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S C SURI
Editor-in-Chief, IIM-DC Newsletter

Domestic Steel Production and Consumption of Finished Steel

Feb.'23 vs. Feb.'22

- 2.9% increase in Production in Feb.'23 to 9.873 million tonnes vs. 9,590 million tonnes in Feb.'22
- 11.1% jump in Consumption in Feb.'23 to 10.095 million tonnes vs. 9.085 million tonnes in Feb.'22
- 44.2% increase in Imports to 593000 tonnes in Feb.'23 Vs 411000 tonnes in Feb.'22
- 50.2% decline in Exports to 575000 tonnes in Feb.'23 vs 1,15,7000 tonnes in Feb.'22

April - Feb.'23 vs. April – Feb.'22

- 6.2% growth in Total Finished Steel Production at 109.352 mt,
- 29.5% growth in Import of Total Finished Steel at 5.592 mt,
- 52.0% decline in Export of Total Finished Steel at 5.904 mt,
- 11.6% growth in Consumption of Total Finished Steel at 107.195 mt
- India was a Net Exporter of Total Finished Steel.

Source: Provisional Report of JPC for Feb.'23

India's First Biomass – based Green Hydrogen Plant

Aranayak Fuel and Power is installing a Rs 50-crore, 1 tonne-per-day, biomass-based green hydrogen plant in Mirzapur district of Uttar Pradesh. The plant, which aims to begin production of green hydrogen on August 15, will be India's first commercial-scale biomass-based green hydrogen project.

Distinction of being the country's first large-scale biomass-based hydrogen plant could well have gone to a 1 TPD plant of Watamo Energies, that was to come up in Khandwa district of Madhya Pradesh. But project is behind schedule.

Aranayak Fuel and Power, will consume 30 TPD of biomass (wood scrap) and produce hydrogen at a cost of around Rs 700 a kg. Biezel Green Energy, a company set up by

Prof Preetham Singh of IIT, BHU, is the technology provider. Prof Singh has developed a 'thermally accelerated anerobic digestor' (TAD), which is a reactor that produces hydrogen, methane and bio-coal from biomass.

Some companies, notably Hindalco, had come forward to buy the hydrogen. The process also produces 3.6 TPD of methane and 7.5 TPD of bio-coal as co-products; GAIL will buy the gas.

TAD technology involves a "novel fractionation process", capable of extracting 30-40 grams of hydrogen, 120 grams of methane and 250 g of bio-coal from a kg of biomass, assuming the gross calorific value of biomass at 7,000 kcal/kg. To put it in another way, the reactor would use 30 kWhr of electricity and 30 kg of biomass to produce 1 kg of fuel-cell grade hydrogen and other co-products.

Swaraj Green Power and Fuel Ltd, is putting up a 3.5 TPD of biomass-based green hydrogen, with Biezel Green's technology, investing roughly Rs 100 crore.

In agri-residue-rich India, the biomass route is the better than the electrolysis route for producing green hydrogen. Biomass-route does not suffer from the demerits of electrolysis, such as the requirement of large quantities of pure water.

Source : Weekly News | International Centre for Sustainable Carbon; Mar 3, 2023

Tata Motor's Vehicle Scrapping Unit

Tata Motors has commissioned its first registered vehicle scrappage facility (RVSF) with a capacity of 15,000 vehicle/yr in Jaipur. The facility, named Re.Wi.Re [Recycle with Respect], is designed for safe and sustainable dismantling of end-of-life passenger and commercial vehicles of all brands, with dedicated stations for components such as tyres, batteries, fuel, oils, liquids and gases.

It is aimed to position India as a vehicle scrapping hub for the entire south Asian region. More such state-of-the-art scrapping and recycling units are needed in India.

India launched a national vehicle scrapping policy in August 2021, aimed at phasing out unfit and polluting vehicles while increasing domestic scrap metal processing capacity and reducing dependence on scrap imports.

In a boost to accelerate the vehicle scrapping policy, the Indian government, in its budget for April 2023-March 2024, allocated funds to scrap old vehicles of the central government and assured support to states in replacing old vehicles and ambulances. It

is aimed to set up 3-4 scrapping centres in every district of the country as demand for scrap increases.

Tata Motors had in 2021 announced the setting up of a 36,000 vehicles/yr scrapping facility in Ahmedabad, and also signed an initial deal with Maharashtra state to set up a 35,000 vehicles/yr scrapping centre there.

Tata Steel already operates a 500,000 t/yr steel recycling plant at Rohtak in Haryana, while JSW Steel has announced plans to set up scrap shredding facilities in India in a joint venture with New Zealand's metal recycler National Steel Holdings (NSHL).

Government-authorised vehicle recycler Mahindra Cero announced plans in 2021 to establish four new vehicle-scrapping units with Maharashtra state, with a planned scrapping capacity of 40,000 vehicles/yr.

Maruti Suzuki Toyotsu India, a joint venture between India's Maruti Suzuki and Japan's Toyota Tsusho, launched a 24,000 vehicles/yr scrapping and recycling unit in Noida in November 2021.

Lower CO_2 Steel to Reduce Scope 3 Emissions of European Steel Processors

Tata Steel Nederland has reached new agreements with Wuppermann, BILSTEIN, EMW Stahl Service and Arania to supply them with Zeremis® Carbon Lite – steel with an allocated carbon footprint reduction of up to 90% – starting 2023. The use of lower CO_2 steel by these steel processors, who supply major players in the automotive and industrial markets, enables their customers to make greener end products such as kitchens, robotic storage systems and passenger cars.

Tata Steel Nederland already supplies a significant amount of high-quality low-CO_2 steel now, and aim to offer large quantities of high-quality green steel by 2030, when they target to commission their first direct reduction plants and electric furnaces at its IJmuiden site.

Tata Steel Nederland is one of Europe's leading steel producers and its IJmuiden steelworks has been among the industry's best 10% in CO_2 efficiency since 2013. Currently, the CO_2 intensity of the steel produced in IJmuiden is around 7% below the European average and almost 19% below the global average. As a result, the site is one of the most CO_2 efficient in the world.

Recently, Tata Steel Nederland revised its climate strategy and sharpened its ambitions. It aims to reduce CO_2 emissions by 35-40% by 2030 and to be completely carbon neutral by 2045. Across Europe, the company is implementing CO_2-reducing measures at its locations, including the switch to green hydrogen-based steelmaking at its IJmuiden steelworks.

As part of the new strategy, the steelmaker has been offering lower CO_2 steel under the Zeremis brand since July 2022. The lower CO_2 intensity is based on CO_2 savings realised within Tata Steel Nederland and is verified by independent assurance expert DNV. Additional Zeremis green steel products will follow in the near future, for example, Zeremis products with increased recycled content. The company also already offers the opportunity to secure Zeremis green steel from the new hydrogen-based steelmaking route.

Tata Steel Nederland is working on producing steel with zero carbon emissions by 2045. It will do so by switching to producing steel by using hydrogen instead of coal.

Source : Tata Steel Europe Corporate News, 28 Feb. 2023

One of the World's Largest Decarbonization Projects by thyssenkrupp Steel

thyssenkrupp Steel placed an order with SMS group, Düsseldorf, for the engineering, delivery and construction of the first hydrogen-powered direct reduction plant at the Duisburg location. This marks the start of one of the biggest industrial decarbonization projects worldwide, which at one stroke will avoid more than 3.5 million metric tons of CO_2 per year in the future. The order volume for SMS amounts to over 1.8 billion euros, and also marks the largest single order in the history of the company. The plant will have a capacity of 2.5 million metric tons of directly reduced iron (DRI), and is scheduled for completion by the end of 2026.

Replacement of CO_2-intensive primary steel manufacture begins

The contract award marks a decisive technological turnaround for Germany's biggest steelmaker in its more than 200-year history: As part of the tkH2Steel transformation concept, the replacement of CO_2-intensive steel production by climate-friendly technologies is now beginning. Up to this point, coal-based hot iron production in the blast furnace always involved emitting large amounts of CO_2, amounting to about 20 million metric tons per year from the Duisburg location alone. Hydrogen-based

processes in direct reduction plants offer a significant basis for manufacturing carbon-neutral steel in the future. thyssenkrupp Steel is already planning to avoid as much as 6 million metric tons of CO_2 by 2030, representing well in excess of 30 percent of its emissions. The transformation to carbon-neutral production should be completed by 2045 at the latest.

High-tech for carbon-neutral steel production

In pursuit of the best technological solution, thyssenkrupp will be the first steelmaker in the world to combine a 100-percent hydrogen-capable direct reduction plant with innovative melters. Positioning the two melters immediately adjacent to the direct reduction plant allows the solid input stock produced there to be converted into molten iron immediately; this makes the entire process particularly efficient. In addition, the spatial requirements and constraints a complex iron and steel plant involves can be taken into account. The direct reduction plant is based on MIDREX Flex technology. SMS will also deliver the innovative melters, slag granulation and other auxiliary equipment, for example water recycling. SMS is building the plant on an EPC basis. This means the company bears overall responsibility for the engineering, procurement and construction of the plant. In addition, significant further work is required relating to structural and civil engineering, infrastructure and media supply.

The innovative concept ensures consistently high product quality. This is because it is seamlessly integrated into the existing iron and steel plant, thereby allowing all subsequent process steps from the steel mill onward to be maintained. As a result, the existing plant structure can be used efficiently. Customers will continue to receive the complete, high-quality product portfolio with the premium quality they are accustomed to.

Major step toward innovative, industrial climate change mitigation

At the present time, thyssenkrupp Steel is still responsible for 2.5 percent of Germany's CO_2 emissions, but the first direct reduction plant alone will save over 3.5 million metric tons of CO_2. This corresponds to 20 percent of the company's current emissions, more or less, and underlines thyssenkrupp Steel's leading role in the steel industry's transformation. At the same time, the underlying technological concept can serve as a model for many other decarbonization projects in the industry in Europe and beyond.

thyssenkrupp Steel Press release, Mar 1, 2023

Recovering Metals and Mineral Fraction from Steelmaking Residues

Each year the EU steel sector generates several million tons of metal and mineral containing residues that are currently largely under-exploited and are often sent to landfills with an enormous waste of resources that could replace virgin materials.

