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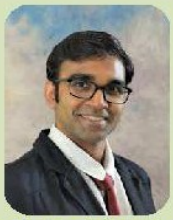

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Chapter Activities

IIM Delhi Chapter welcomes the inclusion of Shri Gaurav Verma as Life Member of IIM. He is affiliated to our Chapter.

The Chapter looks forward to his support in promoting the activities of our Chapter.

Global Crude Steel Production in 2022

Global crude steel production in 2022 fell 4.3% year on year, according to World Steel Association data published Jan. 31. According to worldsteel's preliminary annual tally, production dropped to 1.88 billion metric tons, down from 1.96 billion metric tons in 2021.

Highlights:

- India increased output by 5.5% in 2022 to 124.72 million tonnes, while production from Japan dropped 7.4% to 89.23 million tonnes for the year
- China produced 1.01 billion tonnes of during the year, down 2.1% year on year, making up 55.3% of the global total
- The whole of Europe, including the UK, fell 10.9% year on year to 181.43 million tonnes in 2022, with Germany, the largest European steel producer, producing 36.85 million tonnes, down 8.4% from 2021
- Output from the US fell 5.9% year on year to 80.71 million tonnes in 2022,
- An estimated 71.5 million tonnes was produced in Russia, down 7.2%, mostly likely affected by the Russia-Ukraine war and related sanctions
- South Korea production for the year also decreased 6.5% on the year to 65.86 million tonnes
- Output from Turkey dropped 12.95% to 35.13 million tonnes.

India's National Green Hydrogen Mission

The overarching objective of the National Green Hydrogen Mission is to make India the Global Hub for production, usage and export of Green Hydrogen and its derivatives. The Mission will lead to significant decarbonisation of the economy, reduced dependence on

fossil fuel imports, and enable India to assume technology and market leadership in Green Hydrogen.

To achieve these objectives, the programme "will build capabilities" to produce at least five million tonnes of green hydrogen annually by 2030, with the potential to reach ten million tonnes if export markets grow.

The Mission will support replacement of fossil fuels and fossil-fuel-based feedstocks with renewable fuels and feedstocks based on Green Hydrogen. This will include replacement of Hydrogen produced from fossil fuel sources with Green Hydrogen in ammonia production and petroleum refining, blending Green Hydrogen in City Gas Distribution systems, production of steel with Green Hydrogen, and use of Green Hydrogen-derived synthetic fuels (including Green Ammonia, Green Methanol, etc.) to replace fossil fuels in various sectors including mobility, shipping, and aviation.

The Mission also aims to make India a leader in technology and manufacturing of electrolysers and other enabling technologies for Green Hydrogen.

Green hydrogen should be produced on site, using solar-powered electrolysers, for instance, rather than transported from centralised production bases.

Green Steel with Green Hydrogen

Coke or natural gas is used today in the steel industry to extract iron from ore. The only way to do this in a zero-carbon manner today is by replacing these fossil fuels with green hydrogen, and several pilot schemes are under way, largely in Europe, to make this happen on a commercial scale.

The Indian government does not want to be left behind. Ministry of Steel will identify and facilitate pilot projects and introduce policy measures "to accelerate commercial production of green steel". With the falling costs of renewable energy and electrolysers, it is expected that Green-Hydrogen based steel can become cost-competitive in the coming decade.

Provision of carbon credits and imposition of market barriers on carbon intensive steel are likely to further enhance the viability of Green Hydrogen based steel.

Steel plants can begin by blending a small percentage of Green Hydrogen in their processes, with the proportion being progressively increased as cost-economics improves and technology advances. Green field projects aiming at 100% green steel will also be considered.

Other focuses of the National Green Hydrogen Mission include: regulations, codes and standards; skills development; public awareness and stakeholder outreach; international co-operation; risk management, including safety standards; and new governance frameworks to oversee the programme.

JSW Steel Joins *ResponsibleSteel*

JSW Steel has joined *ResponsibleSteel*, the global multi-stakeholder standard and certification initiative for responsibly sourced and produced steel.

