Sustainable Steel for a Better Everyday

Climate Action Report 2024

Our Invitation

We at JSW Steel Ltd are proud and excited to share with you our first Climate Action Report. We hope you'll find what we've prepared both engaging and informative.

This Climate Action Report is the first in what we intend to be a series of reports, published periodically, in which we provide our many and varied stakeholders with an honest and open appraisal of what JSW Steel has achieved in relation to our efforts to reduce our carbon emissions and in doing so, join the global community to tackle the growing impacts of climate change.

Our future Climate Action Reports shall also chart the progress we are making with regards to our ambitious plans to reduce our 'emissions intensity', as well as the wider progress being made by the Indian steel industry as a whole.

Bigger
Better
Cleaner

Contents

Mr. Sajjan Jindal

Chairman & MD,
JSW Group

I am proud and excited to share with you our first Climate Action Report.

Climate change represents a uniquely global, existential challenge for us all that is unlike anything else we have ever known. Yet we face this challenge at a time of extraordinary economic development in India where the National Steel Policy projects capacity of 300 million tonnes per annum (MTPA) will be required by 2030 to meet the demands of our fast-growing economy.

Steel is already a massive consumer of energy, responsible for one-fifth of industrial energy usage, making steel an extraordinarily heavy emitter. Today, Steel contributes almost a third of direct industrial CO_2 emissions or 12% of India's total energy infrastructure CO_2 emissions.

Given the significance of CO_2 emissions from steel, I believe that decarbonized steel has a big role to play in a low-carbon India as the essential ingredient for India's green future. That is why I believe India must confront the challenge of Decarbonization head on.

But I am under no illusions – Decarbonization will not be quick nor without large investment. Many key decarbonization technologies are not yet feasible nor commercially viable. Does that mean we as a sector must wait for the emergence of appropriate technology?

Or should we seek cuts in emissions with better process and energy efficiency, transition to renewables, use alternative fuel sources, deploy better quality raw materials and accelerate material circularity.

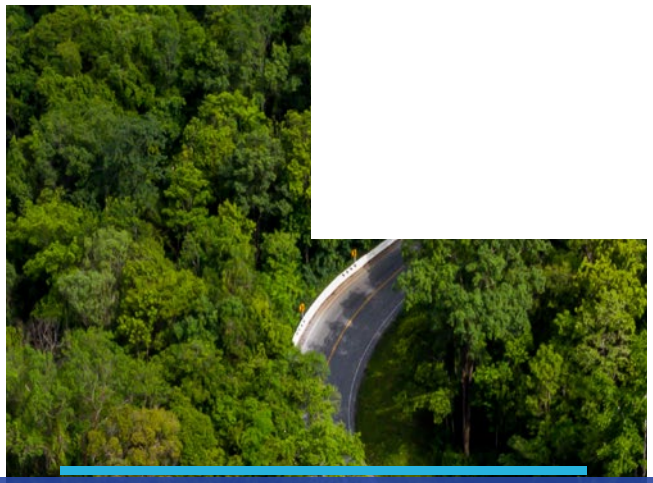
The choice is wide.

At JSW Steel, we have made our choice: we are doing all of the above. We are using the best available technologies, transitioning to renewable energy through our group company JSW Energy, collaborating with external experts to assist in our decarbonization journey, and introducing digital tools to track and monitor progress. We have also recognised the necessity of incorporating environmental, social and governance (ESG) considerations into our investment decisions. It is not only investors, but also employees, customers, suppliers, local communities and other stakeholders who are looking to us to design and implement long-term, sustainable policies that support economic development, address environmental issues and play a crucial role in India's Decarbonization Pathway.

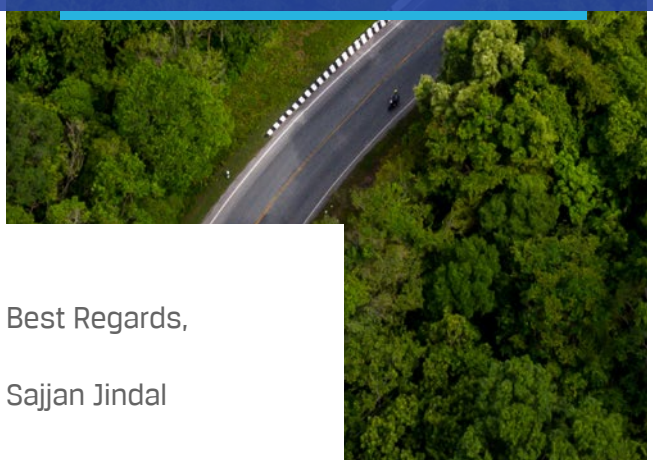
Of course, I recognise that our commitments to decarbonization will throw up challenges that directly impact profitability and shareholder value.

But these are challenges that I, and my Leadership Team, are ready and willing to tackle. We already have a clearly defined Climate Change Policy, and our Sustainability Framework enables all parts of our business to set and pursue ambitious targets and plans for reducing carbon emissions and tackling climate change. And now, through this Climate Action Report, and the future updates we intend to publish in the years ahead, we aim to provide our many and varied stakeholders, including financial markets, with an honest, open and accessible appraisal of what JSW Steel has achieved in relation to our decarbonization efforts.

Within the Report we shall recognise the competing pressure of climate change and economic development, reaffirm our conviction that climate change is a real and immediate threat, recognise with honesty the impact steelmaking has, and explain in detail the options that exist for our industry and what JSW Steel plans to do through our Decarbonization Pathway, including capital allocation required to support the implementation.



We have embarked on a long and challenging journey. It is a journey for which I believe we are ready, and one I hope you will take with us.