The *Recovering Metals and Mineral Fraction* from steelmaking residues, known as the ReMFra project, has been created by a consortium from industry and academia, including Tenova, RINA-CSM, K1-MET, Voestalpine, Thyssenkrupp, TATA Steel NL, CELSA, ESTEP, FEhS and Montanuniversität Loeben and co-financed by Horizon Europe. It aims to promote circular practices in the steel industry.

ReMFra main objective is the development and validation of highly efficient pyrometallurgic melting and reduction demonstration plant at relevant industrial scale for recovering metals and minerals contained in a wide range of steelmaking residues. The ReMFra process will allow to valorise steelmaking residues, such as filter dust, scale, sludge and slags, to obtain pig iron, iron rich oxides, a highly concentrated zinc oxide and an inert slag. ReMFra comprises two main parts to be developed, improved and tested at industrial scale: Plasma Reactor and RecoDust. The first will be dedicated to recover the coarse residues (scale, sludge, slag), while the second will focus on fine-grained dusts. The project will allow the improvement of iron yield using recovered pig iron instead of new pig iron and replacing the iron ore with the iron rich oxide. The recovery of concentrated ZnO and inert slag as by-products will provide a significant source of income and will contribute to the overall carbon neutrality. To reach the full circularity, the process foresees the use, as reducing agent, of secondary carbon sources (i.e. waste plastics). Energy recovery solutions will also be integrated in the metal recovery process starting from enabling the use of molten pig iron.

ReMFra consortium comprises: 5 steelmaking companies, 4 RTOs as technology providers with large experience in steel sector, 1 university and the European Steel Technology Platform. ReMFra is expected not only to enable technological advances in the demonstrators involved but will also contribute to the development of new standards, training programmes, adaptation and certification of industrial processes thus facilitating the replication of the project.

The consortium partners will work together for 3.5 years to develop and validate two highly efficient pyrometallurgic melting and reduction demonstration plants at industrial scale to recover metals and minerals fraction from a wide range of steelmaking residues.

Leveraging their respective field of expertise, the partners will work to develop two main technologies: **Plasma Reactor** and **RecoDust**. The first will be dedicated to the recovery of residues containing high percentages of iron oxide (scale, sludge, slag) with the aim of producing pig iron by using recycled plastic waste as a reducing agent. The second will focus on Zinc recovery from dusts derived from Basic Oxygen Furnace fume abatement system through its reduction into a gas stream containing Hydrogen.

"We are proud to lead such an important project," said **Fabio Praolini**, environment regional director at Tenaris, "this kind of initiative, where there is a keen awareness of a circular economy in the steel sector, are especially important today. This experience will certainly be useful for reducing the consumption of non-renewable resources and therefore Europe's reliance on foreign supplies."

Source: Tenaris website, 28.02.2023

South Korea's Industrial Net Zero Strategy

South Korea has outlined its strategy to achieve carbon neutrality in the industrial sector by focusing on technology solutions, with an aim to cut 120 million tonnes of greenhouse gas (GHG) emissions by 2050.

Representative firms from the four major carbon-emitting industries — chemicals, steel, cement and semiconductor/displays — formed a consortium as part of the country's strategy to promote technology development and signed a business agreement to share development results. These four sectors emit 190 million tonnes, accounting for 72pc of 260 million tonnes of total industrial emissions in 2018. Technology innovation is the only way to cut carbon emissions in these sectors' production processes because of the nature of these industries.

It is expected that carbon-neutral technology development projects in these four major industries shall cut GHG emissions by about 120 million tonnes by 2050, which is over 50pc of the industrial sectors' GHG reduction target of about 210 million tonnes compared with 2018 levels. Motie has also released a steel industry development strategy, with plans to create a fund to boost low-carbon steel production.

The government and industry plan to spend 80pc of their total budget on demonstration projects so that developed technologies can be immediately commercialised. Tax, financial support and regulatory revisions needed for commercialisation will be provided

to maximise technological development.

Three-pronged approach

***Firstly*,** South Korea will secure core technologies needed to achieve its goal of carbon neutrality by 2050.

The country will invest 935.2bn won ($706mn) over 2023-30 to develop carbon reduction technology in the industrial sector, which is a project that had been planned since last year and passed a preliminary feasibility study in October 2022. The project aims to secure core technologies such as naphtha electrolysis furnaces, hydrogen-reduced steel, the substitution of bituminous coal and limestone as raw material in cement manufacturing, as well as low-warming process gas for semiconductors/displays.

A 1mn t/yr demonstration project will be done for hydrogen reduced steel before the commercialisation of 3mn t/yr reactors. There will be a 10 kg/h demonstration reactor for naphtha electrolysis before the commercialisation of a 240 kg/h reactor. For cement mixture there will be a 1mn/yr demonstration firing furnace.

Secondly, South Korea will continue to expand investment tax credits for carbon-neutral technology in the industrial sector. There are 48 technologies, including those for hydrogen-reduced steel, included in the list for investment tax reduction and exemption from last year, with 13 more technologies, including those for steel forging and rolling, to be included from February.

The country is also offering special loans, with W147bn from Motie for carbon-neutral projects, W3.5 trillion from the Export-Import Bank of Korea for low-carbon industrial structure promotion programmes and W100bn from Motie for carbon-neutral technology funds.

Lastly, South Korea plans to streamline regulations and enhance institutional support. The country is looking to develop 100 national standards for carbon-neutral technologies.

It has been pointed out that regulatory-oriented carbon reductions may involve side effects such as "reverse growth" in the manufacturing industry, emphasising that it is a "top priority" for companies to be able to cut carbon emissions through developing technology.

Source: AIST Steel News Rewind, 2nd Mar 2023

Global CO_2 Emissions in 2022

IEA Flagship Report *CO2 Emissions in 2022* provides a complete picture of energy-related greenhouse gas emissions in 2022. The report finds that global growth in emissions was not as high as some had originally feared amid the disruptions caused by the global energy crisis. This latest release brings together the IEA's latest analysis, combining the Agency's estimates of CO_2 emissions from all energy sources and industrial processes, as well as providing information on energy-related methane and nitrous oxide emissions.

- **Global energy-related CO_2 emissions grew by 0.9% or 321 Mt in 2022, reaching a new high of over 36.8 Gt.** Following two years of exceptional oscillations in energy use and emissions, caused in part by the Covid-19 pandemic, last year's growth was much slower than 2021's rebound of more than 6%. Emissions from energy combustion increased by 423 Mt, while emissions from industrial processes decreased by 102 Mt.

- In a year marked by energy price shocks, rising inflation, and disruptions to traditional fuel trade flows, **global growth in emissions was lower than feared**, despite gas-to-coal switching in many countries. Increased deployment of clean energy technologies such as renewables, electric vehicles, and heat pumps helped prevent an additional 550 mn t in CO_2 emissions. Industrial production curtailment, particularly in China and Europe, also averted additional emissions.

- **Specific challenges in 2022 contributed to the growth in emissions.** Of the 321 mn t CO_2 increase, 60 mn t CO_2 can be attributed to cooling and heating demand in extreme weather and another 55 mn t CO_2 to nuclear power plants being offline.

- **CO_2 growth in 2022 was well below global GDP growth of 3.2%**, reverting to a decade-long trend of decoupling emissions and economic growth that was broken by 2021's sharp rebound in emissions. Improvements in the CO_2 intensity of energy use were slightly slower than the past decade's average.

- **Emissions from natural gas fell by 1.6% or 118 Mt**, following continued tightening of supply exacerbated by Russia's invasion of Ukraine. Reductions in emissions from gas were particularly pronounced in Europe (-13.5%). The Asia Pacific region also saw unprecedented reductions (-1.8%).

- **Increased emissions from coal more than offset reductions from natural gas**. Amid a wave of gas-to-coal switching during the global energy crisis, CO_2 emissions from coal grew by 1.6% or 243 mn t, far exceeding the last decade's average growth rate, and reaching a new all-time high of almost 15.5 Gt.

- **Emissions from oil grew even more than emissions from coal, rising by 2.5% or 268 mn t to 11.2 Gt.** Around half of the increase came from aviation, as air travel continued to rebound from pandemic lows, nearing 80% of 2019 levels. Tempering this increase, electric vehicles continued to gain momentum in 2022, with over 10 million cars sold, exceeding 14% of global car sales.

- **The biggest sectoral increase in emissions in 2022 came from electricity and heat generation,** whose emissions were up by 1.8% or 261 mn t. In particular, global emissions from coal-fired electricity and heat generation grew by 224 mn t or 2.1%, led by emerging economies in Asia.

- **A strong expansion of renewables limited the rebound in coal power emissions**. Renewables met 90% of last year's global growth in electricity generation. Solar PV and wind generation each increased by around 275 TWh, a new annual record.

- **Emissions from industry declined by 1.7% to 9.2 Gt last year**. While several regions saw manufacturing curtailments, the global decline was largely driven by a 161 mn t CO_2 decrease in China's industry emissions, reflecting a 10% decline in cement production and a 2% decline in steel making.