JSW is part of the US$22 billion JSW Group and is claimed to be expanding across markets with innovation, digitalization and sustainability as 'key anchors', according to *ResponsibleSteel*, and is executing its strategic growth plan in line with growing steel demand.

Certification of a steelmaking site requires hard work across the board to integrate not only decarbonization plans into the site's strategy but all material environmental and social improvements, which means investment and technological know-how plus a strong commitment from the company's management and its employees.

JSW Steel has set ambitious targets, says *ResponsibleSteel*, for reducing its specific CO_2 emissions by 42% by 2030 (from 2005), aligning its target with the Sustainable Development Scenario (SDS) of the International Energy Agency (IEA) and India's Nationally Determined Contributions.

Source: AIST Steel News Rewind, 26 Jan. 2023

India's Steel Exports in 2022

India's steel export in calendar year 2022 (CY22) touched 10.45 million tonnes, a drop of 43% over 18.50 million tonnes recorded in CY21.

In December, 2022, exports totaled 0.66 million tonnes, a m-o-m drop of 40% against 1.09 million tonnes seen in the same month in the previous year. The December volumes, however, were m-o-m up 53% compared to 0.43 million tonnes in November, 2022.

India's steel exports are seen increasing in the short to medium term. The global and domestic outlook on demand and prices is cautiously positive with gas and energy prices easing although these are nowhere near pre-war levels. EU buyers are back with

restocking intentions and this trend is likely to sustain for some time, which is a positive indication for Indian mills.

Aqua Metals Uses Electricity to Recover Metals from LIBs

Reno, Nevada-based *Aqua Metals Inc.* has announced that it has successfully recovered critical battery metal from end-of-life Lithium-ion batteries (LIBs) at production scale by electroplating. The company says its pilot "*Li AquaRefining System"* has proven the ability to remove impurities and trace metals from tons of recycled lithium battery black mass and then selectively recover pure metal using electricity instead of furnaces or chemical processes.

Copper is the first of the valuable products recycled using electricity in the patent-pending *Li AquaRefining Process*. The company intends to follow by recovering lithium hydroxide, nickel, cobalt and manganese dioxide - recycling all the valuable minerals within common black mass feedstock. Because *Li AquaRefining* is designed to remove trace elements and recovers these pure metals selectively, it believes its system can process feedstock with varying concentrations of critical minerals and adapt to future changes in lithium battery chemistries.

Source: Recycling Today Newsletter, Jan.18,2023

H_2 Green Steel and Mobilaris to Collaborate on Digital Solutions

H_2 Green Steel and digital industrial solutions provider *Mobilaris* will work together to make use of digital solutions for the world's first large-scale green steel plant. Mobilaris and H_2 Green Steel have signed a letter of intent to collaborate for the use of digital solutions during construction, and later operations, of H_2 Green Steel's large-scale steel plant in Boden in northern Sweden. According to H_2 Green Steel, the plant will be the first of its kind, powered by green hydrogen and fully integrated between digital and physical components from the start.

Source: Weekly news from Steel Times International, Jan.11, 2023

Ammonia and LOHC will be Cheaper Options for Shipping Hydrogen than Liquefied H_2 Even with Reconversion Costs

By the end of the decade, it is likely to be cheaper to ship hydrogen across long distances in the form of ammonia or *liquid organic hydrogen carrier (LOHC)* - and then convert it back to H_2 at its destination — rather than transporting it as liquefied H_2.

Transporting compressed hydrogen via repurposed long-distance gas pipeline - or a new large-diameter pipe - would probably be even cheaper.

In 2030, LH_2 [liquid hydrogen] tanker technology is expected to reach the early commercialisation phase, with transport costs of delivering hydrogen averaging $2.0 - 3.7/kg$H_2$ for an 8 000-km trip.

The costs of shipping ammonia and LOHC are expected to be lower, at $1.9-2.2/kg$H_2$ and $2.0-2.5/kg$H_2$ respectively. These figures include investment and operational costs, including converting hydrogen to a higher-density carrier, storing it, shipping it and converting it back to gaseous H_2 - but not the costs of producing hydrogen.

