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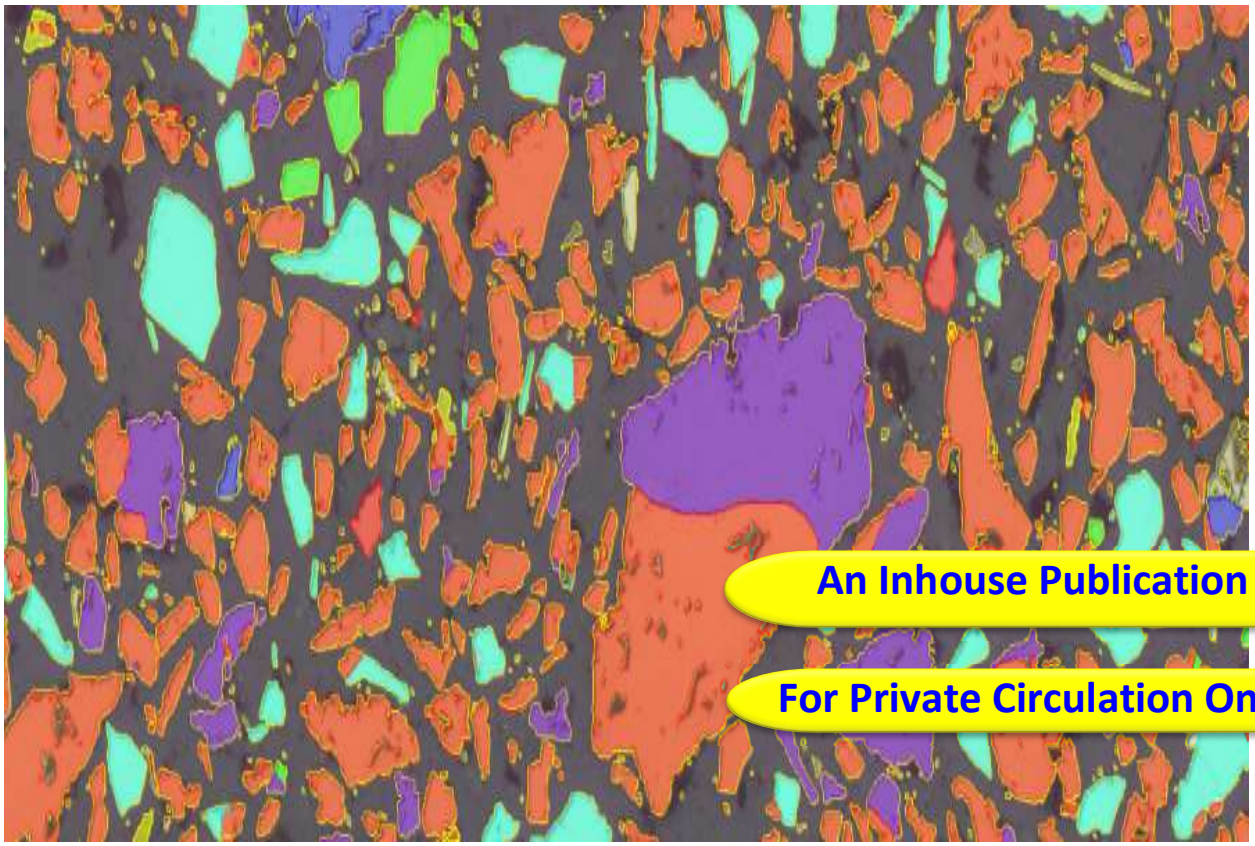

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Jawahar Dhatu Bhawan
39, Tughlakabad Institutional Area, M B Road
Near Batra Hospital, New Delhi-110062

Tel: 011-29955084

E-mail: iim.delhi@gmail.com

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Associate Editor: S.K. Varshney

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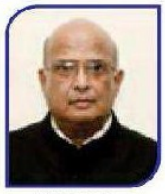

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Executive Committee Members: Contact Details

Name / Designation	Affiliation	Contact No / E-Mail
Shri R K Vijayavergia *Chairman*	Ex. Executive Director Steel Authority of India Ltd	9650155544 rkv.sail@gmail.com
Shri Deepak Jain *Vice Chairman*	Former Dy. Director General (W) BIS	9868640986, 8368622619 deepakjain7177@gmail.com
Shri K R Krishnakumar *Hon. Secretary*	Consultant Ministry of Mines	9818277840; 01202773861 kuduvak059@gmail.com
Shri Ramesh Kumar Narang *Hon. Treasurer*	Consultant Odisha Coal & Power Ltd	9899298857 rknarang62@gmail.com
Shri M P Sharma *Hon. Jt. Secretary*	Scientific & Technical Consultant Aluminium Industries	9212202084; 9818508300 aluminiumconsultant@yahoo.com aflmps@rediffmail.com
Shri B D Jethra *Member*	Former Adviser Planning Commission	9818326878 jethra@yahoo.com
Shri K L Mehrotra *Member*	Ex CMD MOIL	9810203544;klm91048@gmail.com klmehrotra48@gmail.com
Shri K K Mehrotra *Member*	Ex CMD MECON Limited	9868112514; 01203645267 kishorekmehrotra@gmail.com
Shri Manoranjan Ram *Member*	Vice President, Head of Sales & Marketing Danieli Group	99100149989 manoranjanram@yahoo.com m.ram@danieli.com
Shri N K Kakkar *Member*	Former Vice President Somani Kuttner India Pvt. Ltd.	9871008505 nirmalkakkar@gmail.com
Dr. Ramen Datta *Member*	Consultant Steel Research & Technology Mission of India	9958084110 dattaramen@gmail.com
Shri N Vijayan *Member*	Director Technotherma India Pvt. Ltd.	9818695690 technothermaindia@gmail.com
Shri G I S Chauhan *Member*	Former ED I/c, RDCIS, SAIL	9717302437; 7048993116 gisc.delhi@gmail.com
Shri Ram Gopal *Member*	Former ED SAIL	9968605059 ramgopal.sail@gmail.com
Dr. Rahul Sharma *Member*	Director India International Zinc Association	9910299297 rsharma@zinc.org
Shri Anil Kumar *Member*	Ex Tata Steel	7763807077 kvsa2009@gmail.com
Prof. Nitya Nand Gosvami *Member*	Associate Professor Dept. of Materials Science & Engg., IIT Delhi	9958887964 ngosvami@iitd.ac.in
Prof. Suddhasatwa Basu *Special Invitee*	FIPI Chair Professor IIT Delhi	7838134181 drsbasu@gmail.com
Dr. Mukesh Kumar *Special Invitee*	Sr. Adviser JSP Group	9650080849; 9584032329 drmukeshkumar@gmail.com
Shri R K Sinha *Special Invitee*	Ex Director (Operations) Modern Steels Ltd	8968684955 rksinha555@gmail.com
Shri R K Singhal *Invitee*	Consultant Steel Research & Technology Mission of India	9910055630 rksh.singhal@gmail.com
Shri Sushil Kumar Varshney *Invitee*	Director/CEO Academy of Industrial Management Delhi	9312672831 acadim@gmail.com
Shri B R Jain *Invitee*	Sr. Adviser Engineering Council of India	9313190011 jainbinay@gmail.com
Shri Ashok Kumar Khatri *Invitee*	Director Technotherma India Pvt. Ltd.	9818695689 ashokkhatri10@gmail.com

