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Global Steel Production 2023

million tonnes

	December 2023	% change Dec23/22	Jan-Dec 2023	% change Jan-Dec 23/22
Africa	1.9	17.7	22.0	5.7
Asia and Oceania	96.4	-9.7	1,367.2	0.7
EU (27)	9.1	2.7	126.3	-7.4
Europe, Other	3.9	19.4	41.7	-4.6
Middle East	4.9	9.6	53.2	1.3
North America	9.3	5.3	109.6	-1.7
Russia & other CIS + Ukraine	7.1	11.8	88.1	4.5
South America	3.2	-3.2	41.5	-5.7
Total 71 Countries	**135.7**	**-5.3**	**1,849.7**	**-0.1**

The 71 countries included in this table accounted for approximately 98% of total world crude steel production in 2022. Regions and countries covered by the table:

- **Africa:** Algeria, Egypt, Libya, Morocco, South Africa, Tunisia
- **Asia and Oceania:** Australia, China, India, Japan, Mongolia, New Zealand, Pakistan, South Korea, Taiwan (China), Thailand, Viet Nam.
- **European Union (27):** Austria, Belgium, Bulgaria, Croatia, Czechia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovania, Spain, Sweden
- **Europe, Other:** Macedonia, Norway, Serbia, Turkiye, United Kingdom
- **Middle East:** Bahrain, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen
- **North America:** Canada, Cuba, El Salvador, Guatemala, Mexico, United States
- **Russia & Other CIS + Ukraine:** Belarus, Kazakhstan, Russia, Ukraine
- **South America:** Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

Source; World Steel Association, 25th Jan. 2024

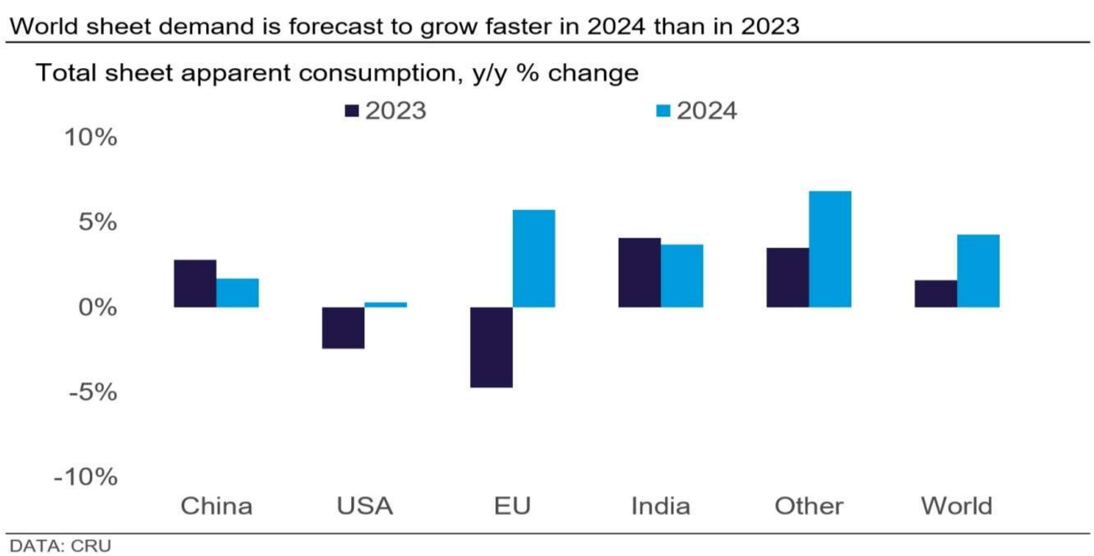
Top Ten Steel Producing Countries

	December 2023 (Mt)	% change Dec-23/22	Jan-Dec 2023 (Mt)	% change Jan-Dec 23/22
China	67.4	-14.9	1,019.1	0.0
India	12.1	9.5	140.2	11.8
Japan	7.0	1.1	87.0	-2.5
United States	6.8	7.6	80.7	0.2
Russia	6.0e	4.3	75.8	5.6
South Korea	5.4	2.7	66.7	1.3
Germany	2.6	-2.3	35.4	-3.9
Turkiye	32.	21.2	33.7	-4.0
Brazil	2.5	0.9	31.9	-6.5
Iran	2.9	12.1	31.1	1.8

Source; World Steel Association, 25th Jan. 2024

2024 Forecast for Steel

World steel sheet demand grew by ~ 1.6% y/y in 2023. This modest growth is the net result of expanded demand in Asia and contractions in North America and Europe. In 2024, growth is likely to return in the West and growth in Asia to continue. At the global level this will result in an acceleration to 4.3% y/y:

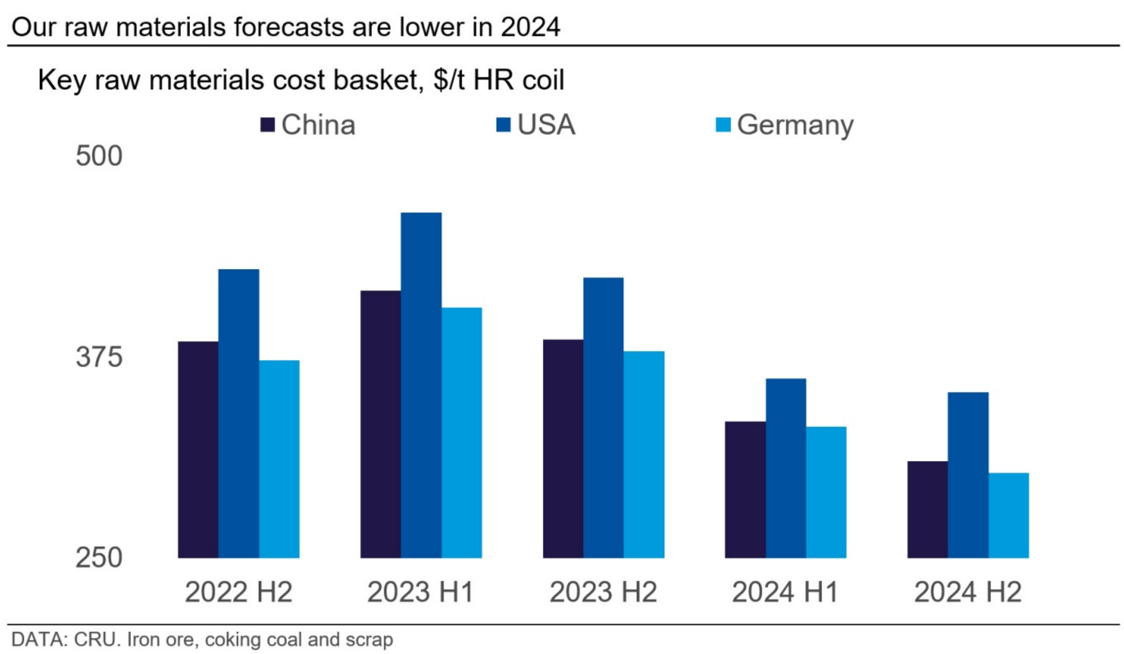


Demand will continue growing in China, but at a slower pace. The real estate sector continues to be a drag on the economy. Infrastructure spending and some areas of manufacturing output, especially in renewable energy and automotive have offset this for sheet and will do so again in 2024. But the pace of that offset will slow.

In USA, decline will stop but return of growth will take longer. Demand will return to positive growth in 2024 – but only just. US industrial output will remain weak in the early part of the year. An expected peak in interest rates by mid-year will help demand from the construction sector. But overall, 2024 will be a year of consolidation before improved demand growth in subsequent years.

In Europe, rebound is expected from a bad year. Demand growth forecast is strong in the EU for 2024. Partly this is a simple base effect after a steep contraction of demand in 2023. But it also partly reflects an improved outlook for Europe's industrial and construction output. As in the USA an expected peak in interest rates will contribute. There is an optimistic outlook on light vehicle production.

- **Raw materials costs will fall**



- **Risks: car production, and China**

Downside: Our base case view of light vehicle production growth in 2024 is strong. But with many worries continuing over current weak economic growth, these forecasts could prove bullish.

Upside: the accumulated economic stimulus in China has underwhelmed outside expectations, though has arguably been consistent with a desire to move the economy away from a heavy reliance on fixed asset investment. Problems in real estate could be resolved faster than expected, or stimulus applied more heavily – which has been the case in the past.

Source: CRU's Steel Outlook for 2024

ArcelorMittal Commissions Plant for Converting Waste Wood into Bio-coal

ArcelorMittal Belgium has commissioned €35 million plant in Gent, Belgium, first of its kind in the European steel industry, (Torero Plant), which converts waste wood into bio-coal for use in the blast furnace at its Gent steelmaking site. The first bio-coal made in the Torero Plant, through a process known as *torrefaction*, was successfully used in a blast furnace in Gent. The project will reduce annual carbon emissions from the plant by 112,500 tonnes, by reducing the use of fossil coal in the blast furnace. The Torero industrial-scale demonstration plant will convert 88,000 tonnes of waste wood into 37,500 tonnes of bio-coal annually.
The use of bio-coal in the blast furnace process will result in the production of bio-gas, which will be captured and transformed into ethanol by ArcelorMittal Gent's Steelanol facility, Europe's first carbon capture and utilisation (CCU) project. Industrial production of ethanol began at the Steelanol plant, a significant step in the journey to the full commissioning of the facility. The ethanol can then be used as a building block to produce a variety of chemical products including transport fuels, paints, plastics, clothing and even cosmetic perfume, hence helping to support the decarbonisation efforts of the chemical sector.

The Torero project is supported by European funding from the European Union's Horizon 2020 research and Innovation Framework Program. The project consortium consists of the full value chain:

- Industry: ArcelorMittal

- Expert research organizations: Joanneum Research, University of Graz and Chalmers Technical University

- Developer of the carbonization process technology: Perpetual Next (formerly TorrCoal)

ArcelorMittal Europe has an ambition to reduce CO_2 emissions by 35% by 2030, and an ambition to reach carbon neutrality by 2050.

Source: ArcelorMittal Press Release

Why Making Hydrogen from Coal could be Better for the Planet than Blue H_2 Derived from Natural Gas?

Hydrogen made from coal is likely to have lower lifecycle emissions than H_2 derived from natural gas when both production methods use carbon capture and storage, according to a new report from the US Department of Energy.
Blue hydrogen, made from fossil fuels but with CO_2 captured and stored, has often been proposed as a route to decarbonise existing H_2 production at a much lower cost than renewables-powered electrolysis.

However, the DOE's Hydrogen Shot Technology Assessment found that lifecycle emissions from steam methane reforming (SMR) and autothermal reforming (ATR) are both higher than the US standard for clean hydrogen's threshold 4kg of CO_2-equivalent (CO_2e) per kilo of H_2 produced.

The DOE also assessed CCS as a way to decarbonise coal gasification - a widely-used "syngas" production method that represents around 70% of hydrogen produced in China — which it identifies as a particularly polluting method of hydrogen production with an emissions intensity of 20 kg CO_2e/kg H_2*.