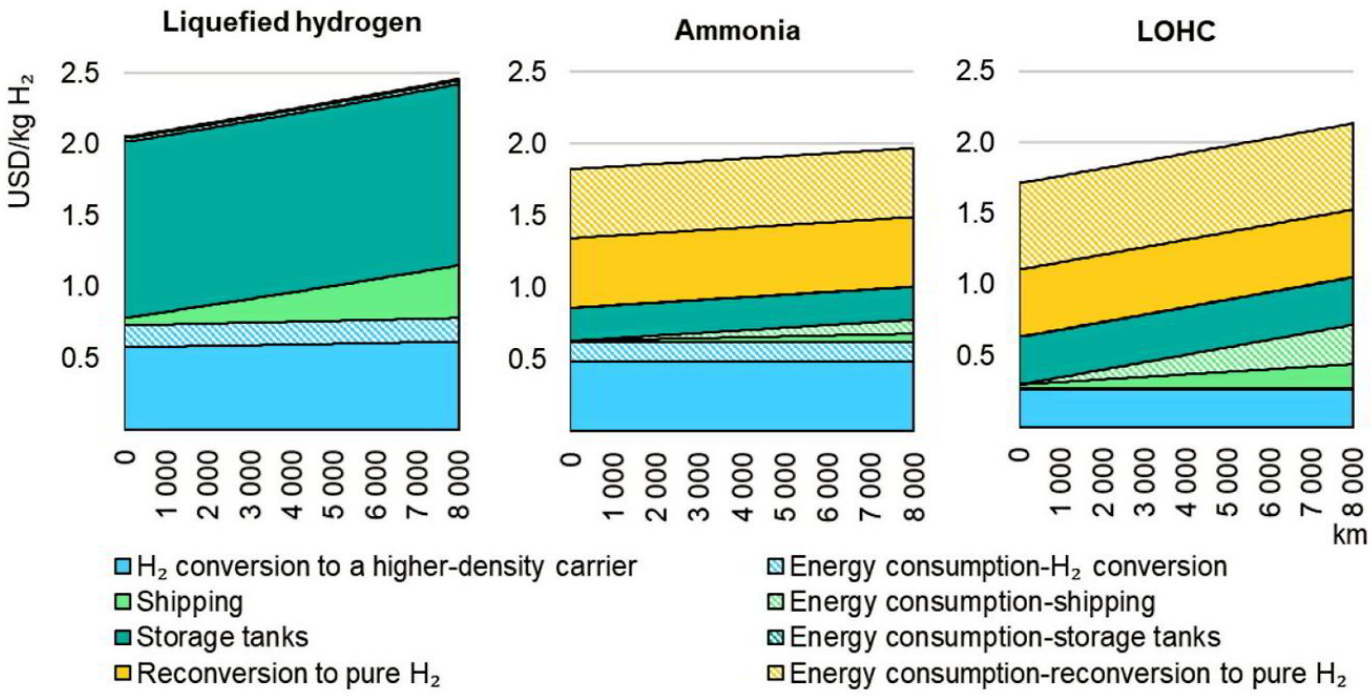
The chart below shows that the shipping part of the transportation process will only make up a small fraction of delivery costs, with the conversion of gaseous hydrogen to more energy-dense carriers (i.e., LH_2, ammonia or an LOHC called methylcyclohexane (MCH)) and back to gaseous H_2 — along with energy losses from the two conversion processes — responsible for the vast majority of the costs.

In the case of LH_2, the highest cost element will be the storage tanks at both the export and import ports — a result of its relatively low energy density by volume and need to be kept at temperatures below minus 253°C.

Liquid ammonia can store 121kg of hydrogen per cubic metre, compared to MCH's 47.3kg/m^3 and 71kg/m^3 for LH_2.

Overall, the cost of shipping hydrogen as LH_2, ammonia or LOHC is $16-31/GJ [gigajoule] by 2030. This is considerably more than the average cost range of liquefaction, shipping and regasification of natural gas, which is currently around $3-7/GJ.