15th Steelie Awards of WSA

World Steel Association announced winners of *15th Steelie Awards* on 14 October 2024. The Steelie Awards recognise member companies for their contribution to the steel industry over a one-year period. Award winners in different categories are given below:

Excellence in low-carbon steel production:

- *China Baowu Steel Group Corporation Limited* **– *HyCROF commercial demonstration project***

Global climate change is becoming increasingly severe, and green low-carbon development has become a global consensus. The steel industry is a pillar of the national economy and holds significant importance for the stable development of the socio-economic landscape. As one of the major sources of carbon emissions, the steel industry can enhance its competitiveness in the international market and promote the development of the industry towards high-end and green directions by promoting and applying original low-carbon metallurgical technologies.

China Baowu has established the world's first 400m^3 industrial-grade low-carbon metallurgical test platform, the Hydrogen-Rich Carbon Recycling Oxygen Furnace (HyCROF). It has overcome major technological difficulties such as full-oxygen smelting, safe high-temperature gas heating, composite injection, gas self-circulation, and hydrogen rich smelting. This has enabled the application of efficient and low-cost CO_2 capture technology for metallurgical gas, and completed the entire process of the HyCROF low carbon ironmaking technology.

In 2023, fossil fuel consumption decreased by 30% for the 400m^3 industrial-grade HyCROF, demonstrating a carbon reduction capability of over 23%, and verifying the technical and economic feasibility of the HyCROF process.

Currently, the HyCROF technology has been further extended to the technical transformation of Baowu's 2500m^3 blast furnace, and it was put into operation on September 28, 2023. This marks the application of the 2500m^3 large and medium-sized HyCROF commercial demonstration project, initially achieving a 27% reduction in fossil fuel consumption, a 19% increase in output, and a 16% reduction in carbon emissions.

Next, the HyCROF will achieve greater carbon reduction through projects such as green electricity substitution, steel-chemical co-production of CCUS, and hydrogen metallurgy. This will create the first long-process carbon-neutral demonstration production line in the steel industry, continuing to contribute to China's green and sustainable development and providing practical solutions for the green and low-carbon transformation of the global steel industry.

Innovation of the year:

- *POSCO* **– *Innovative PosZET® welding technology for eco -friendly / lightweight/ cost-effective auto parts***

As a company, POSCO offers products and solutions that help to mitigate direct and embedded carbon emissions. The company's solutions are designed to reduce total GHG emissions across the life cycle of a product through direct reduction of the carbon footprint and also by offering positive tools, or handprint solutions, which will help users of products and solutions to reach their own sustainability goals.

PosZET® is a handprint solution offered through our proprietary welding technology. When applied, this packaged steel and welding technology produces eco-friendly, lightweight, and cost-effective automotive parts.

A leading benefit of PosZET® is that the weight of parts is made lighter owing to the enhanced durability of the welded parts, resulting in reduced steel gauge and weight. Additionally, the parts manufacturing process is made more sustainable and cost-efficient.

First, because PosZET® technology enhances welding efficiency and productivity, less power and heat are required, thereby improving part durability and reducing total CO_2 produced per component manufactured. Secondly, acid descaling, a key pre-treatment process that improves the welded part's resistance to corrosion, can be omitted, helping to prevent emissions and to save production costs. Finally, PosZET® is immediately applicable in existing facilities; hence, customers can benefit from instant impact without the burden of heavy CAPEX.

POSCO has launched PosZET® GIGA, a welding technology customised for giga steel that offers unrivalled performance. Nissan, a global OEM, recently approved PosZET® GIGA for use in its new vehicle, underscoring its quality and cost-effectiveness.

Finally, PosZET® aligns with the company's corporate vision to be a leading global provider of eco-friendly future materials; hence, it has been introduced as a key milestone in the company's sustainability report and featured in the scientific journal Nature Communications.

With the demonstrated benefits of this welding technology, the goal is to pioneer future handprint solutions in and beyond the automotive industry

Excellence in sustainability:

- *Gerdau S.A.* **– *ESG in the supply chain***

Gerdau, with a 123-year history, is Brazil's largest steel producer and has one of the lowest greenhouse gas (GHG) emissions in the industry. It is the largest scrap metal recycler in Latin America, producing 70% of their steel from this material. Besides producing iron ore for their own consumption in some of their Brazilian operations, they are also the world's leading producer of charcoal for their own consumption. They manage 250,000 hectares of forest used for charcoal production and for the conservation of native forests, thereby preserving biodiversity.

Nationally, Gerdau is recognised for their advanced diversity and LGBTI+ inclusion practices. In addition, the company has set targets for women in leadership and GHG emissions reduction, both linked to the long-term encouragement of senior leaders, thus reinforcing their commitment to these issues:

Women in leadership target: To achieve 30% of women in leadership positions by 2025, up from 25.7% in 2022.

Decarbonisation target: To achieve 0.82 tCO_2e/t of steel (scopes 1 and 2) by 2031, down from 0.86 tCO_2e/t of steel in 2022 (we also have the ambition of neutrality by 2050).

In addition to this, Gerdau has a diverse chain of suppliers, and bringing them in line with our values has become crucial. They have 18,000 business partners globally, 12,000 of whom are in Brazil.

