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CONTENTS

CHAPER ACTIVITIES

STEEL NEWS

OTHER NEWS

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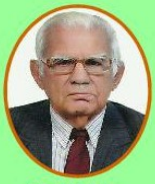

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Chapter Activities

Meeting of MMMM 2022 Working Committees

A meeting of the "Resource Mobilization & Technical Exhibition", "Technical", and "Conference Secretariat & Registration" committees of MMMM 2022 Conference was held on 12th May 2022. The progress of various activities of the Conference was discussed. Various activities to be initiated immediately were also discussed.

Executive Committee Meeting

A meeting of the Executive Committees of was held on google meet platform on 28th May 2022.

Among other issues, the following two important matters were discussed in the meeting:

1. Audited accounts of our Chapter for 2021-22.
2. Actions taken relating to MMMM 2022 Conference and future action plan relating to the Conference.

Technical Talk on "Stainless Steel: Process, Products & Applications

After the EC meeting on 28th May 2022, a Technical Talk on "**Stainless Steel: Process, Products & Applications**" by Shri Ranit Rana, General Manager (Sales and Distribution), Jindal Stainless Ltd. was organized. After the Talk, there was a lively interaction amongst the participants.

Global Crude Steel production: Q1 2022

World crude steel production for the 64 countries reporting to the World Steel Association (worldsteel) was 161.0 million tonnes (Mt) in March 2022, a 5.8% decrease compared to March 2021.

Global crude steel production was 456.6 Mt in the first three months of 2022, down by 6.8% compared to the same period in 2021. Asia and Oceania produced 331.3 Mt of crude steel in the first quarter of 2022, a decrease of 7.8% on the first quarter of 2021. The EU(27) produced 36.8 Mt of crude steel in the first quarter of 2022, down by 3.8% compared to the same quarter of 2021. North America's crude steel production in the first three months of 2022 was 28.1 Mt, a decrease of 0.9% compared to the first quarter

of 2021. Russia and other CIS + Ukraine produced 24.0 Mt of crude steel in the first quarter of 2022, a decrease of 8.5% on the first quarter of 2021.

	March 2022 (Mt)	% Change Mar-22/21	Jan – Mar 2022 (Mt)	% Change Jan – Mar 22/21
Africa	1.2	-17.1	3.8	-2.9
Asia and Oceania	118.6	-5.0	331.3	-7.8
EU(27)	12.8	-8.5	36.8	-3.8
Europe, Other	4.2	-3.5	11.9	-5.3
Middle East	3.5	-3.5	10.2	-1.9
North America	9.7	-2.8	28.1	-0.9
Russia & other CIS + Ukraine	7.4	-19.2	24.0	-8.5
South America	3.7	1.7	10.6	-3.6
Total 64 Countries	**161.0**	**-5.8**	**456.6**	**-6.8**

The 64 countries included in this table accounted for approximately 98% of total world crude steel production in 2020. Regions and countries covered by the table:

- Africa: Egypt, Libya, South Africa
- Asia and Oceania: Australia, China, India, Japan, New Zealand, Pakistan, South Korea, Taiwan (China), Vietnam
- European Union (27)
- Europe, Other: Bosnia-Herzegovina, Macedonia, Norway, Serbia, Turkey, United Kingdom
- Middle East: Iran, Qatar, Saudi Arabia, United Arab Emirates
- North America: Canada, Cuba, El Salvador, Guatemala, Mexico, United States
- Russia and other CIS + Ukraine: Belarus, Kazakhstan, Moldova, Russia, Ukraine, Uzbekistan
- South America: Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

Top 10 steel-producing countries

China produced 88.3 Mt in March 2022, down 6.4% on March 2021. India produced 10.9 Mt, up 4.4%. Japan produced 8.0 Mt, down 4.3%. The United States produced 7.0 Mt, down 1.7%. Russia is estimated to have produced 6.6 Mt, down 1.8%. South Korea produced 5.7 Mt, down 6.1%. Germany is estimated to have produced 3.3 Mt, down 11.8%. Turkey produced 3.3 Mt, down 2.9%. Brazil is estimated to have produced 3.0 Mt, up 5.4%. Iran is estimated to have produced 2.3 Mt, down 6.1%.

Top 10 steel-producing countries

	Mar 2022 (Mt)	% Change Mar 22/21	Jan-Mar 2022 (Mt)	% Change Jan-Mar 22/21
China	88.3	-6.4	243.4	-10.5
India	10.9	4.4	31.9	5.9
Japan	8.0	-4.3	23.0	-2.9
United States	7.0	-1.7	20.3	-0.4
Russia	6.6e	-1.8	18.7	-1.2
South Korea	5.7	-6.1	16.9	-3.8
Germany	3.3	-11.8	9.8	-3.7
Turkey	3.3	-2.9	9.4	-4.7
Brazil	3.0e	5.4	8.5	-2.2
Iran	2.3e	-6.1	6.9	-4.4

e – estimated. Ranking of top 10 producing countries is based on year-to-date aggregate

Source : WSA Press Release, 22 April 2022

World Steel Sustainability Indicators

These indicators provide a systematic way of measuring key aspects of economic, environmental and social performance on a yearly basis.