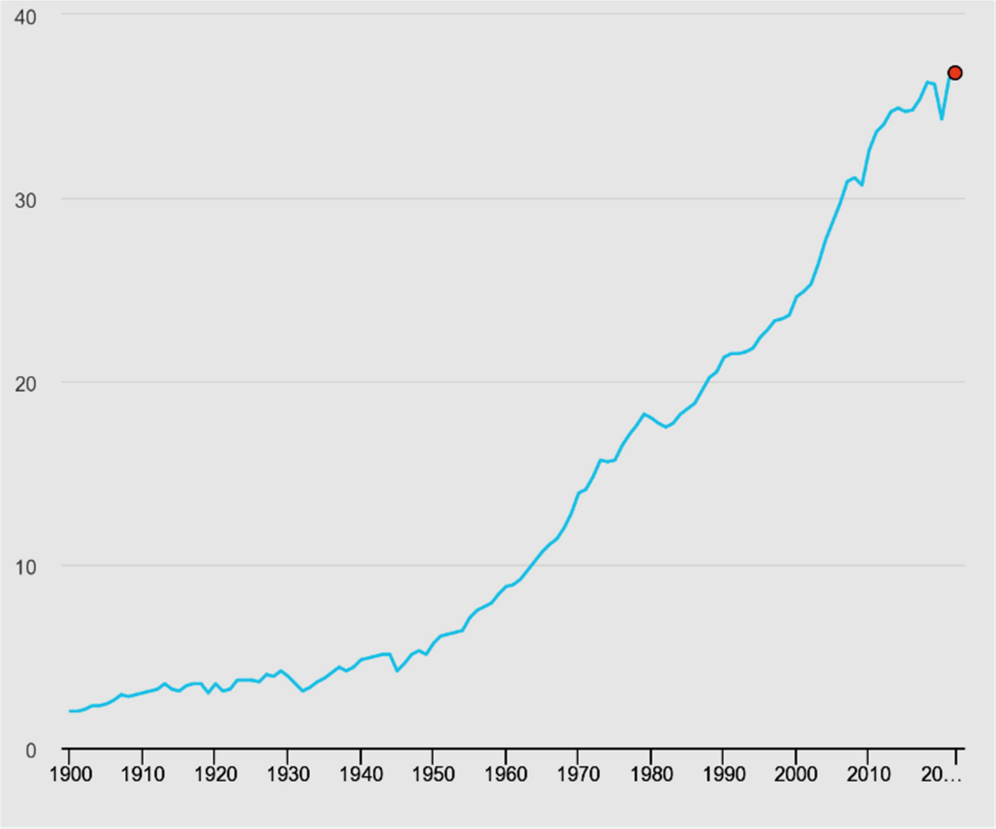
- **China's emissions were relatively flat in 2022, declining by 23 mn t or 0.2%.** Growing emissions from combustion were offset by declines from industrial processes. Weaker economic growth, declining construction activity, and strict Covid-19 measures led to reductions in industrial and transport emissions. Power sector emissions growth slowed compared with the average of the past decade but still reached 2.6%.

- **The European Union saw a 2.5% or 70 mn t reduction in CO2 emissions** despite oil and gas market disruptions, hydro shortfalls due to drought, and numerous nuclear plants going offline. Buildings sector emissions fell markedly, helped by a mild winter. Although power sector emissions increased by 3.4%, coal use was not as high as anticipated. For the first time,

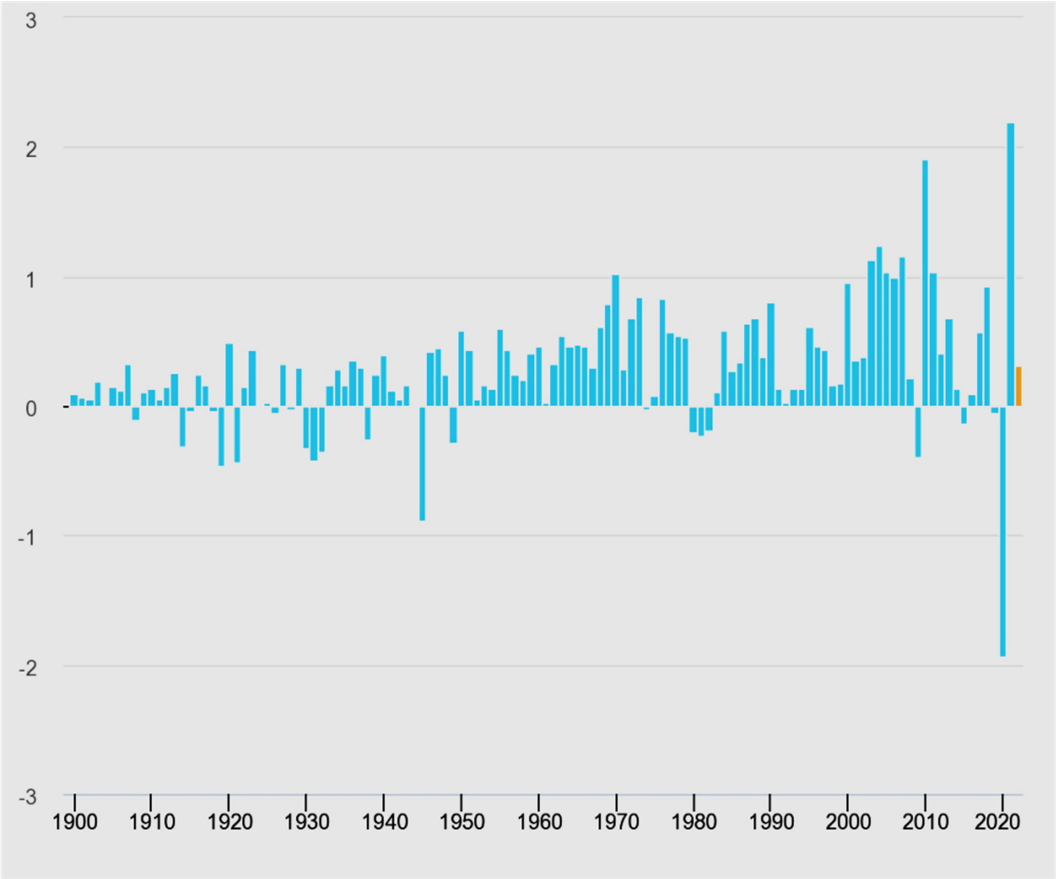
electricity generation from wind and solar PV combined exceeded that of gas or nuclear.

- **US emissions grew by 0.8% or 36 mn t. The buildings sector saw the highest emissions growth, driven by extreme temperatures.** The main emissions reductions came from electricity and heat generation, thanks to unprecedented increases in solar PV and wind, as well as coal-to-gas switching. While many other countries reduced their natural gas use, the United States saw an increase of 89 mn t in CO_2 emissions from gas, as it was called upon to meet peak electricity demand during summer heat waves.

- **Emissions from Asia's emerging market and developing economies, excluding China, grew more than those from any other region in 2022,** increasing by 4.2% or 206 mn t CO_2. Over half of the region's increase in emissions came from coal-fired power generation.



Global CO_2 emissions from energy combustion and industrial processes, 1900-2022, Gt
Last updated 1 Mar 2023



Annual change in global CO_2 emissions from energy combustion and industrial processes, 1900-2022

Key messages

Global carbon dioxide (CO_2) emissions from energy combustion and industrial processes grew 0.9% or 321 Mt in 2022 to a new all-time high of 36.8 Gt. This estimate is based on the IEA's detailed region-by-region and fuel-by-fuel analysis, incorporating the latest official national statistics and publicly available data on energy use, economic indicators, and weather.

Last year's increase follows two years of exceptional oscillations in energy-related emissions. Emissions shrank by more than 5% in 2020, as the Covid-19 pandemic cut energy demand. In 2021, emissions rebounded past pre-pandemic levels, growing more than 6% in tandem with economic stimulus and the roll-out of vaccines.

Spain's First Green Steel Plant

Hydnum Steel, a consortium made up of the Helvella holding company, Siemens, ABEI Energy, and Russula, is cited to be the first to build a green steel mill in Spain. The

consortium will create 400 jobs and produce 600kt of steel per year, all without using fossil energy.

The factory, to be located in Puertollano, will occupy an area of 1.3 million square meters in the industrial area 'La Nava' and will have an investment of €1 billion. This new company will gradually integrate green hydrogen into the production process with the aim of substantially reducing CO_2 emissions.

Location of Puertollano is close to the logistics hubs of central, southern and eastern Spain, as well as Portugal. Hydrogen production projects are already active in the area. Presence of the National Hydrogen Centre opens the possibility of creating alliances with this research pool.

This project will not only have a positive impact on its own facilities in terms of reducing the carbon footprint, but will also impact industries such as automotive and shipbuilding, where using greener steel will help them meet their decarbonization targets.

Source : Weekly news from Steel Times International, 1.3.23

Smart EPD Platform to Monitor, Publish and Digitally Lead the Strategic Direction in Decarbonization

JSW Steel USA, a subsidiary of JSW Steel Ltd (India's leading steel company and flagship business of US$ 22 billion JSW Group), is adopting the ground-breaking Smart EPD Platform to monitor, publish and digitally lead the strategic direction in decarbonization. JSW Steel USA has become the first steel company in the United States to adopt Smart EPD™ to publish Environmental Product Declarations, or EPDs.

EPDs are internationally accepted, third-party verified documents that provide clear and transparent information about a product's environmental impact across its value or supply chain.

JSW Steel USA has collaborated with TrueNorth Collective, a consultancy founded with the vision of accelerating sustainability as serious business. TrueNorth developed a custom EPD generator based on JSW USA operations that calculates the environmental impacts across its product portfolio of slab, plate, hot rolled and coil, and pipe steel products.

The adoption of Smart EPD is the first step in the journey to provide a clear and strong framework towards the decarbonization of business operation.

To create the customized EPD generator for JSW Steel USA, TrueNorth Collective has used SimaPro, developed by PRé Sustainability, to calculate product specific results which are then verified and integrated within the Smart EPD platform to publish EPDs. JSW Steel USA can now directly generate and publish verified digital EPDs on-demand.

Source : JSW USA, 9 March 2023

Korea Steel Plan Low-carbon Steel Project Plan

South Korea has announced a steel industry development strategy and plans to create a 150bn South Korean won ($115.9mn) fund to support low-carbon steel production.