In 2023, Gerdau issued purchase orders to more than 7,900 suppliers of Supplies Brazil (in the procurement of electricity and natural gas, direct and indirect

materials, and CAPEX), of which more than 2,500 have agreements and are spread throughout Brazil, which directly impacts local communities.

In order to encourage the supply chain to adopt governance, compliance, and human rights practices, as well as sustainable initiatives and exert control over their social and environmental management, Gerdau has implemented an ESG Management Journey in the supply chain, which includes the following initiatives: Inspire, ESG Clause, and ECOAR.

Excellence in Life Cycle Assessment:

- Tata Steel **– LCA methodology in multifunctional and circular systems**

Tata Steel has long recognised the importance of exploring multiple avenues to influence the development of robust LCA methodology for legislative and commercial applications. This has also included participation in relevant collaborative projects e.g. the COZMOS EU funded project, which concluded in October 2023 and in which Tata Steel took the lead role in the LCA Work Package. This project was focussed on Carbon Capture and Utilisation (CCU), which required the development of novel LCA thinking and approaches for multifunctionality and circular economy.

In seeking to further the discussion with the broader LCA community (a key influencer in shaping policy and regulation), Tata Steel proposed a session on 'Circularity, Recycling and Multi-functional Systems' at SETAC Europe Annual Meeting, Dublin, May 2023, along with leading academics Professors Tomas Ekvall and Jon McKechnie and Dr Cecile Bessou. The idea was accepted and the session ran successfully, with around 70 participants. Tata Steel provided one of the Chairs for the session and also made a platform presentation ('Exploring Life Cycle Assessment Methodologies for Multi-functionality in the steel sector with a CCU example'), disseminating some of the thinking emerging from, amongst others, the COZMOS project. The primary findings were that whilst the application of LCA to CCU can help support decision making and prioritising different technologies and CCU products, there are a number of methodological issues in dealing with CCU within LCA.

A significant first for the company (and, as far as we are aware, a rarity for the steel industry as a whole), a paper authored by Tata Steel was published in the

International Journal of Life Cycle Assessment, the foremost journal worldwide for methodological development and LCA studies.

The final element was manifested in the leadership role taken by Tata Steel personnel in developing methods and guidance on how to account for reuse and remanufacture in circular product systems. This involved setting up a Task Force, led by Tata Steel, to understand the different approaches being applied across sectors & regions and propose some methods that were interoperable with established LCA standards depending on the goal and scope of the study

Excellence in education and training:

- POSCO **– Quality-Safety-Stability (QSS) training programme**

Our steelworks have been visited by many political and business leaders, artists and journalists. A resounding comment heard from our guests regards the cleanliness of the mills and the plant complex.

The secret to keeping the facilities clean and organised lies in the Quality-Safety-Stability (QSS) programme, which invites every employee across different functions to identify operational issues on site and be part of the solution.

The QSS training programme equips all employees, from new hires to top management, with effective tools and methodologies to rapidly tackle issues such as inefficiency, redundancy and workplace hazards. Trainees learn how to apply proven improvement practices to tackle operational risk factors that could impact productivity and the working environment. Three features differentiate the QSS training programme from conventional operator training programmes.

First, rather than being one-off, learning modules are designed for each career level and delivered to employees throughout their professional life. The continuous training helps to ingrain our original approach to problems in the organisation.

Second, the programme contributes to generating tangible and immediate business outcomes by streamlining procedures and preventing duplication of resource use.

Third, the programme has attracted broad participation, which suggests replicability to other worldsteel members, big and small. For example, the

Improvement Leader Course of the training programme was completed by 1,325 SME employees, 1,528 individuals from business groups of other industries, and 14,654 from our workforce.

Excellence in communications programmes:

- POSCO **– Fantasteel**

To mark 50 years of the commissioning of its first steelworks, POSCO launched an advertisement campaign to promote the "value and sustainability of steel." In particular, the project defined the younger generation in their 20s and 30s, as the key audience. First, this demographic constitutes one-half of POSCO's workforce; hence it is important to speak to this population and to make them feel valued. Secondly, as a B2B business, general consumers have little contact with our company; this lack of connection is especially pronounced among younger generations. Hence, we wanted to promote appreciation for and familiarity of POSCO and our steel products.

To shed the heavy and monotonous impression of steelmaking, POSCO aimed to rebrand steel as an outcome of cutting-edge technology. Additionally, by taking advantage of the rapid traction gained by E-Sports among the 20-30s, we decided to fuse the two unlikely domains of steel and video games to launch a gamified ad campaign. The ad, named "Fantasteel," sought to transform the perception of steel from dull and uninteresting to attractive and engaging, qualities often attributed to video games. Fantasteel became Korea's first corporate ad produced in collaboration with a video game publisher.

The resounding message of the ad is that the "incredible steel-making technology" is what ensures peace in the world. To substantiate, a variety of POSCO's steel products are showcased as technological ammunition for battle in a fantasy world: GIGA steel, our ultra-high-strength steel; Multi-Material, a product that combines the strength of steel with the light-weight quality of aluminum; non-combustible color steel; high Mn Steel that withstands extremely low temperatures. The story concludes by highlighting that POSCO's technology prevails in advancing human civilization.

Touted as unique and unconventional by the advertising society, the ad is available on POSCO's YouTube channel and on Instagram among other social media platforms.

Use of Hydrogen in Steel Production: Effects on Refractories

The international refractories manufacturer RATH recently conducted a broad-based comparative corrosion study to investigate the effects of hydrogen on the refractory materials used in these plants and which ones withstand the changed stresses particularly well – and gained groundbreaking findings.

There are promising approaches towards decarbonization in the steel industry and therefore more sustainable steel production: Hydrogen-based direct reduction plants are going to play an important role in the future. The use of hydrogen in steel production means that the refractory material is exposed to different stresses. How do these new operating conditions affect corrosion behaviour and corrosion dynamics? How strong is the influence of temperature? And how do refractory materials have to be formulated to meet the individual requirements of a customer, thereby enabling optimal and cost-effective performance in direct-reduction systems? To this end, RATH has carried out comprehensive comparative corrosion tests.