This is compared to a 12 kg CO_2e/kg H_2 baseline carbon intensity for steam methane reforming (SMR), which the DOE calculates can drop to 4.6 kg CO_2e/kg H_2 with CCS, while lifecycle emissions for auto-thermal reforming

But despite the sky-high emissions intensity of coal gasification, the DOE calculates that adding CCS technology with a CO_2 capture rate of 92.5% to the process results in lower lifecycle emissions than either of the gas-based routes, at 4.1 kg CO_2e/kg H_2. This is because greenhouse gas emissions from the exhaust stack account for 90% of the emissions intensity of coal gasification, compared to around 75% for SMR.

However, the DOE did note that this figure was calculated based on the properties of Illinois No. 6 (or Herrin) coal, and added that lifecycle emissions could vary significantly based on the type of coal, where it was sourced, and whether the mine was surface or underground.

If coal is "co-gasified" with biomass to a 1.3:1 ratio — and depending on how carbon sequestration by the plant matter is accounted — then a CO_2 capture rate of 92.6% could even lead to negative lifecycle emissions, or 1kg CO_2e taken out of the atmosphere per kilo of hydrogen produced.

However, the report notes that the levelised cost of hydrogen production from co-gasification would be $3.75/kg - compared to less than $2/kg for blue H_2 - mainly due to much higher capital costs.

"Compared to the ATR case, the coal and biomass gasification case capital cost contribution is about five times larger, the fixed O&M [operations and maintenance] cost is about six times larger, and the T&S [transport and storage] cost is about double," it cautions.

While individual feedstock gasifiers have been widely used, the DOE admits that technology to gasify a mix of fuels - such as biomass, municipal solid waste, and waste plastics - is still in development and could come with issues such as corrosion and contamination of the final syngas products.

"Modularity will be an important cost reduction pathway for both nearer-term gasification technology applications and advanced/developmental gasification systems that may emerge in the future," the report adds.

**All lifecycle emissions in this article were calculated using characterization factors from the IPCC's fifth assessment report with a 100-year time horizon and atmospheric carbon climate*

Source: Accelerate Hydrogen newsletter, Dec 7, 2023

Climate Impacts of Hydrogen Leaks

To build a new clean energy system, and considerable hype is being devoted to the possibilities of hydrogen: a colourless, energy-dense gas that produces only water vapour when burnt. Final agreement at Cop28 referenced "low-carbon hydrogen production" as a key technology that needs to be deployed for the world to reach net-zero emissions. The UK government has also announced 11 major new hydrogen production projects, which are to be backed by £2bn of government funding over the next 15 years.

Hydrogen is widely touted as a "missing link" to decarbonise difficult sectors such as steel, shipping, and chemicals production. The International Energy Agency anticipates that global hydrogen demand would increase six-fold if emissions were to be brought to net zero. Low-carbon hydrogen is usually produced either by the electrolysis of water using renewable electricity ("green" hydrogen), or from natural gas coupled with carbon capture and storage technology ("blue" hydrogen).

The world's major economies all have massive programmes in place with the aim of becoming the leader in the hydrogen industry. The EU's REPowerEU programme is aiming for ten million tonnes of renewable hydrogen production by 2030. The US is targeting an industry worth $140bn in revenues and 700,000 jobs by 2030. The UK's target of 10GW hydrogen production by 2030 would consume the equivalent of half of the country's planned offshore wind capacity.

Hydrogen can be a "clean" fuel for the future. But new science suggests that there are climate concerns around even green hydrogen, which has no link to fossil fuel production, should it leak into the atmosphere during production, transport or at storage sites.

A study by climate scientists at the Oslo-based CICERO Centre for International Climate Research has found that leaked hydrogen has a warming effect around 12-times greater than emitted CO_2. This is because hydrogen has a significant amplifying effect on the warming impact of certain greenhouse gases, such as methane and ozone, even though it is not itself a greenhouse gas. A global warming potential of 11.6 is significant, and hence the importance of reducing hydrogen leaks.

"Reducing hydrogen leaks" makes sense in theory, as it will save producers money. But in practice, it is complicated by the fact that hydrogen molecules are much smaller and lighter than those of natural gas, and as a result are harder to contain.

There are also no readily available tools for measuring just how significant hydrogen leaks are; even more established systems for monitoring methane keep vastly underestimating the scale of leakages. But a report from the UK think tank Green Alliance offers some estimates: hydrogen heating tests have found that leakage is around 1.2 to 3 times greater than is the case with natural gas, while researchers at Columbia have forecast standard leakage rates of 3 to 6 per cent.

Modelling from Green Alliance has found that even a leakage rate of a few percentage points could massively reduce the climate benefits of hydrogen, as the below graphic illustrates.

Hydrogen is extending the lifetime of methane in the atmosphere, and methane is a hugely damaging greenhouse gas that is 80 times more potent at warming than carbon dioxide.

Hydrogen could have a "hugely damaging effect", and as a result should not be deemed a "cure-all" for all our energy transition needs, particularly where it would need to be transported by pipelines over long distances.

Source: IEEFA Friday Week in Review; 16 Dec. 2023

Hyperloop Testing Facility at IIT Madras

ArcelorMittal and ArcelorMittal Nippon Steel India deploying materials and engineering resources to construct Asia's first Hyperloop testing facility at IIT Madras, Chennai, India
ArcelorMittal announces that it has established a partnership with Indian Institute of Technology Madras (IIT Madras) and is working closely with IIT Madras' Hyperloop Technology teams - Avishkar Hyperloop, student team and TuTr Hyperloop, a start-up incubated at IIT Madras, which are developing cost-effective Hyperloop technologies for passenger and cargo mobility at scale.

