to supply the key steel growth market of India and green steel demand centres like Europe. However, MENA must act quickly and decisively to capitalise on the opportunity, amid growing competition from iron ore mining nations including Australia, Brazil and Canada.

Rather than trying to find a viable way to export green hydrogen, which looks inefficient and expensive to transport, the region should prioritise domestic use such as in its DRI plants. Steelmakers around the world are already transitioning from blast furnace-based production towards DRI technology that can run on green hydrogen. MENA has an advantage given its steel sector is already based on DRI, with established access to both direct reduction-grade (DR-grade) iron ore and the renewable energy resources that will allow it to produce cheap green hydrogen in the near future – or the green iron it can make from them.

CCUS's poor track record of underperformance strongly suggests it will not be a key solution for steel sector decarbonisation – and nor will 'blue hydrogen' (produced from fossil fuels with carbon capture). Green hydrogen will soon outcompete blue hydrogen on cost as well as emissions.

Iron production is expected to dislocate from steel production as the global steel sector decarbonises. More iron ore will be processed in places with excellent renewable energy resources that can produce cheap green hydrogen, with the resultant iron shipped to centres of steel demand. MENA can be a global leader in the emerging green iron trade, but it faces strong competition in Australia, Brazil and Canada.

The MENA region's access to high-grade iron ore is already set to increase. Vale, the world's largest producer of DR-grade iron ore, is planning green iron "Mega

Hubs" in the Middle East that will supply iron ore pellets to co-located DRI plants to produce hot briquetted iron (HBI) for local consumption and export.

Steelmakers in South Korea and Japan are already considering the import of HBI from places such as the Middle East and are planning projects that would initially use fossil gas before switching to green hydrogen as it gets cheaper. Stricter definitions of phrases like 'green steel', 'near-zero emissions steel' and 'low carbon steel', are expected in near future. Although MENA steel production has low carbon intensity compared to global standards, DRI produced using gas may not meet the definition of 'green steel' for long. This will also apply to steelmakers employing CCUS or using blue hydrogen.

Europe's meaningful carbon price is already seeing it taking a lead in steel sector transformation and green steel demand. A truly low-carbon local steel industry would give MENA a further advantage over other regions as Europe's carbon border adjustment mechanism comes into force. The import of green HBI is likely to be crucial in Europe's efforts to decarbonise its steel sector, and MENA is ideally placed geographically to supply it.

Carmakers are leading global green steel demand growth and Saudi Arabia's ambitions to become a major car manufacturer means it can become a key offtaker of green steel made in the region.

MENA is also well positioned to supply India, the key steel demand growth market globally. Decarbonisation of India's steel industry will occur later than Europe, but probably faster than expected given the historical speed of technology transitions.

MENA's steel sector is already expanding, with numerous plans for new DRI-based plants in Saudi Arabia, Oman and the UAE that will initially run on gas before eventually transitioning to hydrogen. Although gas-based DRI is less carbon-intensive than coal-based blast furnaces, this expansion will still add to MENA nations' domestic carbon emissions at a time when pressure to increase emissions reduction ambition is increasing.

A refocus from green hydrogen exports towards more domestic use can help the region achieve its domestic emissions reduction targets as well as positioning its steelmakers for the global iron and steel sector of the near future.

Source: IEEFA Friday Week in Review,
Institute for Energy Economics and Financial Analysis, 16 Nov. 2023

JFE Mulls Building 'One of the World's Largest' EAFs

Japanese steelmaker JFE Steel aims to build a new large-scale electric arc furnace to replace the No. 2 blast furnace at its Kurashiki plant by 2027 to cut CO_2 emissions.

The steelmaker is considering building an EAF that can produce 2Mt of high-grade steel when the No. 2 unit is due for refurbishment. The EAF would reduce CO_2 emissions by 2.6Mt/yr from current levels emitted by the blast furnace.

JFE is thinking of building one of the world's largest EAFs to produce high quality steel to be used for automotive steel sheets and electrical steel sheets.

JFE plans to import low-carbon steel-making raw material, or reduced iron produced using natural gas and carbon capture storage (CCS), from the United Arab Emirates (UAE).