Environmental Performance	**Unit**	**2018**	**2019**	**2020**
1. CO_2 emissions	Tonnes CO_2/ tonne crude steel cast	1.81	1.85	1.89
2. Energy intensity	GJ/tonne crude steel cast	19.51	20.06	20.62
3. Material efficiency	% of materials converted to products and co-products	96.33	96.49	97.86
4. Environmental management systems (EMS)	% of employees and contractors working in EMS-registered production facilities	97.07	97.16	96.11
Social Performance		**2018**	**2019**	**2020**
5. Lost time injury frequency rate	Injuries/ million hours worked	0.84	0.83	0.85
6. Employee training	Training days/ employee	6.48	6.90	7.18
Economic Performance		**2018**	**2019**	**2020**
7. Investment in new processes and products	% of revenue	6.12	7.09	8.03
8. Economic Value Distributed	% of revenue	94.18	98.27	97.75

Source : WSA

India Posts Record Finished Steel Exports in FY 2021-22

India's finished steel exports rose to a record high in the April 2021-March 2022 financial year as higher international prices prompted Indian mills to boost shipments. Exports of finished steel rose by 25% on the year to 13.5 million tonnes in 2021-22 compared with 10.8 million tonnes in the previous financial year, provisional data from the steel ministry's Joint Plant Committee (JPC) show. Finished steel comprises alloyed and non-alloyed steel.

Vietnam was the top export destination during the year, taking 1.7 million tonnes of shipments, although this was lower by 23% on the year. Italy and Belgium emerged as the next top buyers with 1.3 million tonnes and 1.1 million tonnes respectively, while exports to the UAE rose by over 50% on the year to 1.3 million tonnes and to Turkey by more than 3,000% to 985,200 t.

Finished steel exports in March dropped by 8% on the year to 1.2 million tonnes. The highest shipments last month were to Turkey at about 210,000 t and UAE at around 136,000 t.

India's highest monthly export in the financial year was 1.5 million tonnes in July 2021, after the second wave of Covid-19 infections in the country dented domestic demand. Indian steel mills also increased their exports to Europe last month following a supply crunch in the region because of the Russia-Ukraine conflict, while lower prices in Southeast Asia kept India out of the Vietnamese market.

Flat product exports accounted for 81% of total non-alloyed finished steel shipments in the financial year, with hot-rolled coil (HRC) and strips accounting for the majority share, followed by plates and galvanised sheets and coil. Paradip port in east India's Odisha state saw the largest amount of exports in 2021-22 with 1.9 million tonnes, followed by Goa and Magdalla port in Gujarat.

Finished steel imports during 2021-22 fell by 2% on the year to 4.7 million tonnes, with highest volume coming from South Korea at 2 mn t, followed by China and Japan at 832,600 t and 664,200 t respectively. March finished steel imports dropped by 30% on the year to 351,000 t.

Mumbai port recorded the most imports during the financial year with 1.47 million tonnes, followed by Mundra with 879,600 t and Chennai with 818,000 t.

Flat products accounted for 95% of total non-alloyed finished steel imports in 2021-22, with most of the imports comprising HRC and strips, followed by galvanised sheets, coil and electrical sheets.

India's crude steel production during the financial year rose by 16 % on the year to over 120 million tonnes. Finished steel consumption increased by 11.1 % on the year to 105 million tonnes, while exports jumped by 25 % on the year to 13.5 million tonnes on strong international demand.

Indian steel demand is expected to rise by 7.5 % to 114.1 million tonnes in 2022 and by 6 % in 2023, lifted by new industrialisation processes, according to industry association Worldsteel.

SAIL Declares Financial Results for FY'22, Revenue Crosses Rupees One Lakh Crore: Achieves Best Ever Profitability

Steel Authority of India Limited (SAIL) has declared its financial results for the quarter and year ending 31st March 2022 (FY'22).

During FY'22, the company has clocked its best-ever performance in production and sales while achieving an all-time high revenue from operation of Rs. 1,03,473 Crore and EBITDA of Rs. 22,364 crore. This performance, backed by an uptick in steel demand and positive business outlook, is an outcome of collaborative and concerted efforts for enhancing production and improving techno-economic parameters while seizing possible opportunities in the market place.