ArcelorMittal and AM/NS India are providing foundational steel materials, as well as engineering, design and project management expertise to support the creation of India's and Asia's first Hyperloop test track at IIT Madras' 163-acre Discovery Campus at Thaiyur, on the outskirts of Chennai. The Hyperloop team's central objective is the advancement and commercialisation of Hyperloop technologies for high-speed, affordable, reliable and sustainable transportation. India's Ministry of Railways is a key partner to this Hyperloop technology development initiative at IIT Madras.

AM/NS India is supplying almost 400 tonnes of steel for the fabrication of a 400-metre vacuum tube at the site, in which autonomous, levitating pods will be tested at speeds of up to 200 kilometres per hour.

AMDEC, ArcelorMittal's design and engineering arm based in India, is also posting experienced engineers on secondment to the Hyperloop team to help oversee project progress and provide design and engineering expertise during a pivotal stage of the installation process. The test facility is expected to be operational by the end of Q1 2024.

IIT Madras is at the vanguard of deep-tech development in India, and TuTr Hyperloop's technology and tenacity inspire great confidence about their potential to be pioneers in Hyperloop, a mobility transition industry in which steel would have an important role to play."

This deep-tech initiative will significantly accelerate efforts to commercialize Hyperloop technology. This collaboration between Government, Academia, and Industry has the potential to create an efficient, sustainable, and affordable mass mobility technology for the future.

Following the completion of the proof-of-concept phase, the next stage would be the development of an operational demonstration route for a real-world use-case to validate the techno-commercial prospects of this Hyperloop technology.

ArcelorMittal's latest partnership with IIT Madras builds on an existing collaboration with the renowned technology institute to identify, support and mentor start-ups focused on the most promising industrial decarbonisation technologies in India.

In July 2023, ArcelorMittal announced that its XCarb™ Innovation Fund was launching an accelerator programme to fund and support the next wave of breakthrough ideas on decarbonisation emerging from India.

Launched in 2021, the XCarb™ Innovation Fund invests in companies developing technologies that hold the potential to accelerate the steel industry's transition to carbon neutral steelmaking.

Source: ArcelorMittal Announcement, Jan, 3, 2023

Congratulations to Shri Deepak Bhatnagar

In the 77th Annual Technical Meeting (ATM) of The Indian Institute of Metals held at Bhubaneswar during 22nd to 24th November 2023, Shri Deepak Bhatnagar, Member Executive Committee of IIM Delhi Chapter and Secretary General Pellet Manufacturers Association, made an oral presentation in the above ATM. The theme of his presentation was "Raw Materials Processing".

His presentation was adjudged the best oral presentation in the ATM. He was given the award of Best Oral Presentation as per the Certificate of Appreciation, as under:

IIM Metallurgy Materials Engineering

77th Annual Technical Meeting
The Indian Institute of Metals (IIM)
22nd to 24th November 2023, KIIT-Bhubaneswar

KIIT

ADITYA BIRLA
HINDALCO

CERTIFICATE OF APPRECIATION

This is to certify that Deepak Bhatnagar, PMAI, New Delhi, *has been awarded with the* ***Best Oral*** *Presentation in the Theme:* Raw Materials Processing *in the "Indian Institute of Metals – Annual Technical Meeting 2023" at Bhubaneswar.*

Mr. S. S. Mohanty
Chairman
Core Organizing Committee
IIM-ATM 2023

Mr. Bibhu Prasad Mishra
Convenor
Core Organizing Committee
IIM-ATM 2023

Need for Carbon Dioxide Removal

Carbon dioxide removal (CDR) is not a substitute for emissions reduction, but science says we'll need it too, to protect a livable planet. CDR is needed because emissions reductions alone will not be sufficient to achieve the world's climate goals.

The pathway to a 1.5°C-aligned future that avoids catastrophic climate change will require massive amounts of CDR, i.e., to extract CO_2 from the atmosphere and durably store it.

While we must do all we can to minimize emissions, the world will need billions of tons of CDR annually by 2050. This is a matter of consensus among major climate-focused groups — from the UN Intergovernmental Panel on Climate Change (IPCC) to the National Academies of Sciences, Engineering, and Medicine (NAS) to the International Energy Agency (IEA).

Achieving this scale will require the development, testing, and substantial deployment of CDR solutions in the next decade so that they can be built cost-effectively, sustainably, and equitably when needed. CDR is not a substitute for other climate action, and emissions reductions still comprise the majority of activity needed to keep global warming within target levels.

The emissions budget is shrinking rapidly

The IPCC's latest research makes clear that we have a limited budget for new greenhouse gas emissions to avoid the worst impacts of climate change. Unfortunately, the world is on track to use up that budget in the next 12 years.

As a result, rapid and drastic reductions as well as CDR at the multi-billion-ton per year scale will be needed to stabilize the climate.

It is also likely that — even with a successful and complete transition of the energy system away from fossil fuels and the deep decarbonization of industry — residual emissions will continue beyond 2050 in some sectors, such as agriculture and aviation. It is also possible that emissions from forest fires, permafrost melts, and other events that occur outside of human industrial activity will increase, because of dynamics already unleashed.

Thus, CDR will need to fulfil three roles that cannot be accomplished by emissions reductions:

- **Reducing net emissions** during the decarbonization transition, to avoid temperature overshoot before 2050
- **Counteracting continued emissions** after the decarbonization transition from activities that are very expensive or technically infeasible to mitigate, like some forms of agriculture and aviation, to continue avoiding temperature overshoot after 2050.
- **Removing historical emissions** after achieving net zero, to address any temperature overshoot that has occurred.