However, if hydrogen can be produced at low cost, despite high shipping costs, its cost could be lower than recent record high international gas prices. Long-distance pipelines would be a lower-cost and therefore preferable option to shipping hydrogen for cross-border trade. It is likely that, where feasible, onshore or offshore pipelines will be preferred: it is the most efficient and least costly way to transport hydrogen up to a distance of 2,000-2,500 km for capacities below 600 ktpa (kilotonnes per year) in 2030 in the NZE (Net Zero Emissions) by 2050 Scenario.



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Indicative Levelised Costs of Delivering Hydrogen by Ship, According to Distance

(IEA report Energy Technology Perspectives 2023 study)

Large-diameter pipelines of 48 inches (122 cm) wide may be cheaper even over longer distances, where feasible, while pointing out that hydrogen production may be too small initially to justify investment in a large pipeline (with significant oversizing until production grows), or the construction of a pipeline across different jurisdictions may be impracticable.

A repurposed 48-inch pipeline would be able to deliver hydrogen up to 6,000 km for less than \$0.50/kgH_2, with a new pipe of the same diameter costing about double that - still way cheaper than any of the shipping methods.

Another option — to transport electricity via long-distance offshore high-voltage direct-current and then use it to produce hydrogen via an electrolyser —would be highly likely to be the most expensive option. And, of course, long-distance offshore cables are far cheaper (and easier) to lay than long-distance onshore transmission lines strung from hundreds of pylons stretching across the countryside.

Source: Accelerate Hydrogen Newsletter, 19 Jan.23

EU Funding to Help Establish a European Hydrogen Academy

The EU has unveiled millions of euros of funding to help establish a "European Hydrogen Academy" — a digitally focused network of schools, universities and educational institutions that would offer courses, training programmes, educational material and laboratories to help train up the expected 180,000 workers, technicians and engineers in the hydrogen sector by 2030.

Institutions have been invited to apply for funding from the EU's innovation fund, *Horizon Europe*, to help set up the "academy", which is estimated to require €3m ($3.25m).

Expected outcomes and targets should include:

- The development of educational and training material and to build training programmes for professionals and students on hydrogen and fuel cells
- The training of up to 5,000 qualified engineers at the "mid-term" of the project
- Offer courses on hydrogen at up to 105 universities and/or "educative centres" at mid-term
- A network of a minimum of 500 schools regularly offering hydrogen-related education
- A minimum of 5,000 engineers, scientists, teachers and academic staff registered as users of the project website (to be measured as "experts with the corresponding qualification")
- A network of a minimum of 100 universities and educational institutions offering hydrogen-related courses
- A minimum of 100,000 "accesses" to documents in a multi-lingual library with reference educational material and textbooks specialised in hydrogen topics
- A network of a minimum of five jointly used training laboratories to be accessed by teachers, pupils, academic staff and students

Source: Hydrogeninsight Newsletter, 18 January 2023

European Metal Industry is Staring at Losses due to High Energy Prices

The European Union has lost more than 1 million metric tons of primary aluminum and 3.3 million metric tons of steel capacity as energy woes continue. With energy costs accounting for 23 percent to 30 percent of the total cost of production, the rising prices have hit the European metal industry. Producers, unable to pass on the increased costs

to end users amid weak demand, are facing an existential crisis, as per the European Steel Association, *Eurofer*.

Eurofer's market outlook for steel, released in October 2022, states that total demand for the year 2022 could decline by 3.5 percent, while it projects a possible decline of 1.9 percent in 2023, making it doubly painful for mills.

The recycling industry also continues to face the brunt of a growing energy crisis.