By utilising low-carbon materials, JFE want to realise the world's first large-scale supply system for green high-grade steel that is comparable to the blast furnace method.

JFE is also working to develop new and cleaner steelmaking methods at blast furnaces using hydrogen and methanation, but the use of EAF is a feasible and quick solution to reducing emissions during the transition period.

Source: Weekly News from Steel Times International, 22.11.23

'Hydra' Project Drives 100% Hydrogen Fuelled Steel Production

Italian consultancy firm RINA has announced the launching of a six-year research project, called 'Hydra', to build a 100% hydrogen-fuelled steel production pilot plant. The €88 million project is being backed by the European Commission as an IPCEI (Important Projects of Common European Interest) project. The goal of the project consists of the design and construction of a pilot plant that will use hydrogen in every stage of the steel production cycle and is expected to make up to seven tonnes of different grades of steel per hour.

Currently aimed for completion by 2025, the facility will include a 30-metre high direct iron ore reduction (DRI) tower using hydrogen as a reducing agent, an electric furnace (EAF) and a reheating furnace.

Beyond the technological advancements, the truly unique nature of this project is its position as an open research facility. It is not intended or designed to provide commercial advantage to any one steel producer, rather move the industry, and the world, forward in the use of 100% hydrogen production with near zero emissions. This is why the Hydra project has been supported, since its inception, by leading European steel producers, plant suppliers, utilities, and major stakeholders in the sector.

Weekly News from Steel Times International, Nov. 1, 2023

POSCO to Make All Steel via Hydrogen Route by 2050

South Korean steelmaker POSCO is planning to produce all its steel via the hydrogen reduction method by 2050.

The company is currently looking to finalize the commercialization of its HyREX technology by 2030, and hopes to convert its Pohang and Gwangyang steel plants to those based on hydrogen technology by 2050.

POSCO will replace existing production methods such as the blast furnace method with the HyREX method at Pohang Works in 2033. By 2050, the company will complete hydrogen reduction steel production systems at Pohang Works and Gwangyang Works (three systems at each and six systems in total).

POSCO is developing 'HyREX' based on POSCO's FINEX fluidized reactor. FINEX, which was first commercialized in 2007, is a facility that can directly use cheap, powdery iron ore and bituminous coal to produce steel without any preliminary treatment of raw materials, claims POSCO.

In July last year, the company signed a business agreement with British plant supplier Primetals, which designed the FINEX facility with POSCO, to supply a tentative HyREX facility. The test facility will be built in 2026 to confirm the possibility of commercialization. The company will then complete the commercialization of HyREX technology by 2030.

Source: Weekly News from Steel Times International. Nov 29, 2023

Steel: A Sustainable Solution for Future Mobility

For decades, steel has been the traditional material of choice for automotive applications, and it now can be the sustainable option for future mobility. This is best demonstrated by World Auto Steel's *Steel E-Motive programme*, which has developed one of the world's first fully autonomous, battery electric vehicle body structure concepts for ride sharing, that fully comply with global high-speed crash standards.

Steel E-Motive shows how autonomous, steel-based, ride sharing vehicles used within a green grid can significantly reduce CO_2 emissions.

Steel E-Motive is the culmination of a three-year research programme led by World Auto Steel in partnership with global engineering firm Ricardo. Since programme results were highlighted in August '23, there has been considerable interest in its transformative sustainability capability, especially its potential to reduce total lifecycle greenhouse gas (GHG) emissions by up to 86%. The figure is based on a comparison with a reference 2022 battery electric vehicle (BEV) and an expected production date for *Steel E-Motive* of between 2030-35. It was ascertained through life cycle analysis (LCA) carried out by Ricardo's LCA experts. The focus of the analysis was on GHG emissions and total energy consumption

from the vehicle manufacture and assembly, vehicle use and end of life/recycling phases.

Steel E-Motive takes advantage of the fact that Advanced High Strength Steel (AHSS) is the only automotive material that can have a reduced environmental impact in all three key phases of the vehicle life cycle: manufacture, use and end-of-life.