Investigations into aluminosilicate and high-alumina refractory materials

In the course of this study, RATH's extensive non-basic product portfolio with a composition of 40–99 % Al_2O_3 was exposed to an H_2 atmosphere. Samples of lightweight refractory bricks, dense bricks, monolithic products, mats made of high-temperature wool and vacuum-formed parts were evaluated. The corrosion tests were carried out at the German Institute for Refractories and Ceramics (DIFK).

The temperature exposure was 1250 °C and 1400 °C in a 100-% H_2 atmosphere, with an exposure time of 200 hours. In addition, ageing at 1100 °C under a typical mixed gas atmosphere was performed specifically for use in direct reduction plants. Corrosion was assessed by determining the mass loss to be able to make statements about temperature dependency and corrosion rate. In addition to determining the physical properties, further chemical analyses and X-ray diffractometry measurements were carried out before and after exposure to provide further information on phase stability and new mineral formation.

Important findings from the study:

- High-corundum materials show very good corrosion resistance in all products.
- Under certain conditions (selected raw material usage and production parameters), mullite likewise proves a suitable material in an atmosphere containing hydrogen.
- Glass phases and SiO_2 phases are significantly reduced in the presence of high hydrogen contents.
- Foreign oxides and impurities in the overall system play a significant role with regard to stability in a hydrogen atmosphere.
- The porosity of refractory materials has only a minor influence on corrosion.
- In the temperature range of 1250 °C - 1400 °C, a significant increase in the corrosion rate was recorded.
- Phosphate-bonded fired bricks are only slightly more resistant to corrosion than phosphate-free products.

In summary, RATH's study results are highly relevant for future material selection in the respective application. The targeted further development of refractory materials and systems is particularly important for the transition to direct-reduction plants with additional hydrogen admixture and the goal of producing steel in a completely climate-neutral way in the future.

Source:www.rath-group.com/metals

Less than Half of Top 50 Steelmakers have a Net Zero Target

Less than half of the world's top steel producers have targets to reach net zero emissions by 2050, and even fewer track the full scope of emissions produced by their business, finds a new report from Global Energy Monitor and the Leadership Group for Industry Transition, hosted at the Stockholm Environment Institute.

The analysis of the top 50 steel producers - which rely more heavily on higher emissions steelmaking technologies than the global industry average and are responsible for more than 60% of the sector's emissions - follows the latest production ranking provided by the World Steel Association.

The International Energy Agency has said that CO_2 emissions from heavy industries need to drop 93% in order to reach net zero emissions by 2050.

According to the report, as of September 2024, half of the top 50 steel producers still lack a net zero target: 16 companies have not stated a net zero target in their public reporting, and nine companies have provided no information on climate targets at all. Five companies have targets to reach net zero after 2050.

17 companies have set a 2030 emissions reduction goal, three fewer top 50 producers than in the 2023 update. Two of these companies removed their 2030 goals, while one reduction is due to the shift in rankings of the top 50 steel producers.

The increase in target reporting among the top 50 steel producers is a positive sign of progress, yet it falls short of what is needed to reach net zero by mid-century. The top 50 steel firms can set an example of leadership as not only steel producers, but emissions reducers through target setting and collective action to reach net zero 2050."

Greater transparency from steel producers is essential to demonstrate commitment to decarbonization. While some companies have made initial progress, clearer plans are needed from the majority to reach net zero by 2050, including plans for specific emission scopes reductions. Establishing intermediate targets, tracking progress, and sharing updates publicly can motivate the sector to accelerate its transition towards net zero.

Source: Weekly News from Steel Times International, Nov 13, 2024,

CCUS for Steelmaking Rapidly Losing Its Lustre?

Summary

- *Mounting costs, challenges and failures stall carbon capture plans*
- *Six commercial-scale carbon capture, utilisation and storage (CCUS) projects for iron and steelmaking are in the development pipeline, up from three in 2023. However, the lack of available detail casts doubts over their development status and timelines.*
- *The Al Reyadah project in the United Arab Emirates (UAE) is still the world's only operational commercial-scale CCUS project for steelmaking. It captured only 26.6% of the gas-based steel plant's emissions in 2023. There are still no commercial-scale CCUS plants for blast furnace-based steelmaking in operation anywhere in the world.*

- *Carbon capture projects have continued to fail and underperform in other sectors. Equinor recently admitted over-reporting the performance of its flagship Sleipner CCUS project for years due to faulty monitoring equipment.*
- *Despite mounting evidence to the contrary, major steelmakers and miners such as Nippon Steel, ArcelorMittal and BHP continue to insist to their investors that CCUS will play an important role in meeting their decarbonisation targets.*

Hailed as the solution to reducing greenhouse gas emissions from steelmaking, carbon capture and storage's prospects in the industry look increasingly bleak, according to the Institute for Energy Economic and Financial Analysis (IEEFA).

Nonetheless, major steelmakers and iron ore miners such as Nippon Steel, ArcelorMittal and BHP continue to insist to their investors that the flawed technology will play a significant role in meeting their decarbonisation targets despite growing evidence to the contrary.

Behind the hype, the reality is few, if any, of these projects will likely enter operation. CCUS is predisposed to major financial, technological and environmental risks. Low capture rates is a key ongoing issue that is often under-appreciated. The amount of carbon targeted for capture at a project tends to be significantly below its overall emissions. Furthermore, CCUS projects consistently struggle to meet even these low capture targets.

For example, the world's only operational commercial-scale CCUS plant for steelmaking is the Al Reyadah project in the United Arab Emirates (UAE). In 2023, it captured only 26.6% of the gas-based steel plant's emissions, which are then used for enhanced oil recovery (EOR).

A C$2.4 billion CCUS proposal for power generation near Edmonton, Canada, was cancelled in May on the grounds it was not financially viable.

Revelations that the flagship Sleipner CCUS project off Norway had been grossly over-reporting its carbon capture rates for years due to faulty monitoring equipment.

Sleipner is often held up by advocates as proof of CCUS's technical feasibility. Instead, the project further highlights the risks of attempting to implement CCUS at scale around the world.

Of the six CCS projects in the global pipeline according to the Global CCS Institute, fundamental details remain undisclosed, unknown or “under evaluation”, casting doubt over their prospects (see table below). Should any reach completion, they face a host of technical, financial and site-specific challenges.

Despite 50 years of attempts, the cost of CCUS remains stubbornly high. Innovative steelmakers are looking elsewhere to reduce their emissions, moving away from coal-based production to direct reduce iron (DRI) steelmaking, a mature, proven technology that can run on green hydrogen.