The strategy aims to lay the foundation for the steel sector to evolve and includes plans such as ensuring stable ferrous scrap supply and replacing blast furnaces with hydrogen direct reduction reactors, as per country's trade and industry ministry (Motie).

Ensuring a stable supply of ferrous scrap is especially important given a likely increase in global demand for ferrous scrap, which is an essential raw material for electrical arc furnaces (EAFs), as countries seek to decarbonise. Global steel scrap demand was at 690mn t in 2021 and will rise to 1.26bn t by 2050, Motie said, citing US-based direct reduced iron technology firm Midrex. Japan is also contending with a potential scrap shortage by 2030 as its steel mills switch to EAFs.

Countries have also started to restrict ferrous scrap exports, Motie said. The EU adopted new regulations in December 2022 that will restrict exports of scrap metal to non-OECD countries. But the European parliament in January voted to adopt an amended regulation that will allow exports to non-OECD countries that apply for consent and demonstrate their ability to treat waste sustainably through third-party audits.

Ferrous scrap is currently treated as waste under South Korea's Waste Management Act and is subject to various regulations, resulting in "a lack of an institutional foundation for fostering it as a resource industry", Motie said. Motie will consequently consult the country's environment ministry to exclude ferrous scrap from the act by recognising it as a circular resource, and also review legislation to support business activity such as scrap manufacturing.

Second, South Korea aims to replace 11 blast furnaces with 14 hydrogen direct reduction reactors by 2050. The government will set aside W26.9bn over 2023-25 to finish developing the hydrogen direct reduction technology by 2025, with hydrogen used instead of coal to reduce iron ore. It will also secure a budget to conduct a 1mn t

demonstration by 2030. Motie expects the introduction of this technology to cut the steel industry's carbon emissions by 85pc or 86mn t, from 101.2mn t in 2018.

There will also be an investment of W240bn by 2030 to develop technology to minimise carbon emissions in existing blast furnaces and EAFs through fuel substitutions and high-efficiency EAFs. This is in light of the amount of time introducing hydrogen direct reduction technology will take.

Third, South Korea plans to shift towards developing high-value steel products, in response to changes in material demand from major industries such as automobiles and shipbuilding. This is especially for high-manganese steel that can withstand cryogenic environments such as LNG and liquefied hydrogen storage tanks.

Lastly, South Korea will consider taking countermeasures to trade barriers and exports in efforts to boost steel exports, including consulting with the EU about its carbon border adjustment mechanism(CBAM) that levies a tax on imports with high carbon intensities. The country sees new steel demand from emerging markets such as the Middle East, India and the Asean countries, with plans to continue negotiations for free trade agreements.

Funding low-carbon steel production

The government is also planning to create a W150bn fund as part of an alliance to drive low-carbon steel production.

Motie signed an initial agreement with seven companies, including Posco and Hyundai Steel, on 16 February 2023 to encourage collaboration on low-carbon steel production to promote investment and technology development, as well as enhance global competitiveness of steel produced in South Korea.

The partners will form an alliance in this year's first quarter to achieve their goals and will create a W150bn fund for low-carbon steel production, after using up the W150bn environmental, social and governance (ESG) fund for steel. The ESG fund was created in June 2022.

These measures were in response to a "reorganisation of the global steel market" that is centered on low-carbon and high-value steel. The emergence of new regulations such as CBAM has created a scenario where reducing carbon emissions boosts export competitiveness. The CBAM will take full effect from 2026 after a transition period later this year.

There is also continuing global oversupply, with "steel demand structure also facing a new phase due to the eco-friendly transition of downstream industries such as automobiles and shipbuilding.

Source: Argus Blog, 20 Feb.2023

US Department of Energy to Award $6B Toward Decarbonization Projects

U.S. Department of Energy (DOE), has announced plans to release $6 billion in funding through its *Industrial Demonstrations Program* to accelerate decarbonization projects in energy-intensive industries and provide American manufacturers a competitive advantage in the global clean energy economy.

The *Industrial Demonstrations Program* will focus on helping high-emitting industries where decarbonization technologies will have the most impact, such as iron, steel, aluminum, cement and other energy-intensive industrial processes.

The DOE reports that the industrial sector contributes nearly one-third of the nation's carbon emissions. The DOE says deploying decarbonization projects within these industries is part of the goal to achieve a net-zero economy by 2050 as well as strengthen domestic manufacturing capabilities.

Industrial Demonstrations Program

Industrial emissions account for roughly one third of the nation's carbon footprint, and the industrial sector is considered one of the most difficult to decarbonize due to the diversity of energy inputs, processes, and operations. The sector's emissions result not just from fuel for heat and power, but also from feedstocks and processes that are inherently carbon intensive.

The Industrial Demonstrations Program will fund projects that focus on the highest emitting and hardest to abate industries where decarbonization technologies can have the greatest impact: iron and steel, cement and concrete, chemicals and refining, food and beverage, paper and forest products, aluminum, other energy-intensive manufacturing industries and cross-cutting technologies. Widespread demonstration and deployment of projects within these industries will support to rebuild U.S. leadership in manufacturing as countries, companies, and consumers around the world shift to low- to no-carbon commodities to meet their own decarbonization goals.

Industrial Demonstrations Program received a combined $6.3 billion to support the advancement of transformational technologies necessary to decarbonize the industrial energy sector.

FUNDING MECHANISM:

Grant, Cooperative Agreement, or Other

RECIPIENTS:

Technology Developers, Industry, Manufacturers, Universities, National Laboratories, Engineering and Construction firms, State and Local Governments, Environmental Groups, and Community Based Organizations

ELIGIBLE USES

Industrial production processes, including technologies and processes that:

- Achieve emissions reduction in high emissions industrial materials production processes, including production processes for iron, steel, steel mill products, aluminum, cement, concrete, glass, pulp, paper, and industrial ceramics;
- Achieve emissions reduction in medium- and high-temperature heat generation;
- Achieve emissions reduction in chemical production processes, including by incorporating, if appropriate and practicable, principles, practices, and methodologies of sustainable chemistry and engineering;
- Leverage smart manufacturing technologies and principles, digital manufacturing technologies, and advanced data analytics to develop advanced technologies and practices in information, automation, monitoring, computation, sensing, modeling, and networking;
- Leverage the principles of sustainable manufacturing to minimize the potential negative environmental impacts of manufacturing while conserving energy and resources;
- Increase the energy efficiency of industrial processes.

This announcement is a step in the race to fully decarbonize our heavy industries and will help drastically reduce harmful pollution while ensuring America's manufacturing sector is strong and competitive. This transformational investments in innovation and

clean energy are supporting American industries as they create new economic opportunities across the country while leading the world in clean manufacturing technologies.

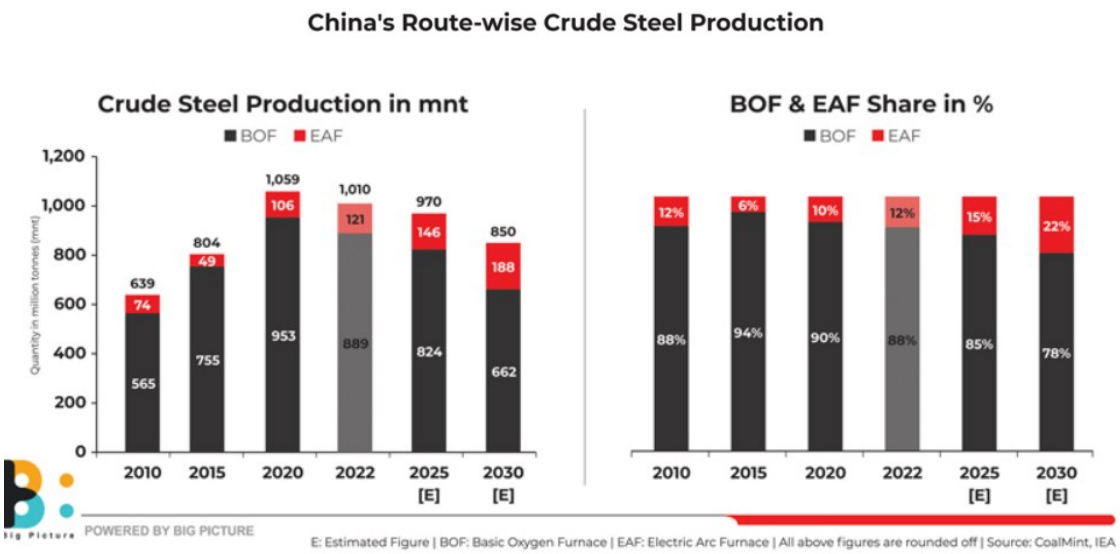
DOE says it is seeking first-of-a-kind or early-stage commercial-scale projects to fund through the Industrial Demonstrations Program and expects to award projects from the highest-emitting industries involving cross-cutting technologies that have the greatest potential, directly or indirectly, to achieve decarbonization domestically and globally. Additionally, the DOE says it is prioritizing a portfolio of projects that accelerate industry toward deep decarbonization; spur follow-on investments for widespread adoption of the demonstrated technologies; enable new markets for cleaner products; and benefit local communities.

Source : Recycling Today, 13 Mar 2023

China may Reduce Coking Coal Consumption in Steelmaking by 20-25% by 2030

In sync with its 'dual carbon' goal of peaking emissions by 2030 and attaining carbon neutrality by 2060, the Chinese steel industry is expected to reduce consumption of coking coal by 20-25% by 2030. It is predicted that the share of scrap-based EAFs in China's total crude steel production will rise to 22% by 2030 from 12% at present. Out of 1.01 billion tonnes (bnt) of steel produced in China in 2022, 88% was churned out through the BF-BOF route.