Manufacturing safe, efficient and economical vehicle architectures

The design of the vehicle using Advanced High-Strength Steel (AHSS) brings several sustainability benefits. *Steel E-Motive* can be produced using existing global manufacturing and supply resources, which eliminates the need to build new plants and machinery to produce them. Steel E-Motive's design and engineering focuses heavily on minimising material thickness, reducing the amount of material it requires, and maximising material utilisation through efficient manufacturing processes that reduce scrap. Steel E-Motive's use of an AHSS body structure, purpose-made for electric vehicles, achieves a 27% mass reduction in the body structure – from an expected steel reference vehicle of 374 kg to 282 kg, a mass that is competitive with multi-material vehicles. This not only means fewer emissions in use, due to the vehicle being lighter, but less material production and emissions in the first place. Further weight savings come from intelligent battery packaging that is 37% lighter than average reference battery pack structures at 27% less cost. AHSS also assures safety: Steel E-Motive's design is engineered to meet global high-speed crash regulations that can achieve the IIHS 'Good' rating. In all, Steel E-Motive has seven Advanced High-Strength Steel structural innovations that provide safe, efficient and economical vehicle architectures.

Already-efficient steel moving to decarbonisation

The automotive industry is increasingly focusing on the manufacturing stage of its materials to drive down the overall lifetime emissions of their vehicles. Steel already scores well in its primary production: alternative materials have emissions that are between six and 17 times higher at this stage. Steelmaking, already a highly efficient industry, is moving as swiftly as it can towards decarbonisation, with many efforts underway. One example is the use of techniques such as Direct Reduced Iron (DRI), which utilises hydrogen as the

reducing agent instead of coal-based coke to chemically reduce the iron ore to metallic iron. Combining a DRI process using 'green' hydrogen (produced by water electrolysis powered by renewable electricity), with electric arc furnace (EAF) steel production which utilises higher percentages of recycled steel, provides the best overall potential for decarbonised steel production, according to Steel E-Motive's Engineering Report. Currently a small number of DRI pilot production facilities are in operation, with many larger scale plants under construction or planned to be operational within Steel E-Motive's envisaged timeframe. By 2035, a significant proportion of the steel in a vehicle's construction is expected to be manufactured using decarbonised production methods.

Gains from green electricity and drive cycle smoothing

Emissions from the generation of the energy expended during a vehicle's use phase is an important consideration. The greening of the electricity grid will account for the single most important change and the highest reduction in emissions.

While green electricity is a key factor, autonomous vehicles also contribute other emissions reduction potential. One important element is known as drive cycle smoothing. The vehicles' advanced gathering of data enables them to optimise acceleration and deceleration, for example predicting traffic signals and adjusting speed accordingly. This means they use less energy to cover the same distance – with a predicted reduction in energy consumption of around 15%.

Steel E-Motive is designed for Mobility as Service (MaaS), where one of the key advantages is to increase passenger occupancy rates, meaning fewer vehicles will be required to transport the same or a greater number of people. Steel E-Motive's urban concept version accommodates up to four passengers per vehicle; an inter-city version accommodates as many as seven passengers. Autonomy also helps: with no driver, there is more room for passengers. High-strength steel, coupled with design efficiency, also means that the interior can be maximised relative to the vehicle's footprint, giving interior designers the greatest scope to make it as inviting as possible for people to share rides. This can significantly reduce the CO_2 per passenger-kilometre.

Consumers must feel comfortable enough to use this transport, with maximum capacity regularly achieved, in order to make the greatest impact towards total emissions reduction. That is why a highly crashworthy, spacious and open vehicle cabin, as Steel E-Motive demonstrates, is key towards attaining consumer confidence, and ultimately, Net Zero ambitions.

MaaS will require vehicles to have a longer service life, at least twice the life of consumer-driven vehicles, which Steel E-Motive will make possible through AHSS's fatigue and durability properties together with the vehicle design, which enables easy replacement of battery modules.

Infinitely recyclable steel offers unparalleled end-of-life advantages

What happens at the end of a vehicle's life is also important within the life cycle. With an already established steel recycling infrastructure across the world, steel provides significant sustainability advantages. The envisaged greater use of EAF will drive up the use and demand for recycled steel, which is infinitely recyclable with no loss of quality.

The Steel E-Motive concept demonstrates that steel is thoroughly fit for purpose in the future mobility landscape. Steel must play a part in the emissions-reduction discussion. Steel E-Motive shows what autonomous, steel-based, ride-sharing vehicles used within a green grid can do to significantly reduce CO_2 emissions.