Best Regards,

Sajjan Jindal

Mr. Jayant Acharya

Joint MD & CEO,
JSW Steel

Given its infinite recyclability and extreme versatility, we at JSW Steel are certain that steel will remain the preferred choice for building the sustainable future we all desire.

However, as the world moves to a low-carbon economy and the need for emission reductions becomes more urgent, the decoupling of growth from emissions in a hard-to-abate industry like ours remains a significant undertaking. This is the challenge of decarbonization, and it is a challenge that myself and my fellow Leadership Team members have accepted with optimism and determination.

We are justifiably proud of the steps that we have already taken in the face of the decarbonization challenge, as this Climate Action Report aims to demonstrate:

- We have recognised that the science is irrefutable, and that climate change is real;
- We have accepted that steel making contributes significantly to carbon emissions;
- We have utilised existing technologies and adopted new technologies within our industry to reduce our emissions intensity by 30% from our 2005-2006 baseline.

We have already achieved much, as the section of this Climate Action Report entitled 'Making a Difference' will attest.

But now we recognise that we have not only to embrace the challenge of climate change, we have to accelerate our response to it. We have to make our Decarbonization Pathway a reality!

The details of our Decarbonization Pathway are fully explained in the section of this Climate Action Report entitled **'Charting the Journey Ahead'**, but they can be summarised simply and succinctly as follows:

Two Phases - Two Milestones

Phase 1 will take us to 2030, by which time we will have reduced our emissions to **1.95** tonnes of CO_2 per tonne of steel produced (our emissions are currently at 2.36 tCO_2/tcs).

Phase 2 will take us to 2050, by which time JSW Steel will be net neutral in carbon emissions for all operations under our direct control.

The enablers for achieving our milestone for Phase 1 we already know and are already implementing across our business.

They are:
1. Ensuring energy efficiency;
2. STEP UP operational efficiency;
3. Transition to renewable energy;
4. Actively improving material quality;
5. Utilising alternative fuel sources;
6. Developing processes for material circularity and efficiency;

For Phase 2, we recognise that other innovative technological enablers will also be required, such as green hydrogen, and carbon capture, utilisation and storage, and JSW Steel is actively involved in the development of these two longer-term decarbonization technologies.

Of course, we are also fully aware that in making our Decarbonization Pathway a reality, we are doing so against a complex and uncertain future. This means that whilst the end-goals of each Phase of our Pathway will always remain fixed, the nature and scale of the enablers which will deliver those milestones will inevitably change, transform and mature as the wider economic, social and technological realities in which the Pathway sits are shaped by future pressures, trends and events.

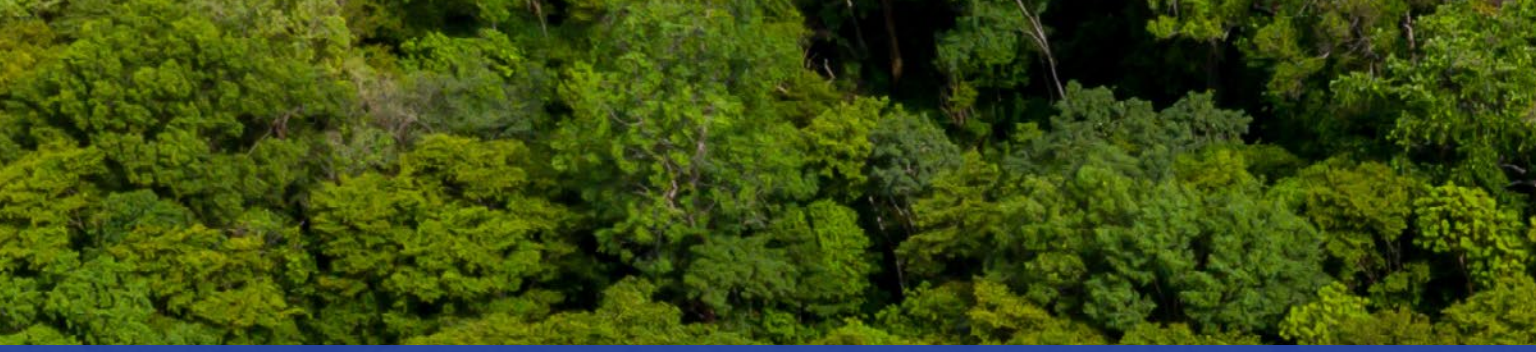
My role, as Joint Managing Director & CEO, and that of my fellow Leadership Team members, will be to ensure that the Decarbonization Pathway, and our two key milestones for 2030 and 2050, remain at the forefront of our planning and decision-making.

We must remain resolutely committed to doing what is necessary, however difficult, however complex, in order to identify, develop, harness, resources and ultimately utilise the enablers of the present and of the future.

It will be, through these, in conjunction with the extraordinary knowledge, skills and boundless enthusiasm of our employees, contractors and suppliers, that we make our Decarbonization Pathway a reality, for the benefit of us all.