Capacity Cuts

A number of aluminum producers within Europe have cut capacity because of the energy crisis:

- Romanian smelter Alro reduced production of primary aluminum from five electrolysis rooms to two in 2022, equivalent to more than 60 percent capacity reduction.
- Slovakian company Slovalco reduced production by 40 percent, or an equivalent of 35,000 metric tons.
- Talum reduced primary aluminum production of 84,000 metric tons per year by 20 percent at its Slovenian unit, according to a company statement in August 2022.
- Norsk Hydro halted all operations at its 175,000-metric-ton-per-year smelter in Slovakia.
- Alcoa stopped production at its 228,000-metric-ton-per-year San Ciprian unit in Spain in December 2021 and cut production by 33 percent at its 94,000-metric-ton-per-year in Lista, Norway.
- Aluminum Dunkerque Industries of France, one of Europe's biggest aluminum producers, announced a 22 percent capacity reduction at its 290,000-metric-ton-per-year unit.
- Trimet cut production by 50 percent in March 2022 at its 165,000-metric-ton-per-year Essen, Germany, plant and by 30 percent at its 135,000-metric-ton-per-year Hamburg, Germany, unit in October 2021.
- Dutch smelter Aldel (Aloft Holdings) completely stopped production at its 110,000-metric-ton-per-year Delfzijl, Holland, unit.

- Uniprom stopped production at its 61,000-metric-ton-per-year Podgorico, Montenegro, unit in early 2022.

Steelmakers in Europe also have cut capacity:

- ArcelorMittal stopped production at its 2.2 million metric ton-per-year blast furnace (BF) at Dombra-Hurnych, Poland, for 10 days. The company also stopped production at two BFs in Dunkerque, France. One of the two BFs at Bremen, Germany, also was shut down. The total crude steel capacity of the Bremen plant is 3.8 million metric tons. BF 1 at Eisenhuttenstadt, Germany, was shut down indefinitely. A 600,000-metric-ton-per-year DRI plant in Hamburg also was shut down. A Spanish unit at Asturias was affected and shut down indefinitely, as well. ArcelorMittal also has delayed its EAF resumption in Sestao, Spain.

- Spain's Acerinox partially shut down its plant in Cadiz with a production capacity of 1 million metric tons per year. Acerinox also temporarily laid off 1,800 workers, or 85 percent of its workforce.

- German steelmaker Salzgitter shut down BF C with 600,000 metric tons of capacity per year. The company also announced a delay to its restart.

- Spanish steelmaker Celsa partially shut down 2.5 million metric tons of capacity per year at its Barcelona plant. The company's Belgian unit in Genk, which can produce half a million metric tons per year of crude steel, also was closed.

- One BF at U.S. Steel's Slovakian unit was completely shut down.

- Liberty Steel shut down one of the two BFs in has in Czechia.

- The Arvedi production shop and Acciaierie d'Italia unit in Italy also partially shut down operations.

- Tata Steel Europe operations also were affected.

Small to medium recycling enterprises, or SMEs, are dealing with an enormous burden of energy costs that are threatening the future of the industry.

German recycling associations, such as the Federal Association of German Steel Recycling, the Federal Association of Waste Disposal, the Association of German Metal Dealers and Recyclers, the Federation of the German Waste, Water and Raw Materials

Management and the Association of German Metal Dealers and Recyclers, demanded their sector be included in the list of those eligible for energy subsidies. The groups argued that the recycling industry makes energy-efficient raw materials available through collecting, sorting and processing. The organizations urged that the German government reinstate the recycling industry as a sector eligible for state assistance and ensure it is provided with the appropriate financial opportunities.

The European Recycling Industries' Confederation (EuRIC) strengthens their case, saying that, compared with the extraction of raw materials, recycling significantly reduces CO_2 emissions and energy use. EuRIC President Olivier François says rising energy prices already are undoing the scant gains made by recycling businesses, especially SMEs. Thus, it is imperative for the government to aid the sector.

Energy crisis hits green steel manufacturing efforts

Rising natural gas and electricity prices in Europe and supply disruptions call for steel mills to reconsider their decarbonization efforts. Flat steelmakers in the region planned to gradually phase out coking coal-based blast furnaces (BFs), replacing them with direct-reduced iron (DRI) plants. Over 16 DRI plants have been announced in Europe, with a total capacity of 25 million metric tons per year. These plants are to be powered by natural gas and process ore into pig iron in an electric arc furnace (EAF) or a submerged arc furnace. Subsequently, a basic oxygen furnace (BOF) will produce flat steel. The Russia-Ukraine war, however, has dampened plans, largely because of the extended supply disruptions for natural gas. Germany depends on Russian natural gas for 65 percent of its requirements. The warring country is responsible for 35 percent of the supply in Europe. These countries are, therefore, staring at a potential supply limitation amid interrupted exports.