Steel E-Motive is the latest in a series of steel industry demonstrations over the past 25 years that showcases new AHSS applications for automotive structures. WorldAutoSteel, which comprises 18 global steel producers, is the automotive group of the World Steel Association. WorldAutoSteel led the Steel E-Motive project, working closely with Ricardo, who managed the overall engineering design, testing, and development.

Source: World Auto Steel Newsletter, *Oct 12, 2023*

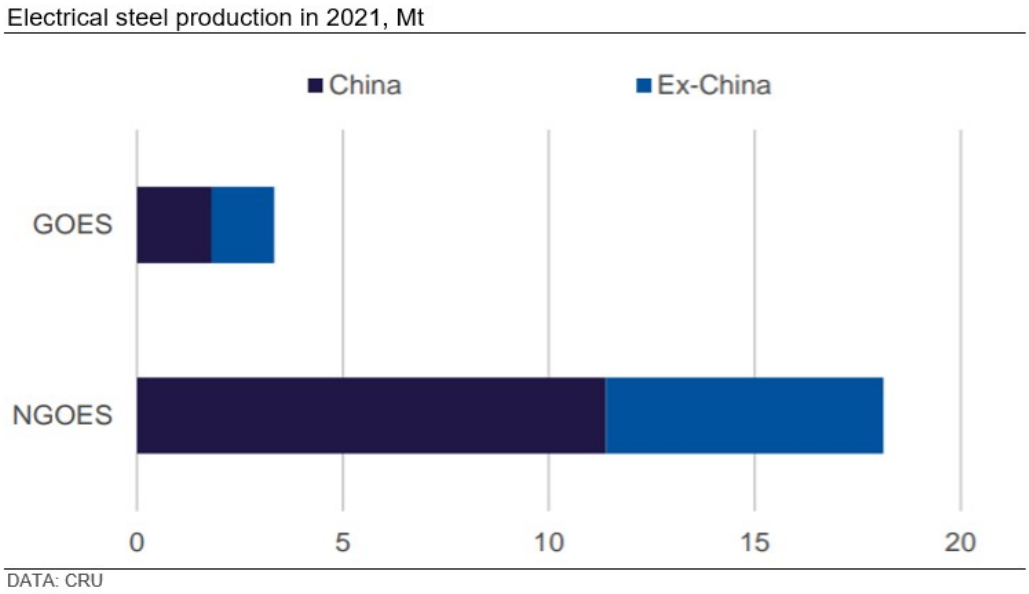
Electrical Steels

Commodities related to electrification normally talked about are copper, aluminium, critical battery materials such as lithium, nickel and cobalt. Electrical steel is often overlooked material - a small, niche segment of the steel industry. Everything with a motor and every transformer contains electrical steel. Many questions have been raised regarding the capacity of steelmakers to produce sufficient volumes of electrical steels, particularly as increasing efficiency standards and more challenging applications drive the need for higher-quality, lighter gauge material. The high levels of required capex, combined with complex, somewhat secretive production methods (with some IP issues as well) and finally the potential for materials substitution with a new generation of amorphous steels have left this segment of the market in flux.