Status of global commercial-scale CCUS projects for iron and steelmaking

Country	Facility Name	Project Status	Operational Year	Capture capacity ($MtCO_2$)	Storage Code
United Arab Emirates	ADNOC Al Reyadah	Operational	2016	0.8	Enhanced Oil Recovery
China	Baotou Steel	In Construction	2024	0.5	Under Evaluation
United States	Indiana Burns Habor Capture	Advanced Development	Under Evaluation	2.8	N/A
United States	ArcelorMittal Texas		Under Evaluation	Under Evaluation	N/A
United States	Nucor Steel DRI		2026	0.8	Under Evaluation
Japan, Malaysia	Japan Malaysia Steel CCS	Early Development	Under Evaluation	Under Evaluation	N/A
Spain	ArcelorMittal Sestao CCS		2025	Under Evaluation	Under Evaluation

IEEFA

A major obstacle is that blast furnace steel plants require multiple points of carbon capture to allow production of low-carbon steel, increasing the costs significantly.

There are still no commercial-scale CCUS plants for blast furnace-based steelmaking in operation anywhere in the world. The cost involved means capturing sufficient carbon at coal-based steelmaking sites will likely never be financially viable.

Virtually all steelmakers planning or constructing commercial-scale low-carbon steelmaking capacity will have to turn to hydrogen-based or hydrogen-ready DRI plants, not CCUS.

The 2030 project pipeline capacity of DRI plants has reached 96 million tonnes a year (Mtpa) while commercial-scale CCUS for blast furnace-based operations remains stuck on just 1Mtpa.

The cost of green hydrogen – a key enabler of truly low-carbon iron and steel production – is also high but has a much better chance of declining through economies of scale and renewables cost reduction.

CCUS for blast furnace-based steelmaking is being left behind by a better alternative that can outcompete it on both cost and emissions reductions.

Source: IEEFA Friday Week in Review, IEEFA.org

British Steel Launches Carbon Capture Trial

A trial using 'ground-breaking technology' to capture carbon emissions from British Steel's Scunthorpe plant has started.

While electrification of the steelmaking process will reduce emissions of carbon dioxide by more than 75%, the company is exploring routes to provide further reductions in CO_2e intensity. This includes the development of technologies for capturing CO_2 generated by other parts of its manufacturing operations.

To support this, and the development of the required technology, a mobile carbon capture pilot plant has been installed at British Steel's Central Power Station in Scunthorpe.

The plant has been developed by the University of Sheffield and will be used to extract carbon from the power station's boiler flue.

If the trial works, it could be scaled-up and play an important role in carbon capture, utilisation and storage. The trial will demonstrate the technology's potential.

British Steel's involvement is part of a wider project by the University of Sheffield which aims to enable the use of waste gases from manufacturing industries like steel and glassmaking to generate an alternative source of carbon for consumer products.

The technology, which is called FluRefin, was developed by Professor Peter Styring and Dr George Dowson from the University of Sheffield in partnership with AESSEAL – the Rotherham-based seal manufacturer. FluRefin uses a novel pressure swing adsorption process – a technique used to separate some gas species from a mixture of gases. This produces purified and importantly, anhydrous (dry) carbon dioxide as the product.

With the support of SUSTAIN, a steel manufacturing research hub, the University team have created a carbon capture system that, claims British Steel, avoids the use of environmentally hazardous chemicals and is cheaper and smaller than other carbon capture technologies.

The CO_2 captured at British Steel will be bottled in gas cylinders and transported back to the University of Sheffield where it will be converted into synthetic transport fuels.

Source: Weekly News from Steel Times International, 06 Nov. 2024

FerroSilva Process

The Royal Swedish Academy of Engineering Sciences has selected *FerroSilva* project for Innovation through interdisciplinary research.

Selection by The Royal Swedish Academy of Engineering Sciences highlights a diversity of research projects from Swedish universities, on the theme *Technology in the service of humanity – innovation through interdisciplinary research.* Through selection, the projects have been judged to have great potential to create benefit, through commercialization, business and method development or social impact.

Participating researchers are interested in increased contacts with business for the application and continued development of their projects.

The FerroSilva process has the potential to turn the steel industry into a carbon sink. This in an economically justifiable way, with a globally scalable concept and without the need for large investments in new electricity production.

The process radically reduces greenhouse gas emissions by using residual products from forestry and agriculture to produce sponge iron as a raw material for future steel production. An iron raw material that is cost-effective, carbon dioxide negative and that consumes less than 10% of the electrical energy that the hydrogen processes require.

The process simultaneously generates liquid biogenic carbon dioxide on an industrial scale for e-fuels and more.

The plan is to build a first production plant with a capacity of 50 ktons of sponge iron per year, which is estimated to be put into operation in 2028. After that, there are plans for two larger plants with a capacity of 500 ktons per year each to be put into operation in the years 2031 and 2034.

At the moment, work is underway with preliminary design and financing of the first facility.

Source: Green Steel World News Update, 14 Nov. 2024

Greenhouse Gas Emissions Surge to New Record in 2023

Greenhouse gas levels surged to a new record in 2023, rising by more than 10% in just two decades, according to a report by the World Meteorological Organization (WMO).

In the course of 2023, large vegetation fire CO_2 emissions and a possible reduction in carbon absorption by forests combined with stubbornly high fossil fuel CO_2 emissions from human and industrial activities to drive the increase, according to the WMO's annual Greenhouse Gas Bulletin.

The globally averaged surface concentration of carbon dioxide reached 420 parts per million (ppm), methane 1934 parts per billion and nitrous oxide 336.9 parts per billion (ppb) in 2023.

These values are 151%, 265% and 125% of pre-industrial (before 1750) levels. These are calculated on the basis of the long-term observations within the Global Atmosphere Watch network of monitoring stations.

We are clearly off track to meet the Paris Agreement goal of limiting global warming to well below 2 degrees Celsius and aiming for 1.5 degrees Celsius above pre-industrial levels. Every part per million and every fraction of a degree temperature increase has a real impact on our lives and our planet.

The 2023 increase of CO_2 in the atmosphere was higher than that of 2022, although lower than that of the three years before that. The annual increase of 2.3 ppm marked the 12th consecutive year with an increase greater than 2 ppm.