What CDR is

CDR is human activity that removes CO_2 from the atmosphere and durably stores it in geologic, terrestrial, or ocean reservoirs, or in products. Many CDR methods are at an early stage, and new techniques are being developed at a rapid pace.

The known CDR techniques can be broadly grouped into three categories: biogenic, geochemical, and synthetic, based on whether the key input to the removal process is sustainable biomass, alkaline minerals, or low-carbon energy. Each of these categories is comprised of a vast and growing number of specific approaches. Each of these has unique benefits, impacts, and potential.

CDR does not include activities that reduce greenhouse gas emissions by capturing CO_2 from processes that generate emissions, such as the combustion of fossil fuels or calcination of carbon-rich rocks to produce cement. The capture and storage of CO_2 from point sources such as power plants (coal or fossil gas combustion) or steel plants reduces emissions from industrial activities but does not reduce the amount of CO_2 in the atmosphere. This is an important distinction to note, as both removal and reduction solutions are necessary.

Decades are required to build an industry

Today's CDR industry is incredibly small compared to what it needs to be in 2050, and it will not be possible to instantly build a multi-billion-ton industry from scratch once the easiest and cheapest mitigation options have been exhausted.

It takes time to create new industries. For example, solar photovoltaic power generation was invented in 1950. A functioning, scaled market to pay for electricity production already existed. However, by 2010, solar provided just 0.1 percent of global electricity and required another decade to reach just 3.1 percent. Many CDR approaches are being tested for the first time now, and there is no functioning, scaled market in place to pay for CDR.

We need to take major steps forward on CDR in this decade so that multi-billion-ton scale removals are possible at a reasonable cost when they are needed. These steps include, but are not limited to: technology research, development, and deployment (RD&D); development of monitoring tools, standards, regulations, markets, and buyers; training thousands of workers; and building the necessary supporting infrastructure.

Critically, a great deal of learning and cost reduction can only happen through building pilot and commercial facilities, so we need to safely test and deploy CDR approaches in the real world starting now.

Concerns and challenges

Given that CDR is necessary and we must develop and responsibly deploy these solutions soon, it is important to note some of the concerns and challenges associated with CDR and emphasize the need for caution.

- A major concern with CDR is mitigation deterrence — i.e., moral hazard — the possibility that the increased plausibility of using CDR to address climate change will reduce motivation to cut emissions.
- In addition to emissions that cause warming, a parallel concern — emphasized especially by environmental justice advocacy groups — is that the use of CDR would perpetuate harms from non-CO_2 pollution on overburdened communities either through direct impacts from the project on air quality, water quality, ecosystems, or quality of life, or by providing emitters with a license to continue operating and generating emissions.
- Another risk is that CDR would result in the diversion of financial and material resources away from emissions reduction efforts.

In short, poorly implemented CDR could cause negative impacts in a range of areas, including environmental, health, and equity. These challenges are especially acute given that many CDR methods are so nascent, the potential scale of these risks cannot yet be fully understood.

CDR's critical role

Excess reliance on CDR could slow or increase the cost of reaching our climate goals, so reduction should be prioritized wherever possible. However, the science is clear: CDR will be needed to reach those goals.

Action is needed now, and this decade represents our only opportunity to ensure that CDR is deployed cost-effectively, sustainably, and equitably on the timeline and at the scale required.

Source: RMI Spark Newsletter, 30 November, 2023

Kabil to Invest over Rs 200 crore to Secure Lithium Supplies from Argentina

Kabil (Khanij Bidesh India Ltd) will invest ₹211 crore ($ 25.712 million) over a five-year-period for exploration stage activities of five lithium blocks in Fiambala area of Argentina. An exploration and development agreement in this regard is expected to be signed with Camyen, a state-owned miner in Argentina's Catamarca province, later this month.

Incidentally, the Kabil board approved proposals of signing an exploration and development agreement with Camyen and opening of branch office in Catamarca; as well as the investment proposal towards exploration stage activities of the five lithium blocks in June last year.

As mutually agreed with Camyen, the agreement is planned to be signed in January 2024 in Argentina and with that, the maiden project of Kabil will be launched.

Officials from the State-run Kabil, a JV of Nalco, MECL and Hindustan Copper Ltd, along with NITI Aayog visited Chile, Bolivia and Argentina "for possible cooperation in lithium mining assets in October 2019". Discussions with Australia and Russia were also started through Missions and Embassies subsequently. An MoU was signed with Camyen, in December 2020 "to establish institutional co-operation for joint development of lithium mining projects". These included five brine-type lithium blocks of Camyen in the Catamarca province of Argentina and were identified by the Kabil.

It is the cornerstone towards India's transition to green energy and reduction in the country's carbon footprints.

The Lithium Rush

Argentina, along with two other Latin American nations – Chile and Bolivia – form the world's 'lithium triangle'. Chile and Argentina account for 30-35 percent of the world's supplies. Chile, which has 11 percent of the world's lithium reserves, supplies 26 percent of the requirements; while Argentina with nearly one-fifth of the global resources supplies 6 percent-odd. The latter has two active lithium mines and 14 more projects underway.

Right now, all of India's lithium requirements are met through imports, mostly China; and the bill is said to run as high as 24,000 crore. India recently put up for auction two of its lithium blocks, one in J&K and the other in Chhattisgarh; and exploration is being carried out for more blocks across States like Rajasthan, Karnataka, among others. So far, the inferred lithium reserves in J&K is 5.9 million tonnes while in Chhattisgarh, exploration is yet to be carried out.