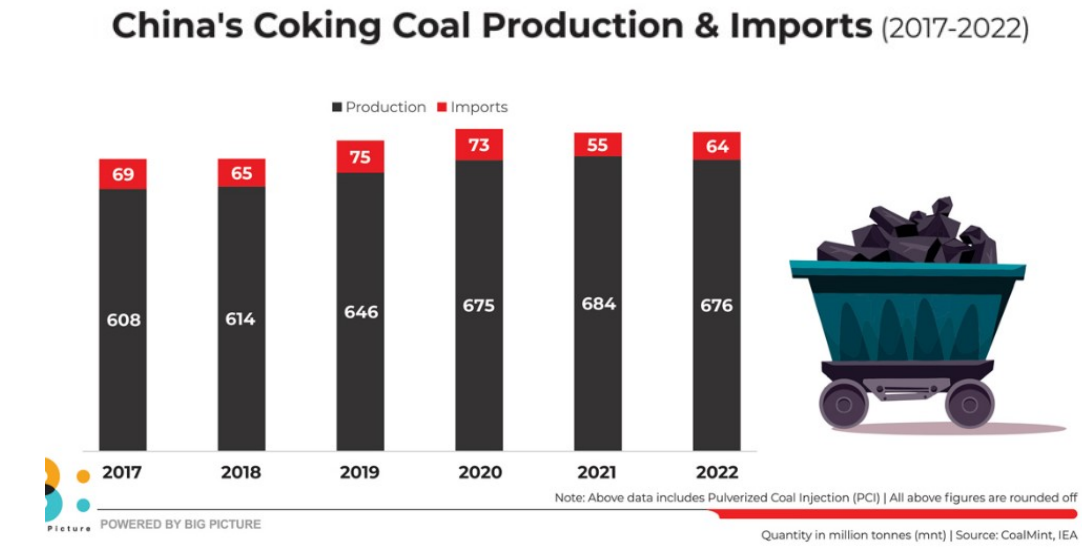
In 2022, China's coking coal production stood at 676 mnt, while another 64 mnt was imported. Due to the heavy reliance on the coal-based BF-BOF route, steel production accounts for about 20% of the country's total annual carbon emissions. Thus, it is a key target in the government's efforts to curb carbon emissions and improve air quality.

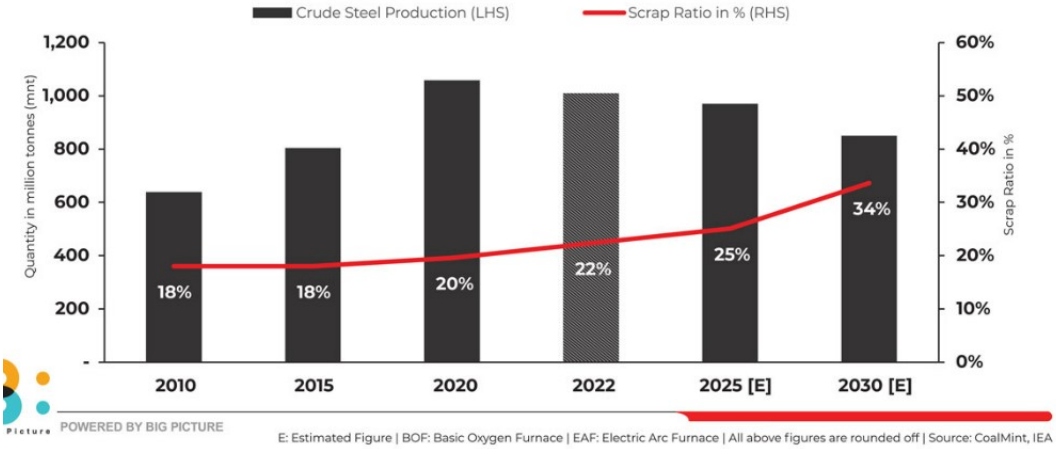


Why might coking coal consumption fall?

- ***Steel production to drop:*** It is expected that steel production in China has almost plateaued. Many experts reckon that the 1.059 bnt of crude steel production in 2020 represented the peak. In 2022, crude steel production fell by 2% y-o-y. It is projected that crude steel production will drop to around 850 mnt by 2030.

- ***Scrap/DRI share in steelmaking to rise***: Higher steel scrap usage expectations could eat into coking coal demand. The National Development and Reform Commission (NDRC) sees China's 2025 steel scrap usage rising to 320 mnt on carbon neutrality goals. The scrap ratio in steelmaking is expected to increase to 34% by 2030.





Hydrogen likely to replace PCI: Reducing carbon emissions from blast furnaces will involve the replacement of PCI with hydrogen. China's steel producers are likely to transition from PCI to coke oven gas (COG) first and then hydrogen. Therefore, overall coking coal demand will drop.

Outlook

Therefore, the long-term demand scenario for coking coal remains bearish, although it will take another decade or so before the final signs of decline become visible.

Due to the heavy reliance on the coal-based BF-BOF route, steel production accounts for about 20% of the country's total annual carbon emissions. Thus, it is a key target in the government's efforts to curb carbon emissions and improve air quality.

Source: Coal mint

OECD Steel Committee: Big Capacity Growth, but Little Demand Growth in 2023

Global steel demand will grow by a mere 1% in 2023, far outpaced by growth in steelmaking capacity, according to the Organisation for Economic Co-operation and Development (OECD)'s Steel Committee. The deterioration in international steel market conditions is being driven by the global economic slowdown, historically high inflation worldwide, the impacts of Russia's aggression against Ukraine, and an ailing Chinese real estate market that has depressed steel demand in the world's largest steel-consuming economy.

Rising interest rates and the tightening of monetary policy, sustained high inflation, weak consumer spending and elevated energy prices are likely to keep steel demand subdued going forward.

But even while the outlook for demand growth appears weak, the gap between production and capacity increased 22% to 632 million metric tons in 2022, driven in part by significant capacity expansions in Southeast Asia and the Middle East.

At its 93rd session held on 13-14 March 2023, the OECD Steel Committee expressed that the consequences of the war are reverberating internationally through the steel supply chain, and have led to an increasing number of export restrictions on steelmaking raw materials such as scrap. These developments are compounding the already poor steel market conditions being caused by a plethora of concurrent factors including increased cost pressures on steel producers and ever-growing excess steelmaking capacity.

The Committee also discussed its role and ambitious work programme on steel decarbonisation, and how its mandate of ensuring a level playing field and open markets can support this fundamental industry transformation that is occurring via different instruments and at various speeds worldwide.

Participants at the meeting expressed concerns about the further increase in global steel excess capacity. Global crude steelmaking capacity rose to 2463.4 mmt in 2022, with significant capacity expansions particularly in Southeast Asia and the Middle East contributing to the growing gap between global crude steelmaking capacity and production that reached 632.0 mmt in 2022 from 516.9 mmt in 2021. The modest longer-term outlook for steel demand growth risks exacerbating these challenges.

Participants highlighted continued concerns regarding Chinese steelmaking capacity, accounting for 47% of the world's total in 2022, particularly given the current market slowdown from an ailing real estate sector and possible steel demand declines in the coming years. Addressing the root causes of excess capacity remains a priority to avoid trade tensions involving steel products in the future. It was Agreed to strengthen their work on the impacts of market-distorting subsidies and other government support on excess capacity, trade and the viability of the steel industry, while encouraging decarbonisation of the steel sector under conditions of fair competition. Some of the pathways to the decarbonisation of the steel sector were discussed under conditions of fair competition across regions using different technologies, and the role of the Steel Committee on this important issue, including the monitoring of different emission measurement approaches.

The economic slowdown and high inflation are weighing on the steel market outlook

Following a very difficult year for the steel industry in 2022, marked by strong contractions in global steel demand (-2.3%), production (-4.4%), trade (-11.1%) and prices (-54%), the outlook for 2023 remains weak. The deterioration in international steel market conditions is being driven by the global economic slowdown, historically high inflation worldwide, the impacts of Russia's aggression against Ukraine, and an ailing Chinese real estate market that has depressed steel demand in the world's largest steel-consuming economy. Following last year's slump, growth in global steel demand is expected to be limited to only 1% in 2023. Rising interest rates and the tightening of monetary policy, sustained high inflation, weak consumer spending and elevated energy prices are likely to keep steel demand subdued going forward. The Committee reviewed recent long-term steel demand forecasts, noting with concern the growing disconnect between the rapid build-up of new steelmaking capacity in some economies and market expectations of steel demand. Government and industry stakeholders alike emphasised the need to ensure that capacity investments are driven by market considerations to not further exacerbate deteriorating market conditions being caused by excess capacity.

Risk of further increases in excess capacity

The increase in global excess capacity is raising risks of future oversupply, steel trade disturbances and trade frictions involving steel products. The global steelmaking capacity increased to 2463.4 mmt in 2022 despite the market slowdown, and the gap between capacity and production surged to 632 mmt. As a result, the average capacity

utilisation rate has fallen to 74.3%, a level that is not in line with a healthy and financially viable steel industry that needs to invest in a low-carbon future and remain competitive vis-à-vis alternative materials. Looking ahead, OECD analysis shows a potential of 166.1 mmt of new steelmaking capacity coming on stream in 2023-25, more than half of which is carbon intensive as it involves investments into traditional blast furnace/basic oxygen furnace plants.