Key highlights:

FY 2021-22

- Remarkable improvement in financial performance due to robust operational performance
- Highest ever Revenue from Operation of Rs.1,03,473 Crore
- EBITDA of Rs. 22,364 Crore, Profit Before Tax (PBT) of Rs.16,039 crore and Profit After Tax (PAT) of Rs.12,015 Crore
- The drive towards deleveraging continues. Borrowings stood below Rs.13,400 crore as on 31.03.2022
- SAIL is focused on proactive stakeholders' engagement, which includes:
  - Sharing of Profit with shareholders, the company recommended Rs. 2.25 as the final dividend for FY'22. SAIL declared the highest ever dividend in FY'22 i.e. Rs. 8.75 per share including the already paid two interim dividends for FY'22

- SAIL emerged as the top-most buyer on GeM amongst all CPSEs in FY'22
- SAIL has supplied steel for various projects of national importance like Central Vista Delhi, Mumbai-Ahmedabad High Speed Rail, Delhi-Meerut RRTS, Polavaram Irrigation Project, Kaleshwaram Irrigation Project, Purvanchal Expressway, several Metro Rail Projects across the Country, etc.
- Supply of Liquid Medical Oxygen in excess of 1.3 Lakh Tonne, majorly during second wave of CoVID -19. SAIL Plants set up separate Jumbo CoVID Care facilities, which increased CoVID-19 dedicated beds
- Implementation of wage revision for the employees

SAIL FY'22 and Q4 FY'22 at a glance

	Unit	FY'22	FY'21	Q4 FY'22	Q4 FY'21
Crude Steel Production	Million Tonne	17.36	15.21	4.60	4.56
Sales	Million Tonne	16.15	14.94	4.71	4.34
Revenue from Operation	Rs Crore	1,03,473	69,110	30,758	23,286
EBITDA	Rs Crore	22,364	13,740	4,783	6,473
Profit Before Tax (PBT)	Rs Crore	16,039	6,879	3,210	4,608
Profit After Tax (PAT)	Rs Crore	12,015	3,850	2,418	3,444

This record-breaking performance in FY'22 is a result of synergy across the Organization. However, the fourth quarter could not be fully insulated from the unprecedented rise in input costs, especially the price rise of imported coking coal on account of various reasons. Notwithstanding the challenges, the Company has taken several proactive steps to contain costs. Going forward, the Company has plans to meet the twin challenges of higher input costs and market price volatility by undertaking various measures for continual improvement in its processes and products basket.

Source: Press Release by SAIL, 23rd May 2022

JSPL Surpasses 8 mt Steel Output in FY 2021-22

Jindal Steel and Power (JSPL) registered an all-time high steel output of 8.01 million tonnes and sales of 7.63 million tonnes in the 2021-22 financial year. JSPL's April 2021-March 2022 output and sales were up by 7% and 5% on the year, respectively. Its January-March production rose by 2% on the year to 2.11 million tonnes, and sales climbed by 8 % compared with the previous year to 2.07 million tonnes.

March output rose by 5.5 % on the year to 0.77 million tonnes, while sales during the month inched up by about 1 % against the previous year to 0.79 million tonnes. Exports accounted for 33 % of total sales volume in March, in line with the share during the financial year, JSPL said.

JSPL aims to produce more than 9 million tonnes in FY23. JSPL's Angul plant expansion is on track and is expected to reach more than 15 million tonnes capacity by FY25. The company has significantly enhanced its raw material supply after winning four new coal blocks recently.

JSPL Eyes 50 MTPA Steel by '50

Union steel minister Shri RCP Singh recently dedicated to the nation a 1.4 MTPA rebar mill constructed by Jindal Steel and Power Limited (JSPL) in Angul, Odisha. The minister also visited the company's 2 MTPA coal gasification plant at the unit. The company is using coal gasification technology to produce steel at its plant in Angul.

Rebars – also known as steel reinforcement bars – are used to improve the tensile strength of concrete used in construction. The JSPL mill is one of the world's largest rebar-making units. The rebar-making facility, India's largest TMT rebar mill is located at JSPL's 6 MTPA plant in Angul, Odisha.

Keeping in line with our focus on sustainable steel production, and the usage of swadeshi (domestic) coal to produce steel, JSPL has commissioned India's first CGP-based DRI plant at Angul. JSPL is planning to expand the plant facility in Odisha to 25 MTPA by 2030.
JSPL's all units across the country will be producing 50 MTPA by 2050. JSPL is aligned with the government's climate commitment at COP26 to become a carbon-neutral Nation by 2070. JSPL can now produce 50 mm TMT rebars, which is the first of its kind in the country. JSPL's research and development team has successfully developed 50 mm rebars and has also obtained BIS approval for the same.

JSPL, a part of the O P Jindal Group, has a significant presence in the steel, power, and mining sectors, with investments worth around Rs 90,000 crore across the globe.