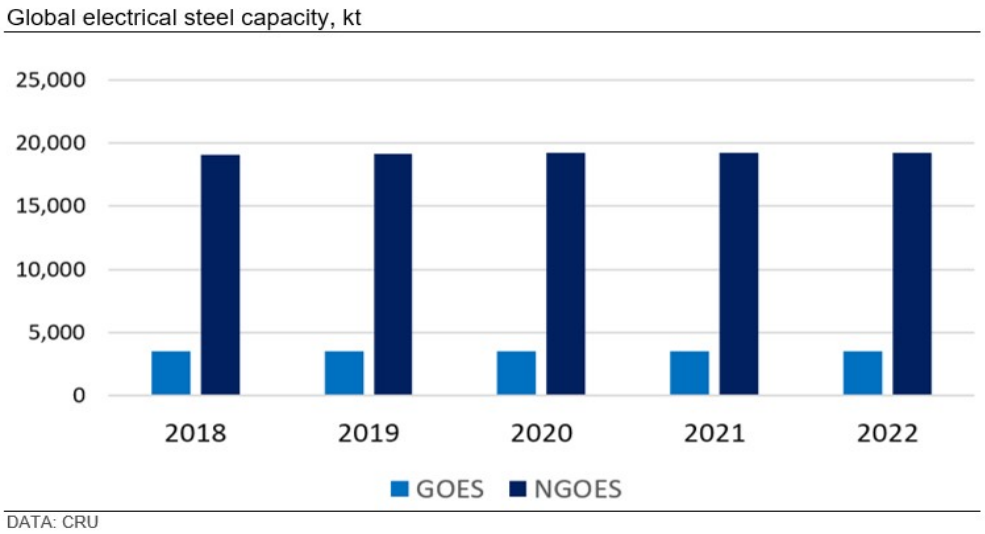
In most applications, steels are selected on the basis of mechanical properties – yield and tensile strength, hardness, toughness, n-values, and so on. Although mechanical properties are also important for electrical steels, it is the magnetic properties that are the key differentiator. High flux density (permeability), which is the amount of magnetisation produced in a material by an electric field) and low core loss, the amount of (unwanted) heat generated by an alternating magnetic field are the most important attributes of electrical steel.

Electrical equipment with rotating parts (such as motors) requires steels with isotropic (non-oriented) properties such as fully-processed non-grain oriented electrical steel (NGOES) or semi-processed cold-rolled motor laminates (CRML). Stationary electrical equipment (primarily transformers) utilises anisotropic grain-oriented electrical steel (GOES), where proper texture and material alignment allows for significantly higher flux density in the rolling direction.

As transformers are the only major consumer of GOES, the market is significantly smaller for that product than for NGOES, at ~1/3 the demand.

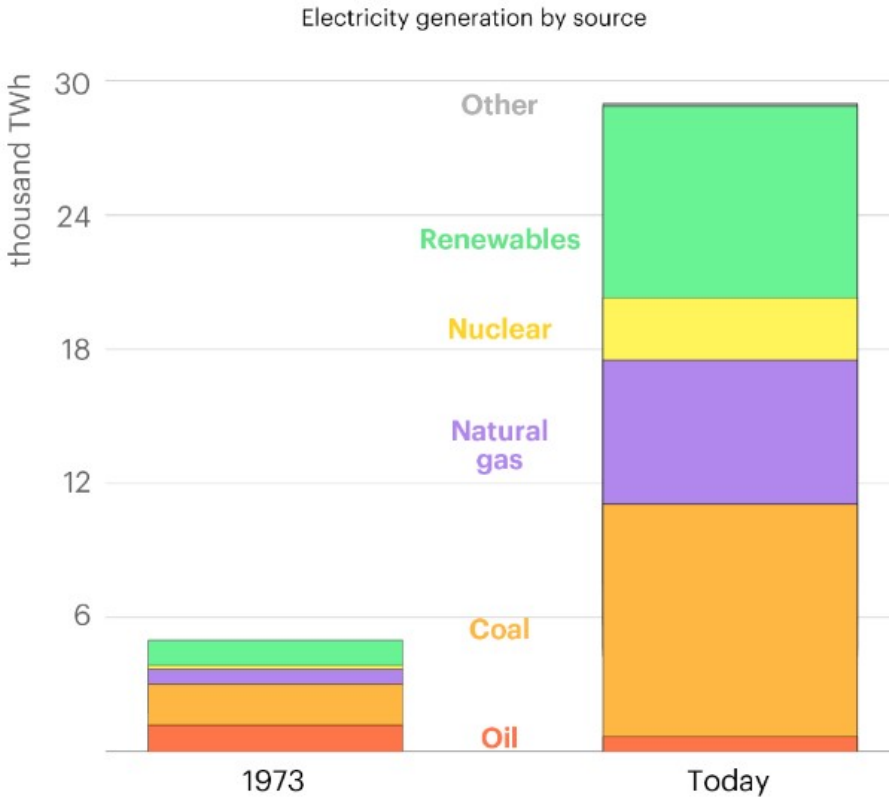


Electrical steels are high in silicon, which adds expense and complexity through the entire production process, including hot rolling, pickling, cold rolling, annealing and temper rolling. The complexity involved in both material development and production, combined with the relatively small size of the market limit production of these products to a handful of advanced mills, which have seen little reason to increase capacity over the past five years. Expected increases in demand will support capacity increases for certain types of electrical steels over the next few years, but this is not the case for all types of electrical steels.