Source : oecd.org, 93rd session of the Steel Committee, 13-14 March 2023

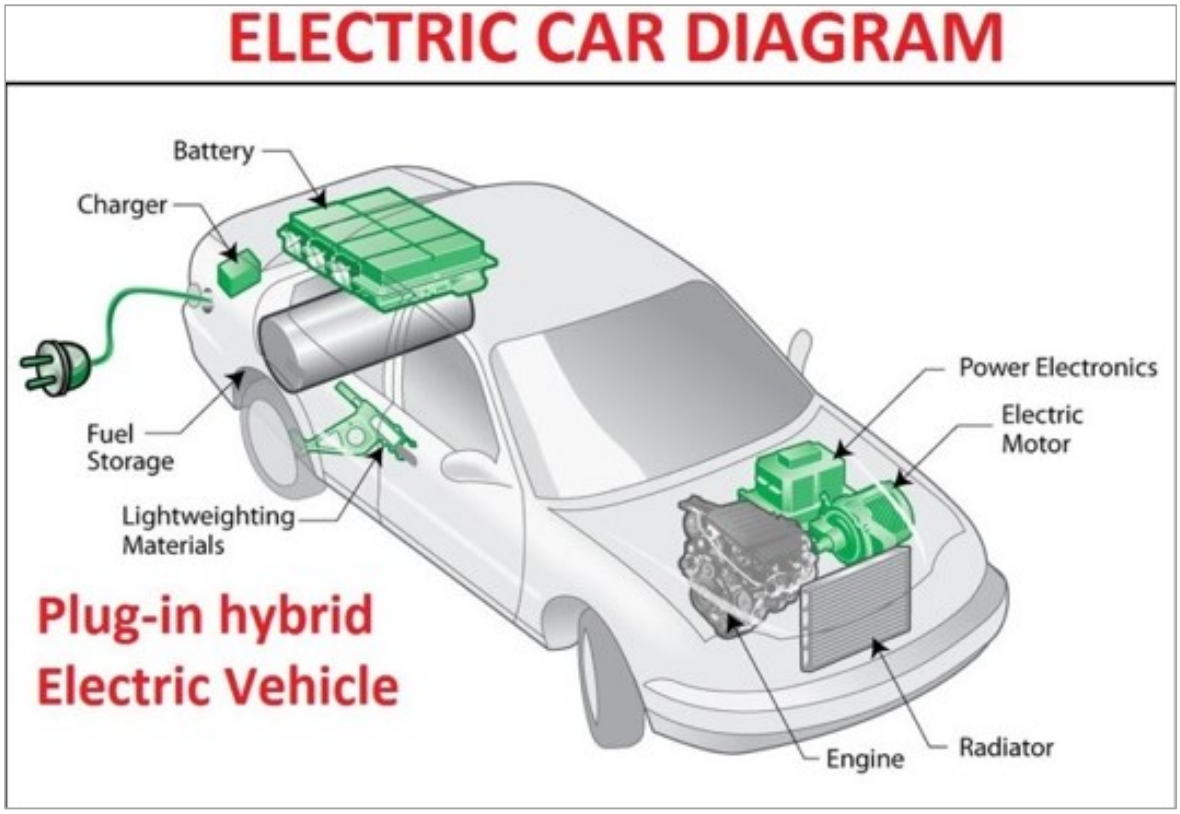
Silicon Steel Production Technology

A New Market for Steel Producers

Today, with the development of electric vehicles, silicon steel or electrical steel has become an important engineering material for the automobile sector. Electro mobility requires two output components on the drive side: chargeable battery, and electric motor. Electric motor, made of silicon steel, is the heart of vehicle and largely determines automobile efficiency.

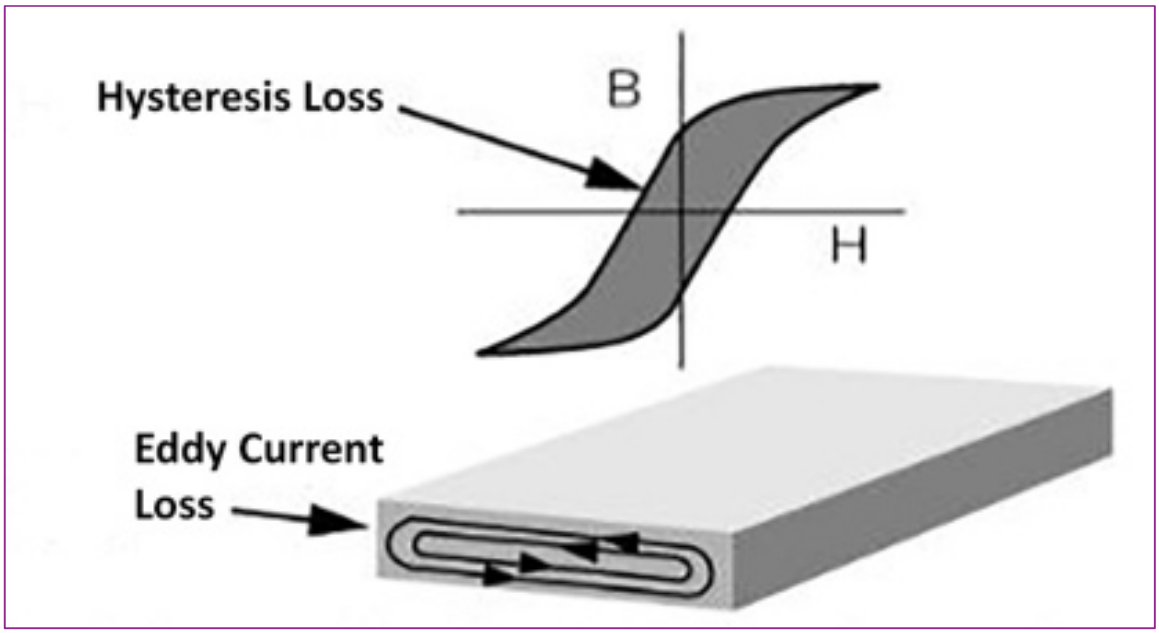
Depending on the size and type of drive motor (battery powered or hybrid vehicle), approximately 10 to 100 kg of electrical steel is used in an automobile. Quality of electrical steel will determine efficiency of future vehicles.

As per the forecast made by various research agencies, by the year 2030, there will be production of 120 million automobiles in the world, and more than 50% will be driven by electric motors. This will generate great demand for silicon steel in quantum of more than 4 million tons per year by 2033, approximately 50% of the current production. The current global annual production of silicon steel is 8.8 million tons. This gives a good business opportunity to steel producers to expand their specialty steel production capacity. In order to meet the increasing domestic and international demands for Silicon Steel, the Government of India has announced an attractive production linked incentive scheme. This new opportunity has generated good interest among leading steel producers. The author of this paper was involved in the silicon steel technology transfer from Armco Steel USA, erection and commissioning of Silicon Steel Mill, and production of silicon steels at Rourkela Steel Plant. The objective of this paper is to provide a comprehensive overview of metallurgy and production technology of silicon steel.



What is Silicon Steel?

Silicon Steel or electrical steel is an Iron-Silicon alloy that utilizes the natural ferromagnetic properties of iron and is used as soft magnetic material in various electrical machines. When steel core is subjected to magnetization by an alternating current, energy losses occur, called iron loss. There are two kinds of iron losses: hysteresis loss-occurs due to migration of the magnetic domains in steel, and eddy current loss-that occurs when an eddy current is induced in steel by an alternating current magnetic flux. Core loss or iron loss reduces efficiency of electric machines and increases the operating costs. Electrical steel, due to its special magnetic characteristics results in minimum iron loss.



Silicon is the main alloying element used to improve magnetic properties and reduce iron loss. It was discovered in 1900 by Hadfield that the addition of silicon improves the soft magnetic properties of steel. As Si content increases, magnetic permeability increases due to low magneto-crystalline anisotropy. To reduce eddy current loss, the thickness of the sheet used for making the core is reduced typically in the range of 0.20 mm to 0.65 mm.

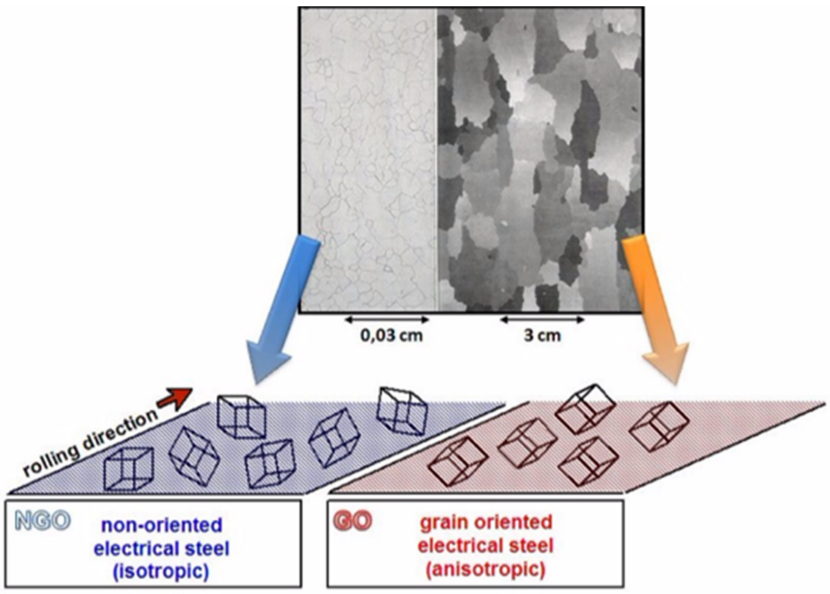
Electrically insulating coatings are applied to electrical steel sheets to create a nonconductive layer between laminations to reduce eddy current loss.