Best Regards,

Jayant Acharya



About this Report

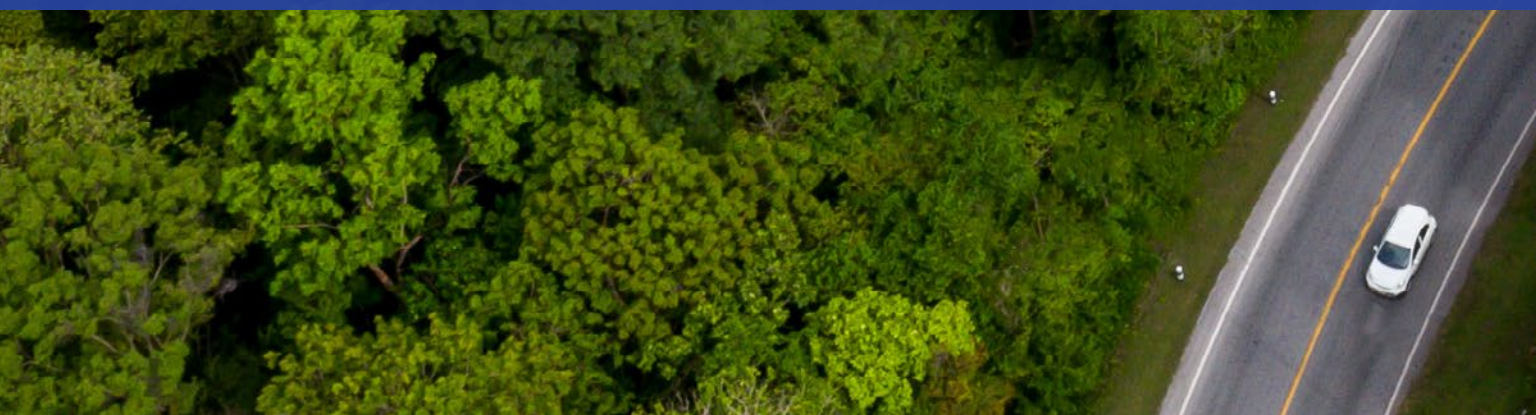
Historically, climate change has long been a topic covered in detail within our annual Integrated Reports. However, given the 'uniquely global, existential challenge' that climate change now represents, we at JSW Steel now believe there is significant value in publishing a report specifically focused on this issue.

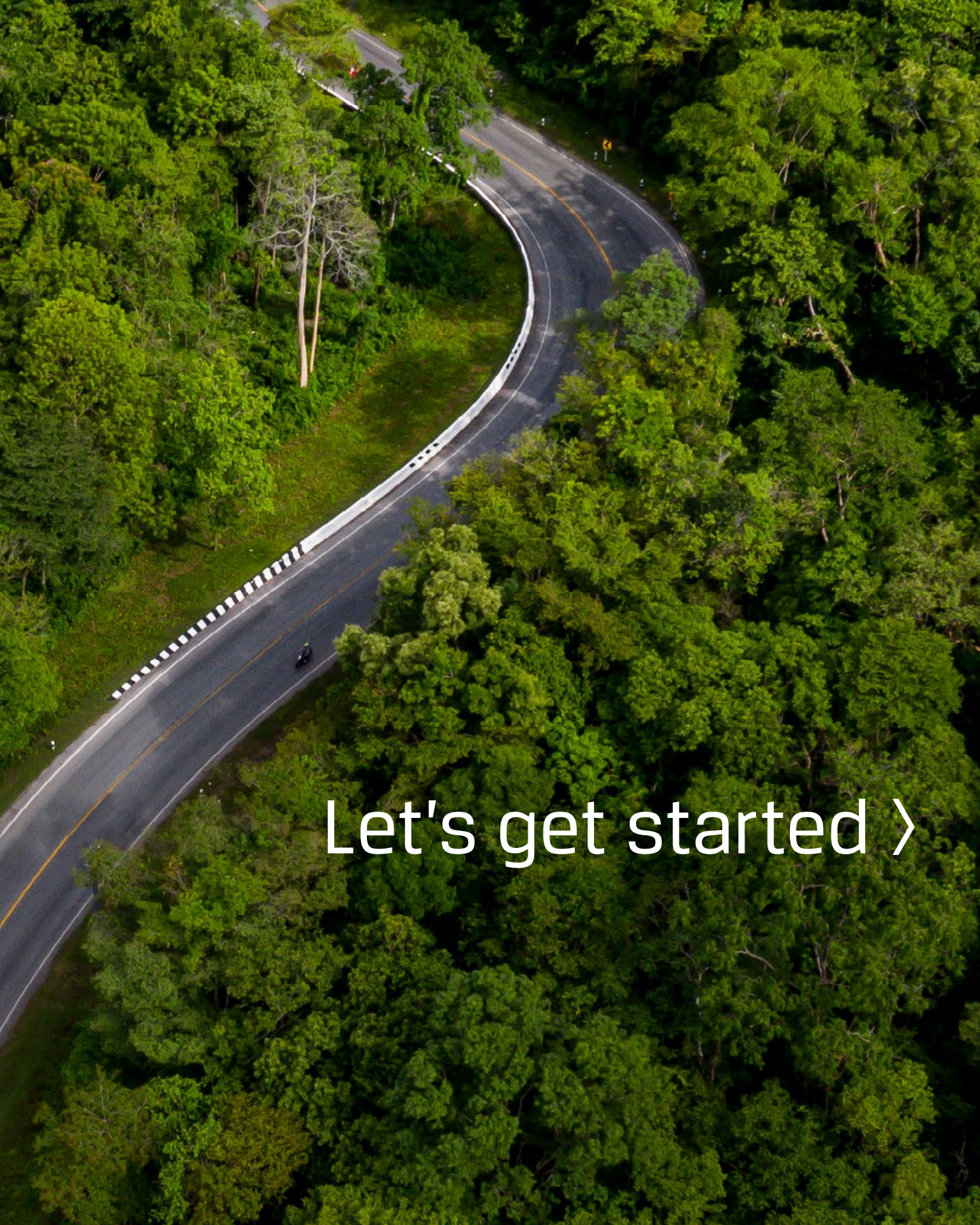
The key aim of this Climate Action Report, and of our future reports, is to present in an engaging and informative manner our challenging decarbonization strategy and the actions into which that strategy translates.