Source: CRU Insights, 16 Oct. 2023

Energy Landscape 1973 and Now



Source: IEA Energy Mix Newsletter, 30 oct.2023

Copper Imports Jumps 30% in FY23

India's copper import bill increased 20 per cent year-on-year in FY23 in value terms to ₹27,131 crore (₹21,985) crore following a post-Covid economic recovery and improved demand, especially driven by electric vehicles and renewable energy segments.

Copper's demand is said to have a direct correlation with economic activities considering its wide usage across construction, home appliances, and other sectors.

According to a report from ICRA, refined copper imports increased 30 per cent in FY23 (by volume) and 180 per cent in H1 FY24.

Production Capacity

Due to low availability and increased usage, copper and copper concentrates are primarily imported into India; and form the raw material from which refined copper is produced.

India's current refined copper production capacity is 5.55 lakh tonnes in (FY 2022-23), making it the 10th largest producer of the metal, as per government estimates.

The spurt in imports in the last two years is due to increased copper refining demand, which reflects "a post pandemic recovery". The recovery is driven by growth in user sectors such as infrastructure, construction, telecom, electrical, renewable energy and electric vehicles. Incidentally, copper is one of the 30 critical minerals identified by the Centre, earlier this year.

Demand Growth

Domestic refined copper demand growth is expected to remain at around 11 per cent in FY24 and FY25, as per ICRA estimates, thereby outpacing the rate of global growth in copper demand.

In India, some 40 per cent of the copper is consumed by infrastructure and construction sectors, and,11-13 per cent each by automobile and consumer durable sectors. Push for affordable housing and EVs also propels the demand.

A new copper smelter of 0.5 million MT (mmt) by the Adani Group is expected to start from FY25 onwards, which, once stabilised, is likely to reduce the deficit situation to an extent.

Source: The Hindu Businessline, Dec. 11, 2023

Corrosion Poem

Mighty ships upon the ocean
Suffer from severe corrosion,
Even those that stay at dockside
Are rapidly becoming oxide.
Alas, that piling in the sea
Is mostly Fe_2O_3.

And where the ocean meets the shore,
You'll find there's Fe_3O_4.
Cause when the wind is salt and gusty,
Things are getting awful rusty.

We can measure, we can test it,
We can halt it or arrest it.
We can gather it and weigh it,
We can coat it, we can spray it.
We examine and dissect it,
We cathodically protect it
We can pick it up and drop it.
But heaven knows we 'll never stop it!
So here's to rust, no doubt about it,
Most of us would starve without it.

KNOW YOUR MEMBERS

N. VIJAYAN

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Professional Qualification	Mechanical Engineer
Current Occupation	Business Director, M/s Technotherma (India) Pvt. Ltd
Experience	51 Years in Design, Manufacturing, Installation & Commissioning of Heat Treatment Furnaces
Specialization field	Heat Treatment Furnaces
Designed & Developed Indigenously	Fuel/Electrically heated N_2 atmosphere Annealing Furnaces Fuel/Electrically heated H_2 atmosphere Annealing Furnaces Electrically heated Roller Hearth annealing furnaces Continuous Black Annealing Furnace Electrically Heated /Fuel Fired Colour Baking Ovens Conveyorized Furnaces & Ovens Pusher Type Furnaces Specialised non-standard Furnaces for research work: NPL/DRDO/TERI/MIHANI/BHEL etc.
Furnaces Commissioned Worldwide	France, Egypt, Turkey, Ukraine, Tanzania, Kenya, Ethiopia, Uganda, Senegal, Zambia, Mozambique, Nigeria, Vietnam, UAE, Saudi Arabia, and Nepal.
Awards	Outstanding Service achievement & Contribution to the Industry by GEC; Award from IIM DC for outstanding contribution to steel industry
Membership of Professional Bodies	Life Member IIM. Played active role in MMMM events of Delhi Chapter of IIM.