There are four potential steel industry responses as it continues efforts to curb carbon emissions.

- The first is the extension of BF lifespans and delayed investments in DRI plants.
- Transition to green hydrogen could be faster from the beginning, forgoing the use of natural gas.
- Third option could be shifting the investment toward carbon capture and storage for decarbonization,
- Fourth scenario would entail moving toward secondary steel from primary steel.

Source: scraprecycling, Digital Edition, Jan.20, 2023

Nippon Steel, Mitsubishi and Exxon to Look at CCS Value Chains in Asia Pacific

Nippon Steel Corp, Mitsubishi Corp and Exxon Mobil Corp will jointly study carbon capture and storage (CCS) and the establishment of CCS value chains in the Asia Pacific regions.

These companies will conduct research on the capture of carbon dioxide (CO_2) emissions from Nippon Steel's steel plants and evaluate the necessary infrastructure development required. This is the first study to develop value chains for carbon capture in Japan and storage overseas in the region. The study includes a detailed evaluation of Asia Pacific storage opportunities, including in Malaysia, Indonesia and Australia.

Cutting carbon emissions from steelmaking, which accounts for about 7% to 9% of global CO_2 emissions, is a key effort in the fight against climate change. Through the study, Nippon Steel will progress the implementation of CCS including securing storage sites for overseas storage of CO_2 emitted from steel plants, developing storage infrastructure, advocating for policies and regulation, and examining its cost adequacy.

Japanese trading house Mitsubishi plans to evaluate the transportation of CO_2 overseas and the development of the CCS value chain.

ExxonMobil is committed to accelerating significant emission reductions through strategic collaborations and providing scalable lower-emission technologies for industries in the Asia Pacific region, a company spokesperson said.

Source: Steel Times International Weekly News, 25 Jan. 2023

Ladle Preheating Station Running on Green Hydrogen

On its way to helping companies in the challenge of decarbonisation and sustainability, *Sarralle* has provided a Spanish steel manufacturer with state-of-the-art technology capable of using green hydrogen in the steel manufacturing process. Sarralle has installed the first ladle preheating station capable of running entirely on green hydrogen, achieving zero CO_2 emissions in this ladle.

The steel industry has always been considered a traditional energy-intensive sector, with high CO_2 emissions. In this context, decarbonisation in the steel sector represents a great challenge that stems from the need to invest in innovative technologies. Ladles are

auxiliary equipment used in the steel melting plant and are used to transport liquid steel from the furnace to the casting area.

The installation of the ladle preheater station, capable of using green hydrogen, is a highly innovative project. The burner that used natural gas as fuel has been replaced by an oxy-combustion burner that can use 100% green hydrogen as fuel. In this way, CO_2 emissions are eliminated, as only water vapour is generated in the combustion of green hydrogen. The new burner installed is a dual burner and it can use natural gas as fuel or mixes of natural gas and hydrogen. On the way to achieving decarbonisation objectives, the project demonstrates that the new hydrogen-oxygen burner can reproduce the usual ladle preheating ramps but allows to work with zero CO_2 emissions.

Conditioning of equipment to oxy-combustion, with natural gas or 100% Green Hydrogen

The main steelmaking equipment with large natural gas consumptions that can be conditioned to work with green hydrogen are the burners of the Electric Arc Furnace, Ladle Heaters, Tundish Heaters, Continuous Casting Oxyfuel-Cutting and the Rolling Mill Reheating Furnace. Oxy-combustion and hydrogen technology applicable to all these equipment, can enable savings in natural gas consumption and total decarbonisation. If steel manufacturers adapt their ladle heaters from air combustion to oxy-combustion and to operate with Hydrogen, significant energy savings and the reduction of CO_2 emissions can be achieved, and when supply of hydrogen is available, they can be operated with 100% green hydrogen.