The Report also demonstrates our alignment to recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) and provides stakeholders with: **'clear, comprehensive, high-quality information on the impacts of climate change'.** It has been prepared following the TCFD guidelines using their recommended terminology and addresses the four thematic areas of the TCFD: Governance, Strategy, Risk Management, and Metrics and Targets. This document is not a mandatory disclosure and thus does not require assurance to be provided by any third-party organization.

The Report includes information published by third-party organizations to illustrate the issue of climate change, the impacts of the steel industry and the potential benefits of climate solutions.

It should be recognised that JSW Steel does not undertake any obligation to assume responsibility or offer guarantees for the information made available by third-parties. In the case that readers request JSW Steel's explanation of relevant information or content, JSW Steel may do so partially with the permission granted by the concerned third parties. All the information from third-parties presented in this document has been annotated with their sources at the foot of the relevant page.




Let's get started ›

A Little Bit About Us

Overview of
JSW Steel

The story of JSW is one of passion, grit and an insurmountable determination to work hard and win against all odds.

It is, in many ways, the story of India itself. What began as one man's dream has evolved into one of India's leading business houses, with a workforce of over 40,000. Over the years, JSW has grown beyond steel, expanding into sectors such as cement, infrastructure, energy and paint, helping to build the very fabric of a new nation.

'JSW has been and always will be, known as the "strategic first mover", keen to venture away from the status quo thanks to its willingness to make fundamental changes and its conviction to drive excellence.

Today, JSW is more than just a billion-dollar conglomerate. It has become a partner in India's progress, and a firm believer in the importance and value of giving back to the society and the people that have been instrumental in making it what it is today.

Our Purpose

- Building world-class infrastructure, products and solutions
- Deploying world-class capabilities
- Nurturing our communities
- Empowering our People

Our Vision

Bring Positive Transformation to every life we touch

JSW is about building, transforming and giving back. Every act of ours is focused upon building something new or bettering something that already exists.

Our Values

Commitment

Courage

Agility

Collaboration

Compassion

JSW Steel

JSW Steel is the flagship business of the diversified US$ 23 billion JSW Group.

Over the last three decades, it has grown from a single manufacturing unit to become India's leading integrated steel company with a capacity of 29.7 MTPA of crude steel in India & USA (including capacities under joint control).

Our three integrated steel plants (ISPs) at Vijayanagar, Dolvi and Salem continue to be our mainstay with a combined capacity of 23.5 MTPA and the upstream and downstream capacity augmentations are enabling them to cater to present and future demand. The boundary of this Climate Action Report are the three ISPs and we will go on extending our boundaries to cover our other entities in our subsequent reports.

Manufacturing Units

Vijaynagar Works (ISP)

Key products

Hot Rolled (HR), Cold Rolled (CR), Galvanised (GI) and Galvalume (GL), wire rods, TMT, slabs, billets

Capacity

12.5 MTPA crude steel, with addition of 7 MTPA crude capacity in the next 3 years

Highlights

+ World's sixth-largest steel plant
+ India's largest single-location and most productive steel plant
+ Awarded Deming Prize for operational excellence in 2018

Dolvi Works (ISP)

Key products

Hot Rolled (HR), Thermomechanical treated (TMT), Billets

Capacity

10 MTPA crude steel

Highlights

+ Strategically connected to a 30 MTPA capacity jetty
+ Setting up 175 MW Waste Heat Recovery Boilers (WHRB) and 60 MW power plants to harness flue gases and steam from coke dry quenching

Salem Works (ISP)