Source: The Hindu Business Line, Jan. 2, 2024

Electric Steels

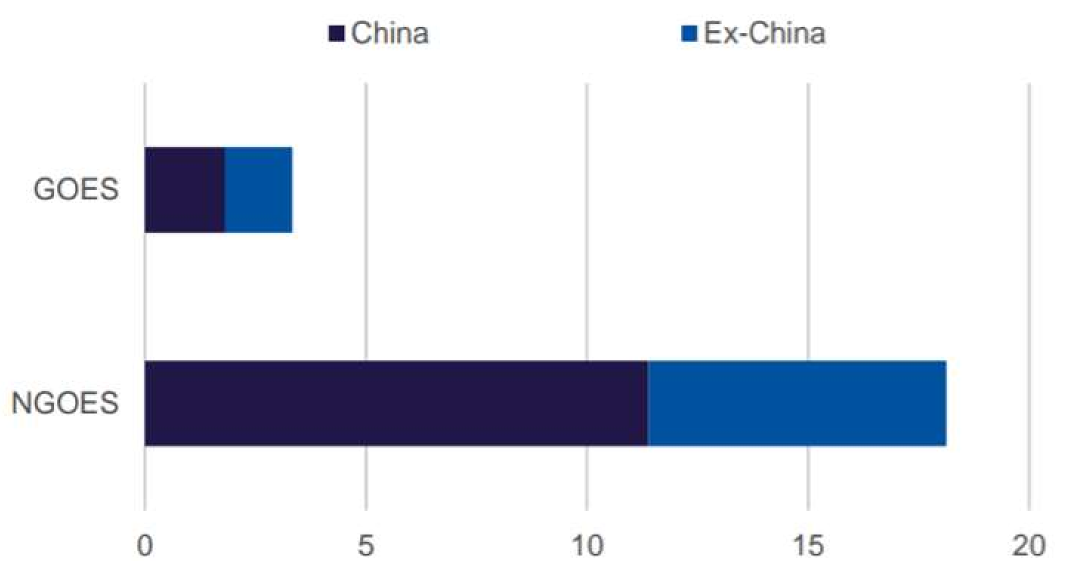
Much effort has been made in examining the supply chain of commodities related to electrification: everything from copper to aluminium to critical battery materials such as lithium, nickel and cobalt. One overlooked material, however, is electrical steel. A small, niche segment of the steel industry – everything with a motor and every transformer contains electrical steel. Many questions have been raised regarding the capacity of steelmakers to produce sufficient volumes of electrical steels, particularly as increasing efficiency standards and more challenging applications drive the need for higher-quality, lighter gauge material. The high levels of required capex, combined with complex, somewhat secretive production methods (with some IP issues as well) and finally the potential for materials substitution with a new generation of amorphous steels have left this segment of the market in flux.

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

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

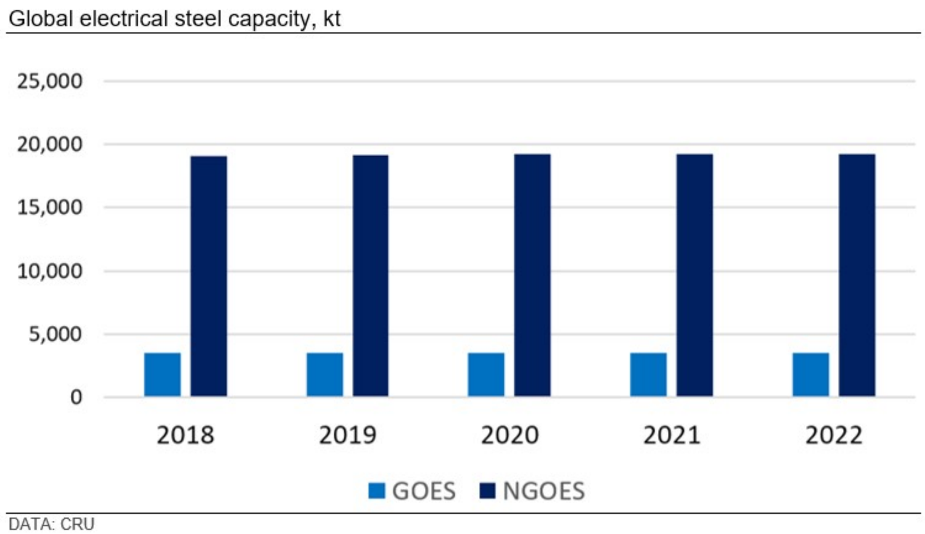
As transformers are the only major consumer of GOES, the market is significantly smaller for that product than for NGOES, at ~1/3 the demand.

Electrical steel production in 2021, Mt



DATA: CRU

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



Stainless Steel for Hydrogen Production

Scientists have developed a groundbreaking stainless steel for hydrogen production, SS-H2, which offers superior corrosion resistance and cost-effectiveness compared to Titanium. This innovation could substantially reduce material costs in water electrolyzers, paving the way for more affordable hydrogen production from renewable sources. This novel stainless steel for hydrogen has been developed by the team headed by Professor Mingxin Huang from the University of Hong Kong's Department of Mechanical Engineering.

This accomplishment is part of Professor Huang's ongoing 'Super Steel' Project, which previously achieved notable milestones with the creation of anti-COVID-19 stainless steel in 2021 and the development of ultra-strong and ultra-tough Super Steel in 2017 and 2020.

The new steel developed by the team exhibits high corrosion resistance, enabling its potential application for green hydrogen production from seawater, where a novel sustainable solution is still in the pipeline.

The performance of the new steel in salt water electrolyzer is comparable to the current industrial practice using Titanium as structural parts to produce hydrogen from desalted seawater or acid, while the cost of the new steel is much cheaper.