Source: The Hindu Business Line, April 5, 2022

AMNS India Installing Advanced Cold Rolling Mill at Hazira Plant

AMNS India is setting up a Cold Rolling Mill (CRM) with advanced steel processing lines to produce value added products at its Hazira plant, as part of the company's Rs 8,500-crore downstream expansion plan. The company is aiming to commission the CRM by 2024. Installation of the CRM with advanced machines will enhance energy efficiency, optimise zinc consumption, and provide a high level of corrosion resistance.

The modern CRM is part of AMNS India's Rs 8,500-crore downstream expansion plan. Galvanizing and annealing line (CGAL) with a capacity of 1 million tonnes per annum (MTPA) will produce cold rolled and highly resistant steel coils processed with aluminum-silicon (Al-Si) coating. The Al-Si coating will be India's first line providing these advanced steel solutions.

New continuous galvanizing line (CGL) with 0.5 MTPA capacity will produce galvanized/galvannealed (GI/GA) coated flat steel for exposed automotive panels. The new processing lines are designed to produce new-age value added steel, embedding the most demanding quality standards.

Source: Financial Express, 5th April 2022

New 880,000 tpy Compact Blast Furnace Complex of BMM Ispat

For the expansion of its steel plant in Danapur, Indian steel producer BMM Ispat selects the most-modern BF technology for its new ironmaking. It awarded Danieli Corus a contract for a complete, 0.88-Mtpy blast furnace complex. The plant will be installed in an iron ore-rich area in India's Karnataka state, where BMM Ispat currently produces pellets, sponge iron and a variety of long products.

The blast furnace will have a 680 m^3 working volume for a design capacity of 2400-2600 daily tons of hot metal. It will feature Danieli top-charging unit with a compact DANCU distributor developed to minimize operating costs thanks to maximum availability and minimum maintenance, and dry gas cleaning technology to eliminate the requirement for large quantities of scrubbing water, while retaining maximum residual thermal energy in the top gas. The hot blast stoves will be based on dome combustion process, with a refractory design proven for ultra-long campaign life capability based on free expansion allowance and a shell mechanical design, resulting in low stresses to prevent premature fatigue and inter–crystalline stress corrosion cracking.The furnace will operate on a charge mix of 80% pellets and 20% lump ore, while the pulverized coal-injection system will inject up to 250 kg/tHM. A third-generation, Danieli Corus level-2 automation system

will support operators in maximizing process efficiency and stability. Browser-based for maximum user–friendliness and customizability, it will enable system access from any device within the plant network.

Source : AIST Steel News Rewind, 05 May 2022

Jindal Stainless Ltd. Installing New 2-Million-Ton Blast Furnace

Jindal Stainless Ltd. (JSL) has contracted SMS group subsidiary Paul Wurth to install a 2-million-ton-capacity blast furnace at its Kalinganagar steel works. The new blast furnace will have a working volume of 2,307 m^3 and features copper and cast iron staves, two tapholes with Tapping Measuring Technology (TMT) machines, and a 46 m^3 Bell-Less Top (BLT), high-efficiency internal combustion stoves incorporating all the latest efficiency improvements, a dry gas cleaning plant (axial cyclone and bag filter) – the first such installation by SMS group for a blast furnace application in India, a pulverized coal injection, an INBA® slag granulation plant (a cold-water slag granulation plant), and level 1 and level 2 automation systems.

Commissioning of the new blast furnace is scheduled for the end of 2023. The plant will serve both existing downstream steelmaking facilities, as well as future ones.

Source: AIST Steel News Rewind 28.4.2022

Vedanta to Move Towards Green Steel

Vedanta is working on solution for hydrogen use as part of its plan to shift towards "green steel". It is working on a solution to use hydrogen instead of coke in its manufacturing process so as to reduce carbon emissions. Vedanta's Sesa Goa Iron Ore Business is looking for a tie-up with IIT-Bombay to carry out research for manufacturing pig iron using hydrogen in place of coke. The solution is aimed at reducing carbon emission in the production process and will help manufacture green steel (an outcome of a climate-friendly process). Coke ovens will become green coke oven very soon, all the coke-making will be through a green process. Power from the grid will not be required, rather it will be given. Vedanta earlier committed to reduce carbon emissions to zero by 2050 or sooner and pledging USD 5 billion over the next 10 years to accelerate the transition to net zero operations. “Use of hydrogen in steel production” concept is at the nascent stage. Use of hydrogen in steel production will ultimately cut down carbon consumption. The environmental impact of steel is enormous given its production process is one of the most energy-consuming and CO_2- emitting industrial activities in the world. Steel production process involves conversion of iron ore into pig iron (by casting and solidifying molten iron). Vedenta aims going in a "very big way" for reducing its carbon footprint and is working tirelessly in this direction. Company is also working on a pilot project on carbon capture, utilisation and storage mechanism. The company

follows the triple bottom line of 'people, planet and prosperity' to create a sustainable future in a 'zero harm, zero waste and zero discharge' environment for the communities.