Method to Reduce Steelmaking's CO_2 Emissions by 90%

Researchers from the University of Birmingham have developed an innovative method for existing furnaces that could reduce steelmaking's CO_2 emission by nearly 90%.

In blast furnace steel manufacturing, coke is used to produce metallic iron from ore - which releases large quantities of CO_2 in the process. This technology aims to convert this CO_2 into carbon monoxide that can be reused in the iron ore reaction. This is realised using a thermochemical cycle which performs chemical reactions through changes in temperature. That way, the typically damaging CO_2 is turned into a useful part of the reaction, forming "an almost perfect closed carbon loop.

This drastically reduces emission by the amount of coke needed and, subsequently, lowers steelmaking's emissions by up to 88%.

It is estimated that if this method can be implemented in the remaining two blast furnaces in the UK, it could reduce the country's overall emissions by 2.9%.

Current proposals for decarbonising the steel sector rely on phasing out existing plants and introducing electric arc furnaces powered by renewable electricity. However, an electric arc furnace plant can cost over £1 billion to build, which makes this switch economically unfeasible in the time remaining to meet the Paris Climate Agreement. The system proposed can be retrofitted to existing plants, which reduces the risk of stranded assets, and both the reduction in CO_2, and the cost savings, are seen immediately.

University of Birmingham Enterprise has filed a patent application covering the system and its use in metal production. It's currently looking for partners to take part in pilot studies and deliver this technology to existing infrastructure, or collaborate on further research to develop the process.

Source: https://thenextweb.com; January 27, 2023

New Sustainable Technology for Carbon Capture and Utilization

On December 8, 2023, ArcelorMittal inaugurated, together with *LanzaTech, E4tech,* and *Primetals Technologies*, the *Steelanol Plant* located nearby ArcelorMittal's steel plant in Ghent, Belgium. In 2014, the four stakeholders partnered to develop the Steelanol Plant, and it is now fully operational.

Transforming emissions

The Steelanol Plant uses the off-gas from the steel plant's blast furnaces to produce ethanol, which then can be used in, for example, sustainable aviation fuel, packaging, and textile production as well as perfumes and household cleaning products. Every ton of ethanol produced at the Steelanol plant will reduce CO_2 emissions by 2.3 tons.

Economic benefits

With this technology, steel producers can prevent emissions and reuse the carbon from the steel making process to make new products, entering markets beyond steel. The market for recycled carbon products is anticipated to grow quickly over the coming

years. Under normal market conditions, this type of plant will pay for itself within a three to five years period and deliver significant return on investment.

Key facts: How ethanol is produced at the Steelanol plant

The concept is a unique fermentation solution that converts previously captured carbon into ethanol, which then is further refined to produce sustainable aviation fuel or other intermediate products for the chemical, textile, or consumer goods industries.

- Step 1: Waste gas is sent to a compressor unit that increases the pressure to levels required by the bioreactor.
- Step 2: Toxic components are removed.
- Step 3: The gas is sent to the bioreactor. Here, microbes use carbon monoxide to produce ethanol and other intermediate products.
- Step 4: The broth is distilled to reach the required quality.
- Step 5: Ethanol and the other intermediate products are stored before being transported to end-users, while the by-products – e.g., water – are cleaned and reused; Steelanol is a zero-waste technology.

Boston Metal Receives Green Steel Funding

Clean steel technology company Boston Metal, which spun out of Massachusetts Institute of Technology, has announced a $120 million funding round, led by ArcelorMittal and Microsoft co-founder Bill Gates' investment fund, Breakthrough Energy Ventures.

In 2018, Boston Metal raised its first round of funding, $20 million, in a round led by Breakthrough Energy Ventures. With the funding, Boston Metal will ramp up production of green steel at its pilot facility on Woburn, Massachusetts, and support the construction of its Brazilian subsidiary, *Boston Metal do Brasil*, where the company will manufacture various metals. It plans to begin construction of a demonstration steel plant in 2024 and a commercial sized plant in 2026.