Key products

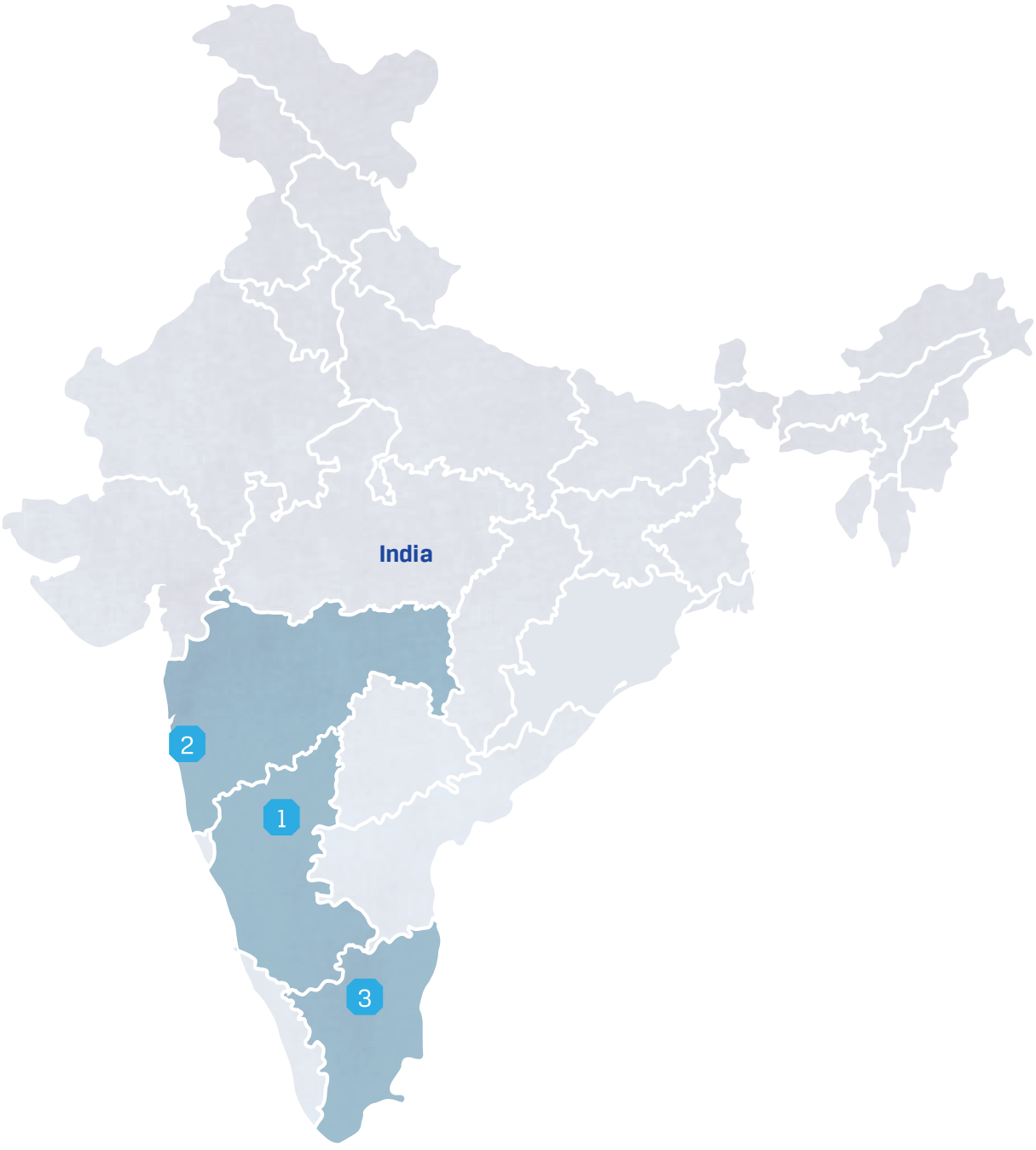
Wire rod, alloy long products, billets/ blooms.

Capacity

1 MTPA crude steel

Highlights

+ India's largest special alloy steel plant
+ Awarded Deming Prize for operational excellence in 2019
+ Became the first steel plant in the world to receive British Safety Council's Five-star rating



1. Vijayanagar Integrated Steel Plant
2. Dolvi Integrated Steel Plant
3. Salem Integrated Steel Plant

Note: Map not to scale

Acclaimed Leaders in the Climate Change Journey

SUSTAINABILITY CHAMPION

Recognized as the worldsteel Sustainability Champion for the sixth consecutive year in 2024

CDP Rating

JSW Steel is in the 'Leadership' band for both Climate Change and Water Security, which acknowledges that the Company is implementing current best practices

STEELIE AWARD WINNER

Honored with the Steelie Award in Life Cycle Analysis (LCA) Category by the worldsteel Association in 2021

Dow Jones Sustainability Indices 2023

JSW Steel included in DJSI World Index & DJSI emerging markets Sustainability Index

Two Competing Pressures

Climate Change Versus Economic Development

In keeping with our aim of making this first Climate Action Report both informative and engaging, we thought it would be worthwhile to put the issue of climate change within the wider context of another hugely significant (and largely competing) societal pressure: **economic development**

India is a rapidly developing nation and home to both the world's fifth largest economy and the world's largest population. That population, like many others around the world, hope to experience for themselves the many benefits that a successful, modern and dynamic economy can deliver. In relation to homes, appliances and connectivity, there is a growing expectation amongst millions of people that their personal standard of living will continue to improve significantly over the coming decades. There is also a similar expectation that the standard of national infrastructure in areas such as health, transportation and utilities will continue to improve, providing people with growth opportunities and cementing India's emerging position as one of the world's leading social and economic powerhouses.

But such optimism may need to be tempered, as there is now a growing body of evidence that demonstrates that unfettered economic development can, and does, come at a price in terms of the serious impacts that such development has on the natural world; impacts such as the loss of habitats, rivers and oceans polluted with plastic waste, and, of course, climate change.

So can these two competing pressures be reconciled?

Unfortunately, there are many who now believe they cannot and that further climate change can only be prevented by curtailing the ongoing development of the world's many emerging economies; conversely, many believe that the further, equitable economic development of those emerging economies can only occur at an unacceptable cost to the climatic stability of the planet.

But we at JSW do not agree with that view.

We believe that whilst it will undoubtedly be challenging, both intellectually and economically, it is possible for India, and indeed for other emerging economies, to continue the economic development that is so transforming (and extending) the lives of its people.