Revolutionizing Corrosion Resistance

Since its discovery a century ago, stainless steel has always been an important material widely used in corrosive environments. Chromium is an essential element in establishing the corrosion resistance of stainless steel. Passive film is generated through the oxidation of chromium (Cr) and protects stainless steel in natural environments. Unfortunately, this conventional single-passivation mechanism based on Cr has halted further advancement of stainless steel. Owing to the further oxidation of stable Cr_2O_3 into soluble Cr(VI) species, transpassive corrosion inevitably occurs in conventional stainless steel at ~1000 mV (saturated calomel electrode, SCE), which is below the potential required for water oxidation at ~1600 mV.

254SMO super stainless steel, for instance, is a benchmark among Cr-based anti-corrosion alloys and has superior pitting resistance in seawater; however, transpassive corrosion limits its application at higher potentials.

By using a “sequential dual-passivation” strategy, Professor Huang’s research team developed the novel SS-H_2 with superior corrosion resistance. In addition to the single Cr_2O_3-based passive layer, a secondary Mn-based layer forms on the preceding Cr-based layer at ~720 mV. The sequential dual-passivation mechanism prevents the SS-H_2 from corrosion in chloride media to an ultra-high potential of 1700 mV. The SS-H_2 demonstrates a fundamental breakthrough over conventional stainless steel.

Unexpected Discovery and Potential Applications

Prevailing view is that Mn impairs the corrosion resistance of stainless steel. Mn-based passivation thus is a counter-intuitive discovery that cannot be explained by current knowledge in corrosion science.

Different from the current corrosion community, which mainly focuses on the resistance at natural potentials, the team specialize in developing high-potential-resistant alloys. Their strategy overcame the fundamental limitation of conventional stainless steel and established a paradigm for alloy development applicable at high potentials.

At present, for water electrolyzers in desalted seawater or acid solutions, expensive Au- or Pt-coated Ti are required for structural components. For instance, the total cost of a 10-megawatt PEM electrolysis tank system in its current stage is approximately HK$17.8 million, with the structural components contributing up to 53% of the overall expense. This breakthrough makes it possible to replace these expensive structural components with more economical steel. As estimated, the employment of SS-H_2 is expected to cut the cost of structural material by about 40 times, demonstrating a great foreground of industrial applications.

From experimental materials to real products, such as meshes and foams, for water electrolyzers, there are still challenging tasks at hand. Currently, a big step has been taken toward industrialisation. Tons of SS-H2-based wire has been produced in collaboration with a factory from the Mainland.

Reference: "A sequential dual-passivation strategy for designing stainless steel used above water oxidation"; Kaiping Yu, Shihui Feng, Chao Ding, MengGu, Peng Yu and Mingxin Huang, 19 August 2023, Materials Today.DOI: 10.1016/j.mattod.2023.07.022

Source: SciTechDaily, Jan 14, 2024

Internet of Things

Internet of Things (IoT) is the inter-networking of physical devices and objects whose state can be altered via the Internet. Connected industrial equipment, smart home devices and connected cars are all examples of IoT applications.

According to some estimates, the number of IoT connections surpassed that of non-IoT in 2020. Semiconductor components of IoT devices have been growing constantly in recent years and are estimated to account for between 5 and 7% of the worldwide semiconductor market. IoT-related patent applications grew by close to 20% a year in 2010-18 and accounted for over 11% of all patenting activity worldwide at the end of the period. Venture capital investment in IoT firms also increased dramatically in the last decade, reaching USD 8 billion in 2020. Despite this buoyant environment, the IoT is diffusing unevenly among firms, industries and countries.

In 2021, 29% of European firms used the IoT, an increase of almost 8 percentage points from the previous year. This share was lower in Canada (23%) and Korea (14%) in 2020, although differences in the survey design limit comparability across countries. Overall, utilities, energy and transport are leading in uptake. The figures also point to a divide between large and small firms: on average, the gap in IoT adoption in OECD countries was as big as 20 percentage points in 2020.

Case studies on manufacturing firms in Germany and Brazil show that the use of IoT increases their competitiveness by reducing costs and improving processes. For instance, one large firm reports that IoT data, in combination with machine learning, has reduced the cost associated with poor product quality by nearly 70%. Concerns about digital security and data protection are among the major barriers to IoT uptake in the sector, with a lack of interoperability and limited scalability also playing an important role.

People enjoy smart TVs and smart speakers in their living rooms but seem less keen on smart fridges in their kitchens. In European countries, on average, 56% of individuals had some smart entertainment device at home in 2020 but only 27% had home automation devices. Smartwatches and wristbands are becoming popular for tracking calories but fewer individuals use smart devices to monitor their health conditions. Only 6% of individuals in the United States and European countries owned health-related IoT devices in 2020, whereas many more had a smartwatch (12%) or a wristband (23%). These statistics suggest an untapped potential for IoT in healthcare.

Remote patient monitoring (RPM) has the potential to reduce hospital length of stay and hospitalisation costs, as found in some pilot projects. However, a few hospitals and general practitioners in OECD countries use smart devices for RPM. The lack of specific reimbursement mechanisms, limited digital skills, and the low degree of digitalisation of the healthcare sector are some of the most cited barriers to higher adoption of RPM.

While these metrics provide useful insights, measurement of the IoT is still in its infancy and statistical efforts need to continue in this rapidly evolving field. In addition, future work should further inquire into the drivers and obstacles to IoT adoption to help policy makers formulate effective policies.

Source: OECD Library

Earth Shattered Global Heat Record in '23

Earth last year shattered global annual heat records, flirted with the world's agreed-upon warming threshold and showed more signs of a feverish planet.