Boston Metal will eventually license its technology to steel companies, rather than being a steel manufacturer itself.

Source: Weekly News, Steel Times International, 1 Feb. 2023

H_2 Green Steel Project

The H_2 Green Steel project aims to reduce CO_2 emissions from steel production by 95 percent on a lasting basis. This contrasts with other projects, which are aimed at achieving a gradual reduction in CO_2 emissions in traditional metallurgical plants. At H_2 Green Steel, electrolyzers were included in the configuration right from the beginning. These basically generate the entire hydrogen as a reducing gas for the direct reduction plant, in which the primary material for the steelworks is produced. The second way in which this project stands out from all the others is that in Sweden electricity can be fully generated from renewable sources and used to power the process. The main portion of this energy is created by the large number of hydroelectric power plants spread across northern Scandinavia.

H_2 Green Steel is a start-up. This is extremely unusual in the traditional steel industry.

Source: SMS Group Newsletter, 1 Feb.2023

Need to Create Strategic Mineral Reserves for Continuous Supply

Emphasising that the shift to clean energy entails a significant growth in requirement for critical minerals (CM), availability of CM and rare earth elements (REE) will be the next "geopolitical battleground", after crude oil.

REE and CM are essential for generating renewable energy (RE). The problem is that they are produced in a few countries and processed in even fewer countries. A globally synchronised energy transition to non-fossil fuels might be difficult to pull off if adequate REE and CM are not available. That would leave fossil fuel-based assets stranded for many countries' economies.

EV Production

Cobalt, copper, lithium, nickel and REEs are critical for producing electric vehicles (EVs) and batteries and harnessing solar power and wind energy. Solar photovoltaic (PV) plants, wind farms and EVs generally require more minerals than their fossil fuel-based counterparts. For instance, a typical electric car requires six times the mineral inputs of conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired plant.

Growing Demand

While the demand for CMs is set to increase because of the global preference and emphasis towards RE, the global CM supply chain is highly concentrated and unevenly distributed. The skewed distribution of resources poses a supply risk in the face of enhanced demand for them.

CMs such as lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density, while REEs are essential for permanent magnets that are vital for wind turbines and EV motors.

Electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity – related technologies.

A carefully crafted multi-dimensional mineral policy would reduce our dependence and address the problems for the future. India has resources of nickel, cobalt, molybdenum, and heavy REEs, but further exploration would be needed to evaluate the quantities of their reserves.

Internal Research

There is a need to create strategic mineral reserves along the lines of strategic petroleum reserves to ensure a continuous supply of minerals.

Also, policies should consider investing in internal research including technological innovation for mineral exploration and processing and the development of Recycling, Reusing, and Repurposing (R3) technologies.

Union Budget Highlights

- To make India a Rs.7 Trillion Economy by 2030
- Capital Expenditure, 33% up, to Rs.10 Lakh Crores to boost demand for metals, cement etc.
- Highways receive Rs.2.7 Lakh Crores, 25% more
- Railways get Rs.2.4 Lakh Crores for modernization
- Green Energy Transition, Rs.5000 Crores push
- Rs.1.2 Lakh Crores for Telecom & Postal projects

- Awas Yojana, housing for poor, gets Rs.79000 Crores, 66% up.
- Jal Jeevan Mission, allocated Rs.70000 Crores
- Urban Rejuvenation Mission sets Rs.16000 Crores
- Green Hydrogen Mission for natural farming
- For MGNREGS, allocation for rural employment, slashed by 33% to Rs.60000 Crores.
- Rs.51000 Crores, target for disinvestment.
- 50 additional airports & heliports for better regional connectivity
- Credit Guarantee Relief Fund for MSMEs set up.
- Cars & EVs to get a demand boost
- Higher allocation for FAME II
- Duty free Lithium ion cells
- 100 Labs to be set up for 5G services
- Infra Finance Secretariat to guide investors in infrastructure