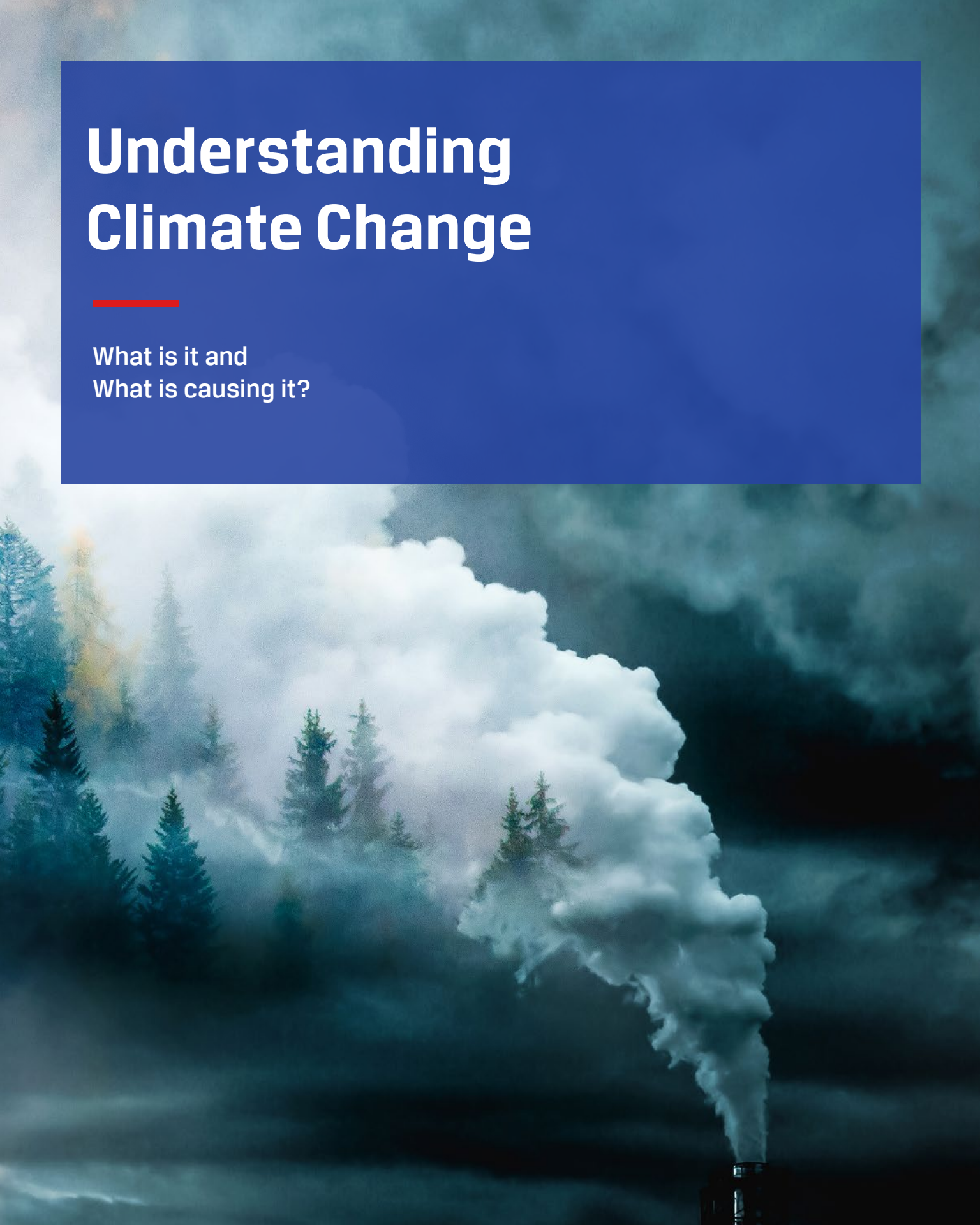
But this can only be done if, at the same time, we recognise and take true ownership of the impacts of that development so that we become part of the solution and do all that is necessary and possible to:

- help deliver the collective global aims regarding greenhouse gas emission reductions;
- mitigate the many and often negative impacts of climate change that so many of us are already having to contend with; and
- help individuals and communities adapt to the changed and increased threats that they now face.

This initial Climate Action Report, and the subsequent Climate Action Reports that will come after it, are our way of demonstrating how our belief in the potential for climate change and economic growth to be reconciled, will actually be delivered.

Understanding Climate Change

What is it and
What is causing it?



We recognise that there are probably few people reading this Report who are unaware of what climate change is and what's causing it, but we thought it worthwhile to include a brief summary of both, if only for completeness.

1.1°C
warmer

According to the United Nations

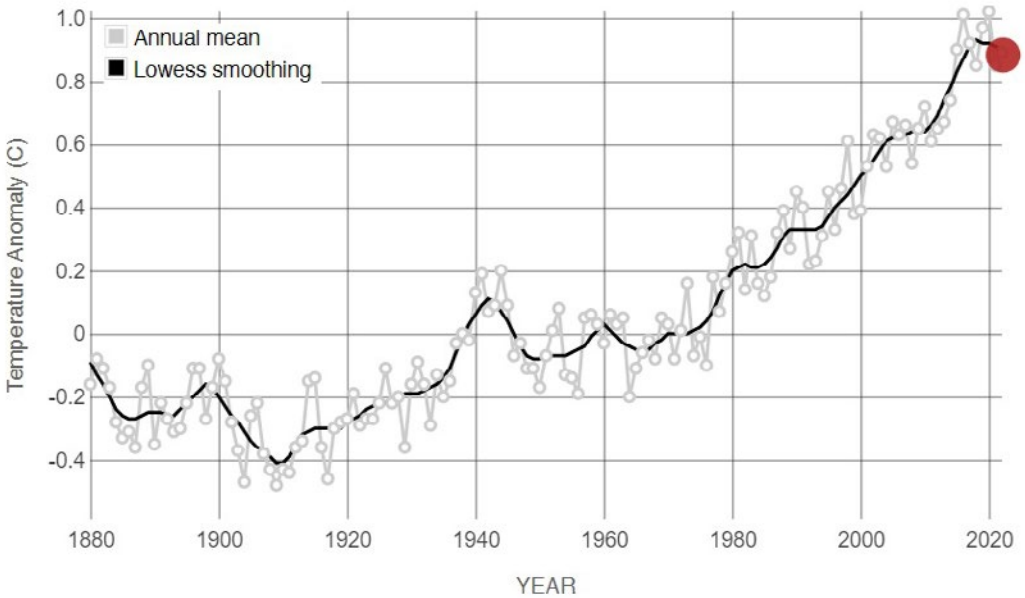
Climate change refers to the long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas.

Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures. The Earth is now about 1.1°C warmer than it was in the late 1800s.

The last decade (2011-2020) was the warmest on record. Many people think climate change mainly means warmer temperatures. But temperature rise is only the beginning of the story.

Because the Earth is a system, where everything is connected, changes in one area can influence changes in all others.

The consequences of climate change now include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity.



Source: climate.nasa.gov

How will this impact India?

There is also another reason for including this section in our Climate Action Report - it gives us an opportunity to talk about impacts. After all, it's the impacts of climate change, on people, on homes, on livelihoods and on our world and the countless species we share it with, that really matters.

The rapid changes in India's climate projected by climate models will place increasing stress on the country's natural ecosystems, agricultural output, and fresh water resources, while also causing escalating damage to infrastructure. These climate models predict serious consequences for the country's biodiversity, food, water and energy security, and public health. Higher temperatures, extreme weather events, and higher climate variability have been associated with an elevated risk of heat strokes, cardiovascular and neurological diseases, and stress-related disorders.

Warmer, higher moisture conditions, on average, are also more favourable for the spread of vector-borne diseases such as malaria and dengue fever. In addition, a decrease in the availability or affordability of food and potable water caused by climate change may lead to reduced nutritional intake, particularly among economically weaker sections of the population.

India's long coastline, where some of its largest cities are located, is among the most densely populated regions of the planet, making it exceedingly vulnerable to the impacts of sea-level rise. The potential impacts of climate change on India's human population also extend to India's incredibly diverse habitats and iconic species. Pressures from climate change increase the risks of human-wildlife conflicts, threatening further the Bengal Tiger and the One-horned Rhinoceros.

Rapidly changing habitats threaten the Snow Leopard and the Nilgiri Tahr in their high-altitude homes. It is these many impacts from climate change, to ourselves and to the natural world we share with countless other species, that have made us recognise the moral duty we have, to this generation and to the generations that will come after us, to work tirelessly on measures to mitigate those impacts.

Projected physical and Economic impacts of climate change in India

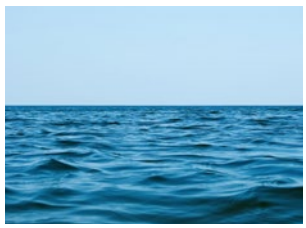
Rainfall patterns

Increase of about two heatwaves and 12–18 days in heatwave duration during each year by 2064.[i]

Higher temperatures

Water flow in the Ganges and Brahmaputra to fall by 17.6% and 19.6% respectively by the end of this century.[ii]

Sea-level rise



Sea levels to rise by 20-30 cm by the end of this century (compared to current levels).[iii]

Storms and cyclones

Cyclones in the Bay of Bengal are projected to nearly double by 2070-2100, compared to 1961-1990.[iv]

GDP in 2100 to be reduced by:

10% at 3°C of global warming due to declining agricultural productivity, sea-level rise and increased health expenditure.[v]

2.6% at <2°C global warming and up to 13.4% at over 4°C of global warming due to declining labour productivity from temperature and precipitation changes.[vi]

90% at 3°C of global warming, based on the historical relationship between temperature and GDP.[vii]

Note: The source studies each adopt different methods, baselines and timeframes. GDP = gross domestic product. (i) Kjellstrom et al., 2017; (ii) Immerzeel et al., 2010; (iii) Swapna et al., 2020; (iv) Sarthi et al., 2014; (v) Kompas et al., 2018; (vi) Kahn et al., 2019; (vii) Nixon (2020).

Source: https://cdn.odi.org/media/documents/ODI-JR-CostClimateChangeIndia-final.pdf

Impact of Steel

How does steelmaking contribute and why?

Steel is fundamental to the modern world. The construction of homes, schools, hospitals, bridges, cars and trucks – to name just a few examples – rely heavily on steel.

Steel is also an integral ingredient in the technologies of tomorrow. At the moment, it is not possible to produce steel without producing carbon dioxide. And as we know, carbon dioxide is the principal greenhouse gas emission contributing to climate change. To understand why CO_2 is produced when making steel, we feel it's useful to provide an overview of how the production of steel at an integrated iron and steel plant (such as our plants at Vijayanagar, Dolvi and Salem) takes place.

The major processes associated with primary steel production (where iron ore is the main input) are:

Coke Production

Metallurgical coke is primarily used in the Iron blast furnaces to reduce Iron ore to Iron. This coking process consists of heating coal in the absence of air to drive off the volatile compounds. The resulting material is a carbon mass called coke and this process is also responsible for around 20% of total CO_2 emissions.

Sinter and Pellet Production

These are two of the agglomeration units in the Iron and Steel industry, the output of which are used as a Fe (chemical name for Iron) feed in furnaces. The Iron ore fines, fluxes and fuels are mixed together and heated in a controlled process to produce these agglomerates. Together, these processes typically contribute around 15% of the total CO_2 emissions.

Hot Metal Production

This is the most important stage in the iron making process. Iron oxide is heated to react with the carbon in the furnace to reduce it to Iron and as a result, CO_2 is liberated in the process. The steel industry is often referred to as a 'Hard to Abate' sector because the process, itself requires the generation of CO_2. While the hot metal is traditionally generated in blast furnaces, some of the hot metal today is also produced using COREX (a smelting-reduction process for cost-efficient and environmentally less-impactful production of hot metal from iron ore and low grade coal). More than quarter of the total CO_2 emissions in the crude steelmaking can be attributed to the hot metal production.