Types of Silicon Steel

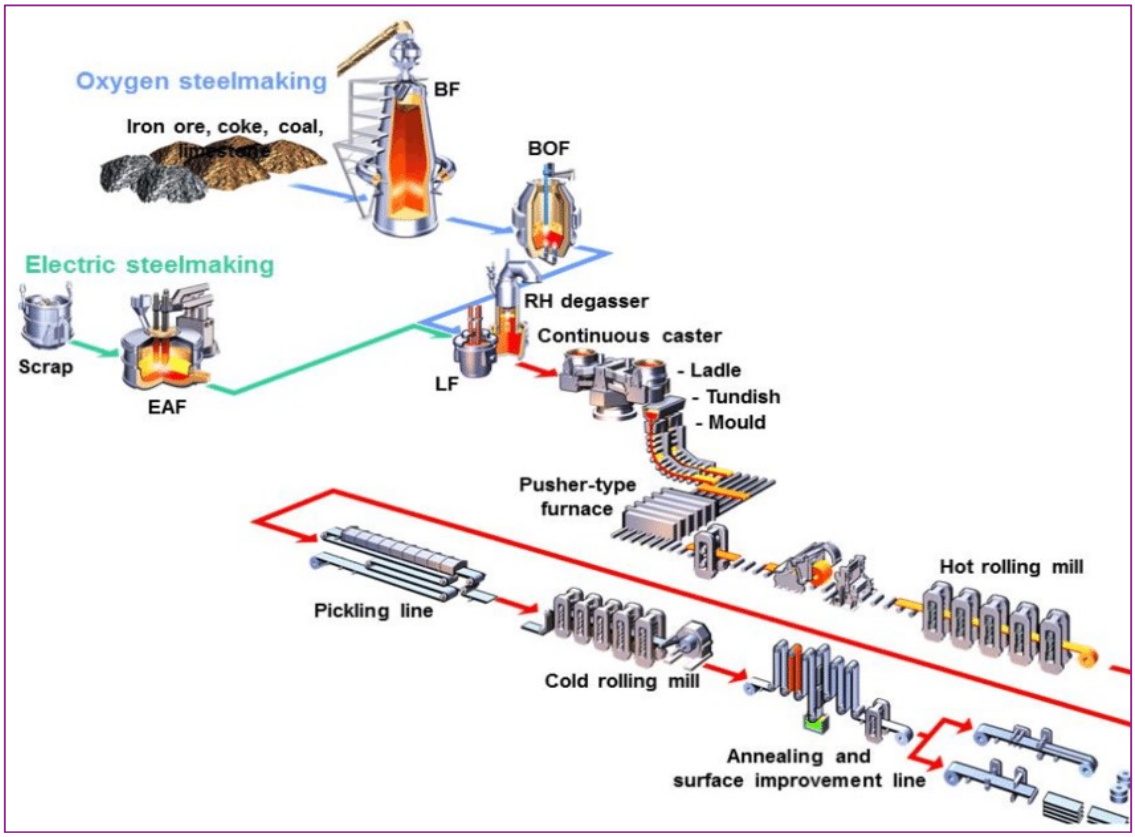
Electrical steel is classified into two main types:

- Cold Rolled Non-Oriented (CRNO), and
- Cold Rolled Grain-Oriented (CRGO)

CRNO electrical steel sheets have similar magnetic properties in all directions. They are widely used for iron core materials of rotating machines ranging from large-size power generators to large and small size electric motors. They are also desirable for the iron core of small-size power transformers.



CRGO electrical steel is mainly used as core material for static equipment (e.g., transformers), in which the magnetization direction is unidirectional. Therefore, the crystallographic texture is one of the most important characteristics determining the magnetic properties of electrical steel. The texture of CRGO steel is characterized by the orientation of all grains in the 001 direction on 110 planes. This is the easiest magnetization direction parallel to the magnetic field direction.



Production of Silicon Steel

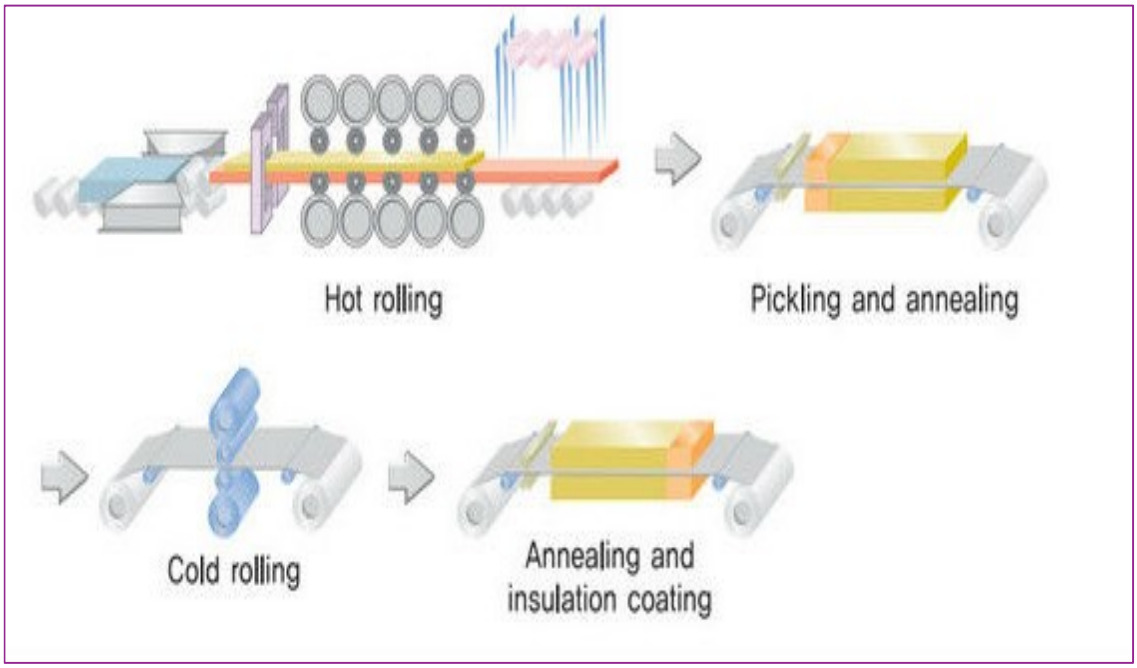
Silicon steel production uses relatively high technology and specialized processes. Know-how of silicon steel production is proprietary technology, developed and patented by very few leading specialty steel producers in the world. Silicon steel requires a very high degree of chemical purity, silicon is the main alloying element, phosphorus, and aluminium also improve magnetic properties up to some extent. All other elements are highly detrimental to silicon steel.

Electrical steel slabs can be produced through BF - BOF - Secondary Refining - Concast, or EAF - Secondary Refining - Concast route. Steel making process can be selected from various options depending on raw material mix, available equipment, and other technoeconomic factors. Blast furnace based steel plants as well as EAF based mini steel plants, both can go for the silicon steel production.

Processing of CRNO Steel

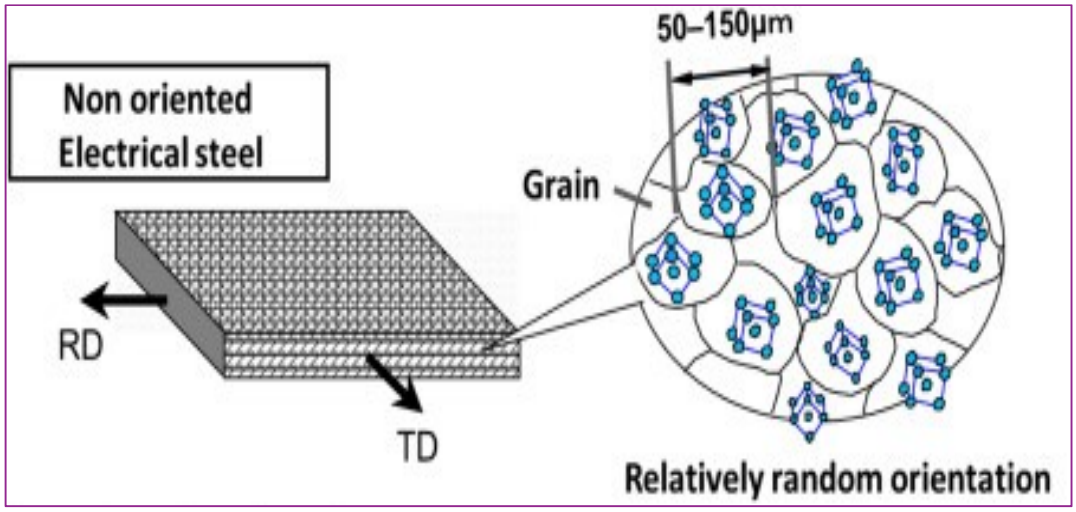
CRNO silicon steel slabs are hot rolled to coils in conventional hot strip mills. After hot rolling following steps are involved In the production of non-oriented electrical steel:

- ***Annealing & Pickling:*** Hot rolled coils are pickled/annealed-pickled in a continuous processing line. The complex oxide scale formed during hot rolling is removed by shot-blasting and hydrochloric acid cleaning. Annealing and pickling improve the surface quality and cold rolling properties of steel as well as its magnetic properties.
- ***Cold Rolling****:* Annealed and pickled coils are cold rolled in reversing or tandem mills to reduce thickness as per specification. To ensure uniform thickness, width, and flatness of the strip, cold rolling mills equipped with automatic controls are used.