In the last 20 years, the CO_2 level has increased by 11.4% (42.9 ppm) above the level of 377.1 ppm recorded in 2004 by WMO's Global Atmosphere Watch network of monitoring stations.

From 1990 to 2023, radiative forcing — the warming effect on our climate — by long-lived greenhouse gases increased by 51.5%, with CO_2 accounting for about 81 per cent of this increase, according to the National Oceanic and Atmospheric Administration Annual Greenhouse Gas Index cited in the WMO Bulletin.

As long as emissions continue, greenhouse gases will continue accumulating in the atmosphere leading to global temperature rise. Given the extremely long life of CO_2 in the atmosphere, the temperature level already observed will persist for several decades even if emissions are rapidly reduced to net zero.

The last time the Earth experienced a comparable concentration of CO_2 was 3-5 million years ago, when the temperature was 2-3 degrees Celsius warmer and sea level was 10-20 metres higher than now.

Source: World Meteorological Organisation Report

Top Green Energy Producers

A recent study focused on renewable energy sources like solar, wind, and hydroelectric power, evaluating the output relative to population size by analyzing energy production per 100,000 people of various countries.

The Netherlands leads the world in this race, producing 171.93 megawatts (MW) per 100,000 capita, placing it at the forefront of renewable energy development. Germany follows closely, generating 161.09 MW per 100,000 people, while Spain ranks third with 130.44 MW.

The study also revealed that 11 of the top 20 countries pioneering green energy are in Europe, with others located across Asia, Africa, North America, and Latin America. Renewable energy sources are key to our future as they do not produce polluting emissions.

Source: OneGreenPlanet website

Global Methane Pledge

Methane is the second most important greenhouse gas contributor to climate change following carbon dioxide. On a 100-year timescale, methane has 28 times greater global warming potential than carbon dioxide and is 84 times more potent on a 20-year times scale. Methane makes up 16 % of all greenhouse gas emissions.

The Global Methane Pledge (GMP) was launched at COP26 by the European Union and the United States. In September 2024, 156 additional countries have joined the GMP agreeing to take voluntary actions to collectively reduce global methane emissions at least 30 percent from 2020 levels by 2030. Meeting the GMP target would reduce methane emissions to a level consistent with 1.5°C pathways while delivering significant benefits for human and ecosystem health, food security and our economies.

The GMP Champions group comprises Canada, the European Union, the Federated States of Micronesia, Germany, Japan, Nigeria and the United States. Together they are working to advocate for methane action and accelerate implementation of the GMP at the international and domestic levels.

The Climate and Clean Air Coalition (CCAC) and the International Methane Emissions Observatory (IMEO) act as GMP core implementers by providing critical support in operationalisation of the GMP. The CCAC also provides secretariat services to the GMP

Global Methane Pledge (GMP) Champions, including Canada, the European Union, the Federated States of Micronesia, Germany, Japan, Nigeria, and the United

States, encourage all GMP countries to cover methane in their next nationally determined contributions (NDCs) under the Paris Agreement, utilizing, where appropriate, the Climate and Clean Air Coalition's new NDC guidance manual.

The GMP Champions call for acceleration of methane mitigation action leveraging technical and financial assistance alongside data-driven solutions.

The Champions invite GMP countries to showcase critical new progress toward meeting the pledge at the GMP Ministerial at COP29 in Baku, Azerbaijan to ensure that we avoid the worst of the climate crisis and keep the 1.5 °C warming target within reach.

With methane emissions continuing to rise around the world, contributing to warming and leading to devastating impacts on both the planet and human health, Global Methane Pledge (GMP) Champions are urging all GMP countries to accelerate action on methane mitigation and communicate information on how reductions in methane, as well as other super pollutants, will contribute to the implementation and achievement of their NDCs. GMP Champions play a unique role in galvanizing further progress towards reaching the goals set by the Pledge, to collectively reduce global methane emissions by 30% from 2020 levels by 2030.

This year is critical to include methane reduction measures more explicitly in national climate policy planning. NDCs are at the heart of limiting warming, embodying efforts by each country to reduce national emissions. The inclusion of information on how methane reductions will contribute to the implementation and achievement of countries' NDCs, including in the first Biennial Transparency Reports (BTRs), in a way that enables tracking of progress under the GMP, will be critical to realize necessary measures and keep the Paris Agreement long-term temperature goal within reach.

To support countries with methane mitigation planning, the CCAC has prepared a guidance document for countries on how to address methane as well as other super pollutants in NDCs. In this guide, national governments will find specific recommendations on how to assess and incorporate measures to mitigate methane in national climate plans, strengthening the climate, environmental, social, and economic outcomes of NDC implementation.

Recognizing the need for credible data to drive mitigation, GMP Champions also urge governments to leverage the Methane Alert and Response System (MARS) – which provides transparency on global super-emitting incidents. Also, recognizing that not all jurisdictions have robust reporting frameworks, the GMP Champions encourage private companies operating in these jurisdictions to join the Oil & Gas Methane Partnership (OGMP) 2.0, to improve emissions management with accurate data. The Champions further urge all GMP stakeholders to engage via IMEO's Methane Data Platform.

"Temperatures are rising quickly and breaking records around the world. It is more and more urgent to work together for a liveable planet now and into the future. Reducing methane emissions remains one of the fastest and most cost-effective ways to do this.

Methane is a very potent greenhouse gas, that has contributed already by one third to global warming. Germany has undertaken effective measures in the waste and energy sectors with a ban of municipal solid waste dumpsites, phasing out coal mining, and utilizing and destroying all remaining coal mine methane from the closed mines.

Most of the 100 million tonnes of hydrogen produced each year is made from methane. Some of this methane leaks during extraction, processing, transportation and hydrogen production. This is a major problem because methane is a highly potent greenhouse gas. So called "blue hydrogen" uses carbon capture and storage to reduce CO_2 emissions. But if even if CCUS can achieve high CO_2 capture rates – and that's a very big if! – many blue hydrogen projects still have a significant methane problem.

Despite this well documented problem, many hydrogen standards allow hydrogen producers to use generic national level emission factors, therefore underestimating hydrogen's true climate impact.

At COP 28 in Dubai last year, the number of countries to have signed the Global Methane Pledge reached 155, committing to reduce methane leakage in 2030 by 30% compared to 2020.