Source : https://timesofindia.indiatimes.com/business/india-business/vedanta-to-move-towards-green-steel-working-on-solution-for-hydrogen-use/articleshowprint/90759532.cms Apr 10, 2022

Mercedes-Benz Initiates Green Steel Supply Chain

Mercedes-Benz is setting up a green steel supply chain to expand its use of low-CO_2 and zero-CO_2 steel. Working closely with steel suppliers, the company is focussing on the avoidance and reduction of CO_2 emissions. The car manufacturer aims to at least halve the CO_2 emissions per passenger car, over the lifecycle, by the end of this decade, compared to 2020 levels.

To achieve this goal, the company listed the following key strategies: electrifying the vehicle fleet, charging with green energy, improving battery technology, and an extensive use of recycled materials and renewable energy in production. Mercedes-Benz plans to cover more than 70% of its energy needs through renewable energy by 2030 by rolling out solar and wind power at own sites as well as through further Power Purchase Agreements.

In 2021, the company became the first car maker to take an equity stake in Swedish start-up H2 Green Steel (H2GS), with the aim of introducing green steel in a number of production models by as early as 2025.

By applying its “Design for Environment” and ”Design for Circularity” approaches to the selection of materials, Mercedes-Benz Cars aims to increase the use of recycled materials per vehicle by 2030 to 40%.

Source : Weekly news from Steel Times International ; 20.4.22

Voestalpine Researching Hydrogen Plasma for Green Steel Production

Voestalpine is researching the use of hydrogen plasma for the carbon-free manufacture of crude steel in a single step at a pilot facility in Donawitz, Austria. Voestalpine aims to produce carbon-neutral steel by 2050. As part of its “sustainable steelmaking” (SuSteel) research project, the company will investigate the use of hydrogen plasma “to simultaneously reduce iron ore and smelt it into crude steel in a special direct current electric arc furnace”.

Voestalpine is working on novel processes for achieving the breakthrough of decarbonizing steel production at the sites in Linz and Donawitz. Their two flagship projects, H2FUTURE and SuSteel, make them global pioneers in the industry when it comes to researching the use of green hydrogen to apply new technologies in steel production. The company aims to partially replace its existing blast furnace route with hybrid steel production using electricity, and to progressively increase the share of green hydrogen used in the steel production process.

Agencies joining Voestalpine in the project include the K1-MET Competence Center for Metallurgy and Montanuniversität Leoben. SuSteel was initially funded by K1-MET via the Austrian Research Promotion Agency (FFG) until 2023.

Voestalpine is consistently following its plan to achieve climate-neutral steel production. The aim is to partially replace the existing blast furnace route with hybrid steel production using electricity as of 2027, and to successively increase the share of green hydrogen used in the steel production process to 2050. The requirements for realizing this revolutionary vision are clear: green electricity and hydrogen must be available in sufficient quantities and at prices which reflect market conditions.

At the new pilot facility, which commenced operation in Donawitz in 2021, research is being conducted into the use of hydrogen plasma for the carbon-free manufacture of crude steel in a single process step. Conventional steel production uses coke, coal, or natural gas as a reducing agent for ores. The SuSteel project replaces these with hydrogen. Hydrogen plasma is used to simultaneously reduce iron ore and smelt it into crude steel in a special direct current electric arc furnace. The advantage of using green electricity and hydrogen as the reducing agent is that water vapor is the only end product, completely avoiding carbon dioxide emissions.

Source : AIST Steel News Rewind, 28 April 2022

Two World Records in Stainless Steelmaking

Two world records in have been set recently in stainless steelmaking

- Largest-ever heat size at a vacuum oxygen decarburization (VOD) plant
- Record-low carbon levels

A vacuum oxygen decarburization (VOD) plant achieved a heat size of 298.2 tons – a world record in stainless steelmaking. In addition, the same plant reached a carbon content to 5 parts per million (ppm) after decarburization, which marks another world record for VOD plants. Turkish steel producer Çolakoğlu operates the plant, located in Dilovası about 60 kilometers to the south-east of Istanbul.

To reach record-breaking results at the VOD plant, there were many obstacles in the steelmaking process that needed to be overcome. For example, the process parameters for the furnace must be very accurate and well-thought-out to allow tapping at high temperatures. In that way, any clogging issues during tapping, water-cooled panel leakage, and furnace refractory problems are avoided. Also, the VOD-system needs to be designed for a very large heat size – usually, these plants operate with heat sizes between 60 to 150 tons of stainless steel.