The European climate agency Copernicus said the year was 1.48 degrees Celsius (2.66 degrees Fahrenheit) above pre-industrial times. That's barely below the 1.5 degrees Celsius limit that the world hoped to stay within in the 2015 Paris climate accord to avoid the most severe effects of warming.

And January 2024 is on track to be so warm that for the first time a 12-month period will exceed the 1.5-degree threshold. Scientists have repeatedly said that Earth would need to average 1.5 degrees of warming over two or three decades to be a technical breach of the threshold.

The 1.5 degree goal has to be kept alive because lives are at risk and choices have to be made, and these choices don't impact us today but they impact our children and our grandchildren.

The record heat made life miserable and sometimes deadly in Europe, North America, China and many other places last year. But scientists say a warming climate is also to blame for more extreme weather events, like the lengthy drought that devastated the Horn of Africa, the torrential downpours that wiped out dams and killed thousands in Libya and the Canada wildfires that fouled the air from North America to Europe.

The World Weather Attribution team only looks at events that affect at least 1 million people or kill more than 100 people. But there were more than 160 of those in 2023, and only 14 could be studied, many of them on killer heat waves. Basically, every heat wave that is occurring today has been made more likely and is hotter because of human-induced climate change.

The United States lurched through 28 weather disasters last year that caused at least $1 billion in damage, smashing the old record of 22 set in 2020. The number of these costly disasters, which are adjusted to account for inflation, has soared, averaging only three per year in the 1980s and just under six per year in the 1990s.

The U.S. billion-dollar disasters last year included a drought, four floods, 19 severe storms, 2 hurricanes, a wildfire and a winter storm. They combined to kill 492 people and cause nearly $93 billion in damage, according to NOAA.

Antarctic sea ice hit record low levels in 2023 and broke eight monthly records for low sea ice.

Global average temperature for 2023 was about one-sixth of a degree Celsius (0.3 degrees Fahrenheit) warmer than the old record set in 2016. While that seems a small amount in global record-keeping, it's an exceptionally large margin for the new record. Earth's average temperature for 2023 was 14.98 degrees Celsius (58.96 degrees Fahrenheit).

There are several factors that made 2023 the warmest year on record, but by far the biggest factor was the ever-increasing amount of greenhouse gases in the atmosphere that trap heat. These gases come from the burning of coal, oil and natural gas.

Other factors including the natural El Nino — a temporary warming of the central Pacific that alters weather worldwide — other natural oscillations in the Arctic, southern and Indian oceans, increased solar activity and the 2022 eruption of an undersea volcano that sent water vapour into the atmosphere.

Climate scientists say that about 1.3 degrees Celsius of the warming came from greenhouse gases, with another 0.1 degrees Celsius from El Nino and the rest being smaller causes.

The Japanese Meteorological Agency estimated that it was the warmest year at 1.47 degrees Celsius (2.64 degrees Fahrenheit) above pre-industrial levels. The University of Alabama Huntsville global dataset, which uses satellite measurements rather than ground data and dates to 1979, last week also found it the hottest year on record, but not by as much.

Though actual observations only date back less than two centuries, several scientists say evidence from tree rings and ice cores suggest this is the warmest the Earth has been in more than 100,000 years. It basically means that our cities, our roads, our monuments, our farms, in practice all human activities never had to cope with the climate this warm.

For the first time, Copernicus recorded a day where the world averaged at least 2 degrees Celsius (3.6 degrees Fahrenheit) more than pre-industrial times. It happened twice and narrowly missed a third day around Christmas.

And for the first time, every day of the year was at least one degree Celsius (1.8 degrees Fahrenheit) warmer than pre-industrial times. For nearly half the year — 173 days — the world was 1.5 degrees warmer than the mid-1800s.

It's only going to get hotter. Following the current trajectory, in a few years time, the record-breaking year of 2023 will probably be remembered as a cold year.

Source: Microsoft Start Daily

KNOW YOUR MEMBERS
Gur Iqbal Singh Chauhan

Educational Qualifications M.B.A. (Human Resources Management)
Masters in Mechanical Engineering

Professional Qualification Certified Lead Assessor for assessment of Quality Assurance Systems as per ISO 9001 standards

Professional Experience

Independent Consultancy Activities

- Identification, evaluation and utilization of metallurgical coals for their optimum usage, along with existing coal components, in Coking Plants in India; Evaluation of Recovery & Non-recovery Coke Ovens for Coal Carbonization; Raw materials and Energy Optimization studies in Metallurgical Plants; Assessment and evaluation of technological processes in steel industry; etc.

UNDP – GEF Project

- Participated in the Project `Removal of Barriers to Energy Efficiency Improvement in the Steel Re-rolling Mills (SRRM) Sector'

Steel Authority of India Ltd. (1967-2006)

R & D Centre for Iron & Steel

- Extensive technological & managerial responsibilities in R&D activities related to Coal & Coke; Raw Materials & Energy Optimization; Technology Dissemination & Total Quality Management; Human Resource Management, Direct Reduction & Emerging Technologies and Project Development & Engineering. Superannuated as the CEO of RDCIS, SAIL

Durgapur Steel Plant

- Independent responsibilities for Maintenance activities; planning, design and introduction of modifications for enhancing productivity at shop floor in Coke Ovens & Coal Chemicals Units at Durgapur Steel Plant

Technological Expertise Areas

- Coal & Coke Management
- Raw Materials & Energy Optimization
- Modernization/Upgradation Schemes of Steel Plants
- Technology Dissemination Activities
- Total Quality & QMS for ISO 9001
- Energy Optimization Studies in Secondary Steel Sector Rolling Mills

Professional Associations

- Indian Institute of Metals – Life Fellow
- Institution of Engineers (India) – Life Fellow
- Computer Society of India – Senior Life Member