If governments and companies are serious about 1.5 degrees, about the energy transition, they should commit to and require robust site-specific reporting of any

methane leakage. And there should be clear thresholds about what levels of leakage are acceptable.

Renewable green hydrogen is indispensable for the energy transition. Lending credibility to blue hydrogen, with significant methane leakage would be a huge step in the wrong direction.

Methane emissions need to be reported with accuracy, granularity and transparency. Carbon capture and sequestration must be permanent, demonstrable and verified.

Source: RMI Spark Newsletter, October 31, 2024

Electrochemistry-Based Carbon Dioxide Removal

In 2019, there were only three companies using electrochemistry for carbon dioxide removal (CDR). As of March this year, that number had grown to at least 24, with some companies raising over $20 million each. This growth is perhaps unsurprising given the promise of electrochemistry for CDR. Electrochemistry, defined as the study of relationships between electrical energy and chemical reactions, has the potential to significantly simplify and reduce the energy requirements of key CDR approaches like direct air capture.

The role of electrochemistry-based CDR in a diversified CDR portfolio

A diverse range of carbon removal approaches is essential to meet the unique needs of various geographies and industries. Synthetic carbon dioxide removal (sCDR) approaches — those that rely on engineered systems powered by low-carbon energy to capture CO_2, such as direct air capture — offer advantages like a smaller physical footprint and precise measurement and permanence of carbon removed. However, they typically require the most energy and are more expensive compared to other CDR methods. Electrochemistry stands out as a promising avenue to reduce both energy consumption and associated costs.

The promise of electrochemistry in CDR

Electrochemistry has five benefits that can support lower-cost scale-up of CDR:

1. **Lower energy use (reduces OpEx):** Direct air capture systems first capture CO_2 from the atmosphere to create a concentrated stream, then release

that concentrated CO_2 for utilization or storage. For this release step, electrochemistry can target CO_2 bonds directly, using less energy than, for example, systems that require heating an entire reactor to release the captured CO_2. This benefit is somewhat similar to that of induction cooking: induction stoves are more efficient since they use electromagnetism to directly heat pots and pans instead of heating the air around the cooking surface as a more traditional electric stove would do. Electrochemistry similarly allows us to convert electricity directly into a desired chemical reaction instead of using heat or pressure to release the CO_2.

2. **Simplified systems (reduces CapEx and OpEx):** By avoiding complex temperature and pressure swings found in some direct air capture systems, electrochemistry-based systems are simpler, cutting both CapEx and OpEx.

3. **Modular designs (reduces CapEX and OpEx):** Electrochemistry enables adaptable, modular system designs suitable for various environments and energy sources, facilitating standardization and mass production.

4. **Valuable byproducts:** Producing valuable byproducts like hydrogen not only supports the energy transition but can also enhance overall project economics.

5. **Application beyond CDR:** Electrochemical technologies can be leveraged in other sectors, including energy storage, green hydrogen production, wastewater treatment, desalination, chemical production, and drug discovery.

India's Li-ion Battery Storage Demand to Reach 54 GWh by 2027

Demand for lithium-ion battery storage in India is expected to expand to 54 gigawatt-hours (GWh) by fiscal year 2027 from currently around 15 GWh driven by the push to decarbonise electricity grids and the increasing penetration of electric vehicles (EV). This level may even reach 127 GWh by 2030.

Domestic demand is currently met through imports of lithium-ion cells/batteries. This is expected to decline sharply to 20% by 2027 from near-full dependence presently, due to giga-size integrated battery capacities coming onstream.

Government policies and incentives, including the Advanced Chemistry Cell (ACC) Production Linked Incentive (PLI) scheme and state subsidies, are expected to drive the development of giga-scale lithium-ion battery manufacturing.

India has allocated 40 GWh of integrated battery capacities under PLI, with the remaining 10 GWh expected to be awarded shortly. Additionally, existing conventional battery manufacturers and few other companies in India are expected to set up battery capacities outside of the scheme.

Source: asian-power.com

A New Generation of Cheaper Batteries for the EV Industry

A form of lithium-ion battery called LFP is becoming increasingly popular among automakers due to its advantages on cost, safety, and materials.

A significant shift is underway in the electric-car segment. There is a subtle change in the makeup of EV batteries that carries some significant implications.

A type of lithium-ion battery called lithium iron phosphate, or LFP, is becoming increasingly prevalent in EVs around the world. Manufacturers like Ford, Mercedes-Benz, Rivian, Tesla, and others are now offering these packs as an alternative to, or an outright replacement for, the nickel manganese cobalt (NMC) and nickel cobalt aluminium oxide (NCA) chemistries that have dominated for years. While LFP cells made up just 6 percent of the market in 2020, they've now jumped to roughly 30 percent.

It's all in the cathode

Batteries have three major components: anode, cathode, and electrolyte. When there's a draw created in an electrical circuit — for example, when you press your EV's "on" button — a chemical reaction occurs within the battery. Negative ions travel between anode and cathode, across the electrolyte, to generate current. It's the cathode that determines the battery's behaviour, including its temperature resilience, energy density, and overall lifespan.

When we talk about lithium-ion chemistries, we're really talking about the materials that make up the cathode, which in an LFP battery is literally lithium iron phosphate (LiFePO4).

LFP batteries have a few key advantages, but for anyone who's concerned about the environmental and ethical impact of EV ownership, the primary benefit is that LFP batteries do not contain materials like nickel, manganese, or cobalt.

These minerals are problematic in numerous ways. Mining them takes a heavy environmental toll.

LFP batteries also cost significantly less, on average, are 32 percent cheaper than NMC cells. In September, LFP batteries fell below $60 per kilowatt-hour, helping drive global battery cell prices to a record low.

LFP batteries are also more resilient, resulting in a longer lifespan. This means that vehicles with an LFP battery can handle more charge-discharge cycles before the battery begins to lose capacity, making EVs well-suited for fleets and other applications requiring frequent recharges.

This resilience also helps these batteries handle extreme temperatures. LFP offers more thermal stability than ternary [three-part] battery systems like NCM or NCA. Sol battery fires are less of a concern for LFP-powered cars.

If LFP batteries have all those advantages, why aren't they in every single EV? Sadly, they have some significant downsides.