The VOD-system is a tank degassing unit which, compared to a VD-plant, is additionally equipped with an oxygen blowing lance, vacuum pump regulation for oxygen blowing conditions, and other necessary components such as gas cooling, dust filtering, and CO-burning systems. Furthermore, advanced process models are required to reach accurate end process parameters such as end chemical analysis and liquid steel temperature. The additional oxygen supply can be used for producing extra-low carbon stainless steel grades (forced decarburization) or for chemical heating of the melt in conjunction with aluminum/silicon additions (the VD-OB process).

Source : Press Release, Primetal Technologies, 03 May, 2022

Consolidation in China's Steel Industry

China's largest steelmaker Baowu Group is taking majority control of a steel company in the Jiangxi province, fast-tracking the company's consolidation plan and boosting production capacity at time of heightened emphasis on decarbonization. The Jiangxi province has agreed to transfer a 51% stake in Xinyu Iron & Steel Group (Xingang Group) to the steel giant. The move will take Baowu one step closer to its annual crude steel output target of 200 million mt by 2025. The transaction marks the first such deal in 2022 in China's steel industry, following an eventful 2021 that saw a series of combinations in the industry. Consolidation has accelerated in China's steel industry in line with the country's decarbonization goals that got a major push in 2021, giving the industry more negotiating power over raw material and prices. China's top 10 steelmakers are likely to account for about 46% of the country's production by end-2022, up from about 41% at the end of 2021 and 37% at the end of 2020. The Jiangxi provincial government will hold the remaining 49% stake in Xingang Group after Baowu takes the majority share. Xingang Group produced about 11 mt of crude steel in 2021 that will take Baowu's annual crude steel production to about 131 mt. Baowu, which is also the world's largest steelmaker, remains at the forefront of consolidation efforts by China's steel industry. The company is also in the process of taking over state-owned Shandong Iron & Steel Group (Shangang Group) with annual crude steel production of about 28 million mt. Baowu's steelmaking entities will span eight provinces and two municipalities following the absorption of Xingang Group and Shangang Group, with

annual crude steel output of about 160 million mt, accounting for 15%-16% of China's total steel production, up from 12% currently. Baowu's target of achieving 200 million mt/year of crude steel output by 2025 suggests its acquisition spree will likely continue over the coming years. China's steel industry consolidation is expected to maintain a healthy pace in 2022, with some potential mergers and acquisitions in sight. Privately-owned Fangda Steel Group has been in negotiations to take over an 80% stake in state-owned Anyang Iron & Steel in northern China's Henan province. The takeover, if successful, will take Jiangxi-headquartered Fangda's annual crude steel output to 31 million mt/year, from 20 million mt/year currently, elevating it to the position of the seventh biggest steelmaker in China, up from 10th. China's steelmaking hub Hebei province in February 2022 also urged leading local steel mills to form several mega steel companies through cross-province or cross-border mergers and acquisitions. China's steelmakers are expected to expand through mergers and acquisitions to gain market share and maintain healthy profit margins, with the country's steel production capped due to its decarbonization efforts, and steel demand at a plateau as urbanization nears completion, market sources said. Small steelmakers that are facing rising environmental protection costs and shrinking market shares are also looking to partner with big companies to survive.

Why Fossil-free Steel?

Fossil-free means that a product or service that has been produced or created without using fossil-fuels or fossil raw materials. Fossil-free steel is made without creating CO_2 emissions and by using fossil-free energy sources. Thus it is a material that has created zero CO_2 emissions from fossil-fuels. The production of fossil-free steel leaves fossil fuels in the ground; this means that steel producer and end-users become part of a fossil-free value-chain. The only disadvantage of fossil-free steel is that start-up production costs are expected to be higher, making it more expensive to produce. The production cost of fossil-free steel is higher than regular steel, which means it has a higher price.

Fossil-free steel will be a premium product with a higher price than regular fossil-based steel products. The main cost-drivers for fossil-free steel are the investments in production and infrastructure, to switch from coal to fossil-free electricity and hydrogen, from natural gas to biogas, and from iron ore pellets to HYBRIT sponge iron.

Reasons to choose fossil-free steel

Adding environmental value to the business by investing in steel that has created zero carbon emissions during its production is the main factor. Several leading steel producers are taking action and investing in innovative technologies to reduce the

CO_2 emissions of steel production. Reasons for choosing fossil-free steel when the cost is higher than traditional steel are given below:

1. Reduce greenhouse gas emissions

Reducing or more importantly, eliminating CO_2 gas emissions is vital if global warming is to be managed and ultimately halted. The steel industry is a major contributor of global CO_2 emissions and all players, from producers to end users, have a role to play in making a difference. Choosing fossil-free steel is a critical environmental and business decision that will contribute to an industry wide transformation.