- ***Special Annealing****:* Desired magnetic properties are developed in a special annealing furnace, which performs two metallurgical purposes; decarburization and quality annealing. Decarburization is a unique patented technology used to reduce the carbon content of steel in the solid state, using a special furnace

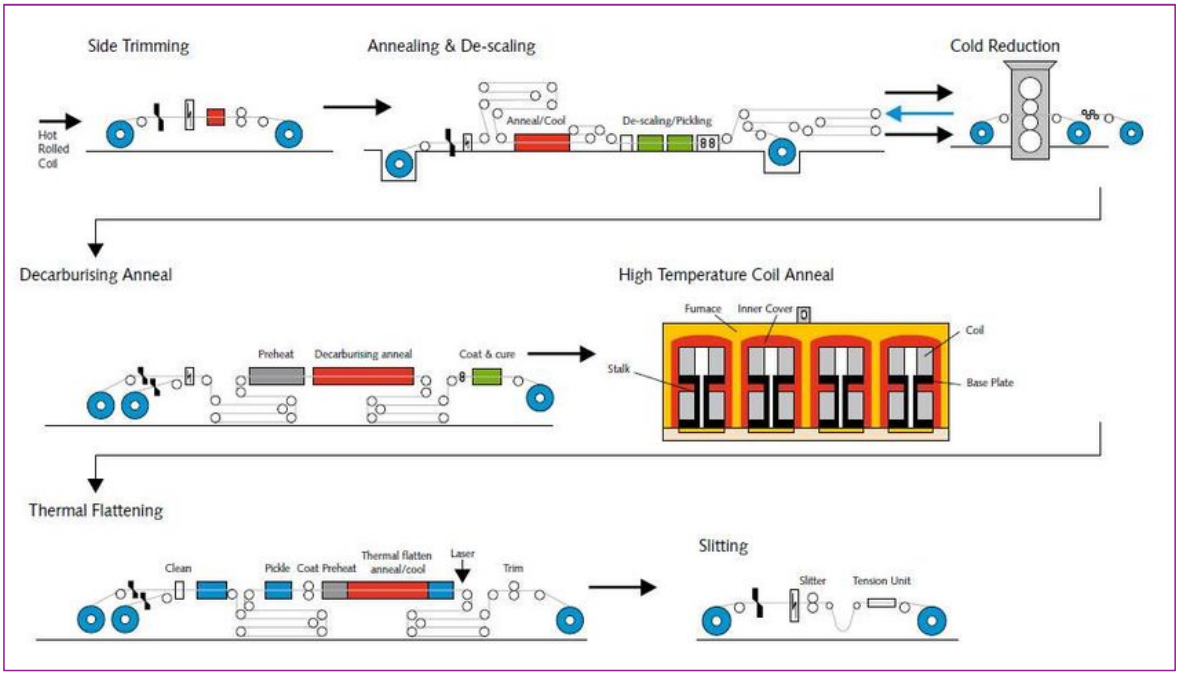
atmosphere and controlled temperature. After decarburization, a high temperature heat treatment is done for the recrystallization of hardened and elongated cold-rolled structures to develop equiaxed isotropic grains with improved magnetic properties. Decarburization and quality annealing can be performed in a single tandem annealing line.



- ***Insulation Coating****:* To reduce eddy current losses a special insulation coating is applied in a coating line equipped with a coater and drying furnace. Insulation coating separates thin lamination to reduce eddy current loss.
- ***Sheet Shearing and Slitting Lines****:* Finished CRNO silicon steel coils are slitted in desired width or cut to the required length as per the requirements of the customers.

Processing of CRGO Steel

CRGO electrical steel usually has a silicon level of 3.5%. It is processed in such a way that the optimal properties are developed in the rolling direction, due to precise control of the crystal orientation. The magnetic flux density increased in the coil rolling direction, although its magnetic saturation decreased to some extent. It is used for making cores of power and distribution transformers. The production technology of CRGO silicon steel is much more complex and high-tech than CRNO steel right from steelmaking hot rolling to cold finishing. Another special feature of CRGO steel is a stringent quality specification, it is produced either prime or scrapped. As shown in the process flow diagram, cast slabs are reheated at higher temperatures in a specially designed re-heating furnace and rolled to hot rolled coils in a hot strip mill. Hot rolled coils are processed in the following processing lines of a cold rolling mill complex.



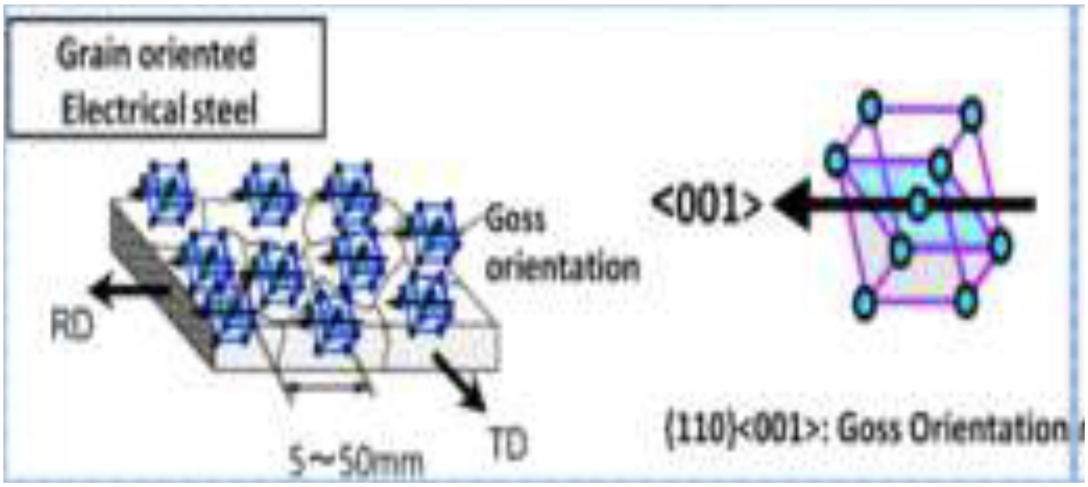
Annealing & Pickling: Hot-rolled coils are annealed and pickled in a continuous annealing and pickling line. The complex silicon oxide scale formed during hot rolling is removed by shotblasting and hydrochloric acid pickling. Two-stage annealing and pickling of CRGO coils improve the surface quality, grain orientation, and magnetic properties of steel.

Cold Rolling: Annealed and pickled coils are cold rolled in reversing mills or tandem mills to reduce thickness. To ensure uniform thickness width, and flatness of the strip, cold rolling mills equipped with automatic controls are used.

Decarb Annealing: Carbon is the most detrimental element in silicon steel. Carbon is reduced to a great extent during steel-making and secondary refining processes. Further reduction of carbon is done in a special continuous decarburizing and annealing furnace. Decarburization is a unique patented technology used to reduce the carbon content of steel in the solid state, using a controlled atmosphere and temperature. After decarburization, a special magnesia coating is applied to the strip surface to form an insulating film in the next process of high-temperature annealing.

Box Annealing: Decarburized magnesia coated grain-oriented coils are annealed at very high temperatures in an ultra-pure hydrogen atmosphere in specially designed box annealing furnaces. The main technology of glass film formation, grain growth, and grain orientation takes place during the box (batch) annealing. This is the core process of

grain-oriented technology, which requires very high-quality equipment and a fool-proof control system.



Insulation Coating*:* Box annealed coils are again processed in a continuous line, in which thermal flattening and a special insulation coating done on finished CRGO strips.

Sheet Shearing and Slitting: Finished CRGO silicon steel coils are slitted to the desired width or cut to the required sheet lengths as per the requirements of the customers.

Packaging & Handling: CRGO silicon steel is very sensitive to the careless handling of finished sheets. Any jerk or mechanical impact increases the stress in sheets resulting in higher iron loss. Therefore, special care is taken during the packaging, handling, and delivery of CRGO steel to customers. CRGO is usually supplied by the steel mills in coil form and has to be cut into "laminations", which are used to form a transformer core. Grain-oriented steel is used in large power and distribution transformers and in certain audio output transformers.

World-class Manufacturing of Silicon Steel

Silicon steel is a special type and expensive material. It can be efficiently manufactured by adapting world-class metallurgical techniques. In order to make it globally competitive and profitable, a Just-In-Time world-class system should be used. JIT production technique developed by Toyota, can facilitate Silicon Steel producers to increase throughput, reduce inventory, ensure faster delivery, and higher profitability. To adapt JIT, the entire process, right from steelmaking-hot rolling cold rolling-to dispatch should be designed and managed as a single value stream. To minimize the production costs and maximize utilization of silicon steel production facilities, the throughput and cycle time of all processes must be levelled according to demand rate, which is a unique approach of JIT production system. It may be an out-of-box thinking for steel producers.

Source : Akhilesh N Singh, Steelworld, No. 12, February 2023

BIS Standards for Stainless Steel Seamless Pipes and Tubes and Welded Pipes & Tubes

Two new standards, namely IS 17875:2022 Stainless Steel Seamless Pipes and Tubes for General Services and IS 17876:2022 Stainless Steel Welded Pipes and Tubes for General Services have been published by Bureau of Indian Standards. These Standards were adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Tubes, Pipes and Fittings Sectional Committee had been approved by the Metallurgical Engineering Division Council. The Panel for formulation of Standard on Stainless steel pipes and Tubes consists of experts from ISSDA, RDSO Lucknow, IDMC Anand, Ratnamani Metals and Tubes, Welspun Limited and SS pipes and tubes manufacturers association. The convenor of the panel is Mr. N. K. Vijayvargia, IIM Life Member affiliated to Delhi Chapter

Apart from these two standards, revision of two existing very old standards on Stainless Steel Pipes and Tubes and preparation of further 3 new standards are in the pipe line. A large quantity of stainless steel seamless and welded pipes and tubes are manufactured in India for various applications. The welded pipes and tubes can be produced easily as compared to seamless pipes and tubes and are less expensive. These pipes and tubes have wider applications. Seamless pipes and tubes have no weld joints, allowing them to withstand high levels of pressure and temperature for a given nominal thickness. Therefore, stainless steel seamless pipes and tubes are quite versatile. Due to its unique combination of ductility, elasticity and hardness, stainless steel finds application in various industries. Given the diverse applications of stainless steel pipes and tubes, coupled with corrosion resistance and desired mechanical properties at low as well as high temperatures, stainless steel pipes and tubes are used in various mechanical and engineering industries, apart from wide applications in oil and gas industry. There are many grades of stainless steel and corrosion and mechanical properties varies vastly from grade to grade and hence proper selection of the grade for a particular application is of utmost importance. Proper care should be taken while production, handling storage and fabrication of final product to retain the important properties of stainless steel pipes and tubes. These standards would bring a uniformity in the quality of Indian stainless steel pipes and tubes and will also help Indian pipes and tubes manufacturers in improving the quality of their products and bring more recognition in the national and international market. These standards will also help in bringing a uniform standard in the import of these products. Many manufacturers have already taken licence to use BIS mark on their products under these Standards.