The biggest is energy density. An LFP battery will offer fewer kilowatt-hours of capacity for a given weight and volume. This means fewer miles of outright range on a charge. That's offset somewhat by the faster charging mentioned above, so for frequent, short trips, this is less of an issue. But, since so many consumers still look at maximum range before any other factor, this is a potential strike against LFP-powered cars.

Another issue is poor cold-weather performance. LFP-powered EVs lose more of their maximum range when the battery is cold and can even struggle to recharge in low temperatures.

Finally, while LFP batteries cost less to manufacture, they are also worth less when recycling. There is less inherent metal value in an LFP pack versus a nickel-based pack. Less value potentially means less motivation to recycle these batteries, but the good news is that they're just as easily recyclable.

So, it's a give-and-take, but manufacturers are increasingly deciding that the trade-offs are worthwhile, especially in their fleet applications.

Mercedes-Benz selected LFP cells for its new eSprinter van. Cell degradation is lower than other batteries, ensuring durability and low maintenance requirements at the very same time as well. It's ideal for light commercial vehicles.

As EV-charging stations become more widespread, LFP cells will make more sens. For people more willing to accept shorter trips, smaller trips, who can charge more often, and want to fast-charge more often, LFP battery technology allows them to do that.

The same is true for personal-use vehicles. Mercedes-Benz unveiled its Concept CLA Class last year, a small, next-generation electric sedan to debut next year.

Given LFP batteries' durability and cost advantages, lining up an LFP supply will be vital for manufacturers.

Source: Canary Media Daily Newsletter, 12 Nov. 2024

The Limits of Lithium in Meeting Future Battery Demand

Whether lithium-ion batteries will maintain their grip on powering EVs and supplying energy storage capacity will depend on progress in solid-state battery development and recycling technology.

By any measure, the world is still in its formative phase of electrification that will initiate an exit from the current fossil fuel–heavy economy. In terms of lithium-ion (Li-ion) battery production capacity, for example, it is estimated that only one percent of the job is done when it comes to complete electrification of transportation.

Besides powering passenger and commercial vehicles, Li-ion batteries are a core component of battery energy storage systems (BESS). This market may grow at 21% per annum through 2030, reaching 137 gigawatts (GW) of installations in 2030.

Li-ion alternative is worth its salt

The BESS market is dwarfed by the scale of EVs, which will require an estimated 3,700 GW of capacity by 2030. Further, to realize even more ambitious targets across these and other market segments, other battery formats need to come into play. “Li-ion batteries are not replaceable and will be here for many decades to come but we need another battery technology. Sodium metal solid-state batteries can retain more than 91% of capacity over 500 cycles, are fast-chargeable, and feature high output discharge. And sodium is a low-cost alternative.

Solid-state niche may eventually have its day

Lithium-ion batteries that operate via solid-state technology are also the focus of intense development initiatives, as evidenced by efforts at Toyota based on "bipolar" lithium iron phosphate (LFP), which promises a 900-mile-plus range and less than 10-minute charging times, and Mercedes Benz, which is collaborating with Factorial to commercialize sulfide-based all-solid-state electrolyte systems. However, the jury is out as to how quickly these chemistries will enjoy commercial success. According to industry experts, the outlook from fundamental science looks bright but one can’t predict the difficulty of scaling.

Solid-state battery cost and durability are key issues to be addressed, and it is not as if conventional Li-ion battery technology is standing still.

Alternatives to Li-ion batteries will eventually have their day according to automaker Hyundai. “The energy density of Li-ion batteries will one day reach its technical limits, and next-generation batteries will become essential for driving longer distances and enhanced safety.

Recycling readiness

Li-ion battery recycling will become an important component of the supply chain. It is estimated that by 2040, up to 60% of the materials used to make batteries in Europe could come from recycling old ones, boosted by innovations in recovery processes.

Echoing this outlook, US think-tank RMI forecasts that mining of metals used in battery production could peak by the mid-2030s due to a combination of continued progress in battery chemistry boosting energy density and development of more efficient recycling technologies.

Interactive session with team of Yiji Digi

Yogiji Digi was a **Gold Sponsor** of our MMMM 2024 Conference on *Process and Product Innovations in Metal Production*. They presented a very informative paper also in the Conference.

Yogiji Digi extended an invitation to Dr Ramen Datta, Executive Committee Member, to visit their Works, along with other colleagues located, in Palwal (Haryana).

Dr Ramen Datta along with some members visited Yogiji Digi Works on 08 Nov. 2024. Mr Aseem Gill of Yogiji Digi made a presentation before the members about working of their three plants. The members had an informative interaction with the experts of Yogiji Digi. The Management of Yogiji Digi took great pains to take us around their three Units and nicely explained the working of their plants. The visit widened the perspective of our members about the functioning of their Units.

IIM Delhi Chapter extends it heartfelt thanks to Yogiji Digi for inviting us to their Works and the nice hospitality extended to the team.

Know Your Members

Dr. Jayant Jain

Dr Jayant Jain, B. Tech with Honours in Metallurgical Engineering from NIT Raipur, obtained M. Tech in Materials Engineering from IIT Kanpur, in 2004 and Ph. D. in Materials Engineering from University of British Columbia, Vancouver, Canada in 2010. He subsequently worked as a Post-Doctoral Research Fellow at Institute for Frontier Materials in Deakin University, Geelong, Australia till 2012.

Dr Jayant Jain joined Department of Applied Mechanics in IIT Delhi as an Assistant Professor in 2012. He was been promoted to Associate Professor and then Full Professor at Department of Materials Science and Engg., IIT Delhi in 2018 and 2022, respectively. During this period, Dr Jain has also held Visiting Professor positions in various universities across the globe such as NYCU Taiwan, UBC Canada, Deakin Australia and CNU South Korea.

Dr Jayant Jain is currently working as a Professor and Head in the Department of Materials Science and Engineering, IIT Delhi. He is leading the light metals research group at IIT Delhi. His research work is focussed in the areas of materials characterization, microstructure-property correlation, alloy design and control of microstructure and texture through processing. He has published more than 150 international journal papers. He has completed nearly 45 industrial consultancy projects and more than 10 sponsored research projects. A total of 12 students have completed Ph.D. under his supervision.

Contact Details:

Mob: 9582513867
E-mail: jain@mse.iid.ac.in