2. Suitable for all applications

The quality of fossil-free steel will be same as other high-quality steel, but without the negative environmental impact. Fossil-free steel can be used by all customers, in all industries, with the guarantee that it has not created any CO_2 emissions during the production process.

3. Environmentally attractive to customers

Green is the new black – and there is no turning back. All along the value chain, customers will be demanding that businesses are investing in technologies and solutions that make products, services and processes as environmentally friendly as possible. Switching to fossil-free steel will be an action that demonstrates that the business is committed to eliminating the carbon footprint of the steel use also.

4. Get a head-start in the green race

Around the globe, legislation and regulations will be increasingly forcing industries to develop infrastructure and processes that meet specific environmental conditions. This trend is only just beginning, and companies will need to invest now to ensure their business is fit for the future.

5. Meet the demand of green all the way

Consumer awareness and demand for sustainable value chains defines and pushes the industry. No chain is stronger than the weakest link. Each actor needs to do their part to guarantee a fossil free value chain to the end user. It will be important that products made of steel is fossil-free, including other raw and input materials. Fossil-free steel will be a key component in helping to meet zero emissions targets across all industry applications.

Coal Supplies to Non-power Sector Down 15%

Coal Despatch to Power & Non-power Sector

(Million Tonnes)

Fiscal Year	Power	CPPs*	Steel	Cement	Sponge Iron
FY22	677.67	35.60	8.13	7.57	8.38
FY21	544.07	45.77	8.38	6.72	9.49
FY20	567.25	53.05	10.73	8.52	10.15
FY19	555.00	74.51	0.60	8.82	12.25
FY18	519.82	69.91	11.07	7.71	8.53

FY17	450.99	44.06	10.13	6.36	5.54
FY16	483.12	34.65	12.27	9	7.76
FY15	435.44	62.25	11.00	11.36	17.77
FY14	394.53	54.42	15.04	11.94	18.49
FY13	387.77	60.00	15.00	13.11	20.90
FY12	358.60	42.61	15.64	12.88	16.00

CPPs: Captive Power Plant, Source: Coal Ministry

Source: The Hindu Business Line, April 5, 2022

Hydrogen Technology to be Tested for Use in Mining Trucks

Hydrogen technology will be tested for use in mining trucks at Antofagasta's Centinela copper mine in the Antofagasta region of northern Chile, for the first time in the country. As part of the first pilot project in Chile to advance the use of hydrogen in large mining equipment, researchers are working on a stationary prototype that will be placed on site at Antofagasta PLC's Centinela copper mine. The prototype is expected to be launched in June 2022.

The Hydra consortium—made up of French utility Engie SA, Australian mining research organization Mining3, Mitsui USA, Thiess Pty. Ltd., Ballard Power Systems Inc., Hexagon Purus ASA and Chile's Reborn Electric Motors—has been working to replace the use of diesel in high tonnage vehicles as part of the project, which commenced in April 2021. Antofagasta will be the first mining company to install a pilot project in Chile to integrate hydrogen into large mining equipment, such as extraction trucks, according to an October 2021 release. Chile's authorities want hydrogen to power 87% of the country's 1,390 mining sector haulage trucks by 2050. The Hydra project seeks to replace the conventional diesel engine with a modular plug-in system made up of hydrogen fuel cells and batteries.

The Chilean office of CSIRO is leading the project. Having completed the conceptual study, the consortium is now working on pre-feasibility and engineering studies of a propulsion system and the renewable hydrogen value chain. This will include design and manufacture of a modular skid-based prototype composed of a 60-kilowattfuel cell and 140-kilowatt-hour battery. The important part of this is that it's going to be tested in Chile under mining conditions" including altitude, dust and temperatures. The prototype, a container-based structure akin to "a truck without wheels," will be placed near the pit at Centinela so it can face the conditions a truck would experience while remaining stationary. This truck will have a daily hydrogen consumption equivalent to between 800 kilograms and 1,000 kilograms. If it is successful, the consortium will scale up to more vehicles in 2025, bringing down costs. CSIRO sees mobility as an initial target market for hydrogen use in metals and mining, as the technology is an "early win" for companies to

start demonstrating a pipeline of decarbonization options, particularly compared with "harder to abate" complex systems like blast furnaces for steelmaking. While the availability of coal and gas still makes them far cheaper than hydrogen to power mining equipment, hydrogen is shown to be competitive with diesel, as hydrogen refuelers and fuel cell vehicles are already available for order, reflecting the technology's maturity. This has already been demonstrated by Hyzon Motors Inc. deploying a fleet of hydrogen-fueled coaches for iron major Fortescue Metals Group Ltd. in 2020. Fortescue, which has one of the industry's most aggressive carbon neutrality targets for 2030, started funding CSIRO to develop and commercialize hydrogen technology in 2018 with an eye to its subsidiary Fortescue Future Industries Pty. Ltd. producing 15 million tonnes of green hydrogen per year by 2030. Scale and more of such projects are needed to bring the cost of hydrogen technology down further to make it cost-competitive with gas. The Chile project's results will be used to support government agencies in the country and beyond by establishing safety protocols for hydrogen use at scale for mining, which is seen as critical for the successful deployment of that hydrogen solution. By allowing the researchers to do detailed studies of the prototype's behavior and performance under Chilean conditions, the technology will help Antofagasta move toward its 2050 net-zero goal and aid the development of protocols for the safe use of hydrogen on mine sites for the broader industry.

Source: Antofagasta PLC

ArcelorMittal Successfully Tested the Use of Green Hydrogen to Reduce Iron Ore at a Site in Canada

ArcelorMittal has successfully tested the use of green hydrogen to reduce iron ore at one of its industrial sites in Canada. At Contrecoeur in Quebec, it replaced about 7 per cent of the natural gas typically used to reduce iron ore with hydrogen made from renewable electricity during the 24-hour test earlier in April 2022.

Arcelor partnered with a local hydrogen producer that uses electricity from the Quebec grid, which is powered by renewable hydroelectricity, to source the gas. Steelmaking is highly carbon-intensive. Traditional blast furnaces use coking coal to melt iron ore and remove oxygen. The initiative marks another step in the global effort to improve the green credentials of an industry that accounts for 7 to 9 per cent of all direct fossil fuel emissions. Some of the world’s biggest steel makers, including ArcelorMittal, Thyssenkrupp and China’s Baowu, have launched various initiatives to reduce their carbon footprint. Steelmaking is highly carbon-intensive. Traditional blast furnaces use coking coal to melt iron ore and remove oxygen. A by-product of this chemical reaction is carbon dioxide, while large amounts of energy are also required to heat the furnaces above 1,000C. An alternative route is direct-reduced iron, whereby natural gas is used to remove oxygen from iron ore pellets. The solid intermediate, called sponge iron, is then melted in an electric arc furnace. The process currently requires natural gas, but

industry experts believe that once the use of hydrogen made from renewable sources is scaled up, it could mark a revolution in steelmaking. Sweden's SSAB is at the forefront of such efforts, producing fossil-free steel using hydrogen gas last year. Arcelor's Canadian test was focused on proving that hydrogen injection is a "good part of the solution" for direct-reduction plants. Having this technology proven and eventually scaling it up to higher levels could be a big part of the puzzle to decarbonising our industry. ArcelorMittal has so far invested $US5.6 billion ($7.9 billion) in four such projects, in Spain, Belgium, Canada and France. In Europe, Arcelor has committed to reducing its CO_2 emissions by 35 per cent by 2030. The company would follow up with further tests as the numerous challenges still existed, not least the large volumes of hydrogen that would be needed. Arcelor used 92,000 cubic metres of green hydrogen over the test period.

Source: Steel-making giant successfully tests green hydrogen at plant https://www.afr.com/policy/energy-and-climate/steel-making-giant-successfully-tests-green-hydrogen-at-plant-20220502 dtd. May 2, 2022

Hydrogen as Aviation Fuel: Opportunity & Challenges

Aviation contributes to 2% of all CO_2 emissions. This share could increase in future due to reductions by other CO_2 emitting sectors and increasing demand of air travel. The industry has committed to being carbon neutral by 2050. Options being considering include leveraging Hydrogen as a fuel, sustainable aviation fuels (SAF) and pure battery-electric. Airbus is targeting to have hydrogen fuelled aircraft by 2035.

Hydrogen as a fuel source is being considered by many industry sectors. There are different ways one can use hydrogen to power an aircraft:

- To burn hydrogen in the turbo engine.
- To use hydrogen in a fuel cell. The fuel cell creates electricity and the electricity then powers electric motors.
- Hydrogen can also be used to manufacture sustainable aviation fuels.

The challenge is when one start adding in weight of the storage tanks, and all the weight required to hold that hydrogen, that energy density drops by roughly a third to two-thirds. It's not a perfect solution even though hydrogen in itself has a higher energy density than other fuels. The technology exists to make hydrogen-fueled aircrafts a reality, but its drawbacks prevent it from being a scalable solution at present. Overall, however, it holds promise for the future.

Getting to zero emissions is more than just the emissions coming out of the jet; the production of green fuels counts too, and the industry is looking at ways to balance out

both ends. Producing hydrogen fuels today is more expensive than producing traditional kerosene jet fuels. Bringing costs down will be another factor in moving the industry forward in its path toward green -fuel.

Thus, the most significant barrier to putting hydrogen in an aircraft is storage. When aviation adopts green technologies, efficiency and cost reduction will follow.