Direct Reduction of Iron (DRI)

This is also known as sponge iron and is produced by the reduction of iron ore (in the form of lumps or pellets) by either non-coking coal or a reducing gas produced by the reforming of natural gas. This reduction process happens at high temperature but substantially below the melting point of iron. The produced DRI is widely used as a coolant as well as used in Electric Arc Furnace (EAF) for crude steel production.

Crude Steel Production

This is the process where the actual production of steel takes place. The additional carbon and other impurities in hot metal are oxidized in this process to produce steel. While Basic Oxygen Furnace (BOF) is the predominantly used route for steel production, Electric Arc Furnace (EAF) is also used to produce steel from DRI and Scrap. This process, together with secondary metallurgy and continuous casting, is responsible for around 15% of total CO_2 emissions in the steel production.

Ladle Metallurgy

After tapping of steel from a primary steelmaking furnace such as BOF, EAF or EOF, molten steel for high quality or specialty applications is subjected to further refining in a number of alternative processes collectively known as ladle metallurgy. Ladle metallurgy is sometimes also called ladle refining or secondary steelmaking.

Continuous Casting

This is the process where the liquefied steel is solidified into semi-finished products for subsequent rolling in the finishing mills.

Rolling

Steel slabs from the casters are further rolled into flat products in a Hot Strip Mill and the billets from the casters are sent to bar and blooming mills to produce long products.

Finished Product

This is the final stage of product manufacturing where the products from the rolling are customized as per the end use customer demand. Hot Rolled Coils from HSM are further treated with Zinc and Aluminum to produce Galvanized/Galvalume coils and sheets which are further added with color coating for further applications.

The entire process from rolling to finished products produces around 15-20% of total CO_2 emissions mostly due to the use of electricity and heating fuels to run the equipment.

THE PROCESS OF MAKING STEEL

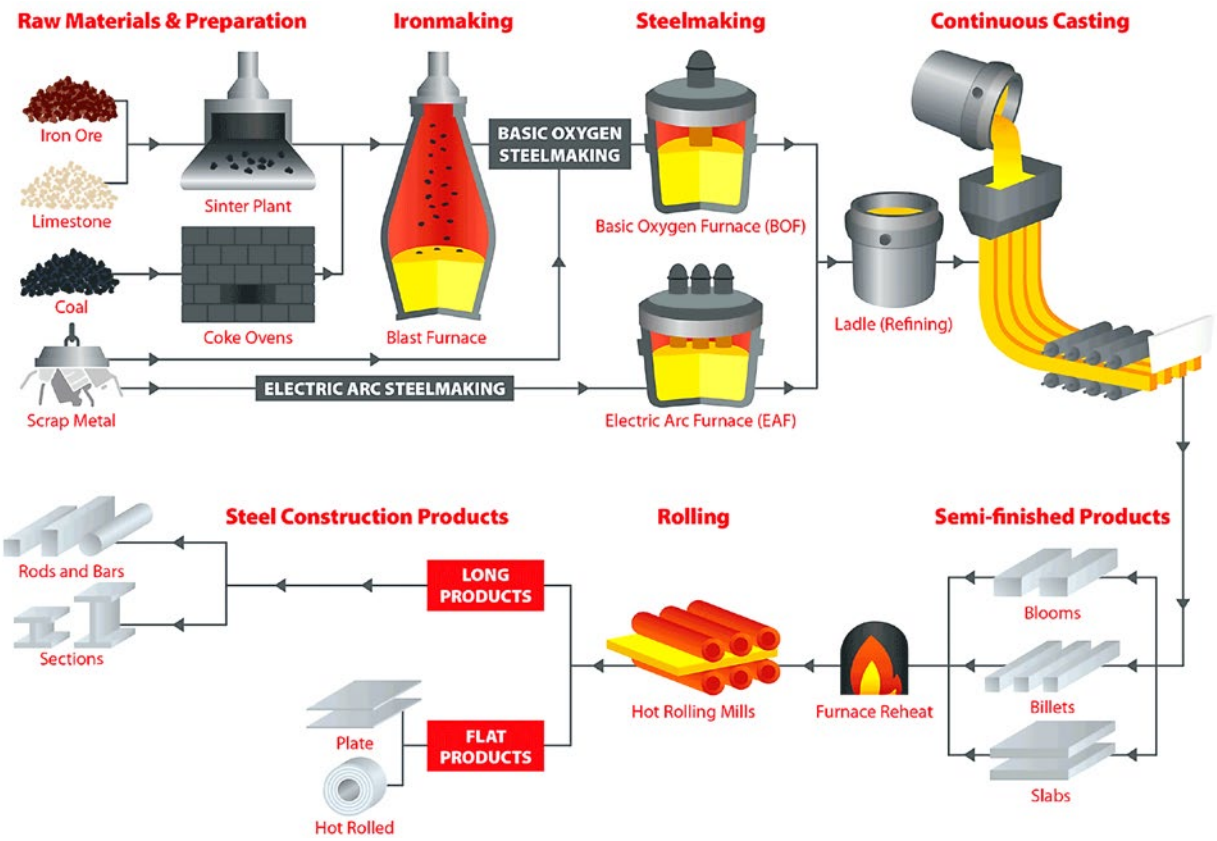


Image Credit: New Steel Construction

Carbon monoxide and hydrogen are used in the primary steel making process as reducing agents that help cleave the oxygen from the iron ore molecules. Virtually all of the carbon monoxide and hydrogen used to reduce iron ore today is generated from fossil fuel energy inputs, mainly coal and its derivative coke (and to a much lesser extent natural gas).

So, in summary, the greenhouse gas emissions associated with steel making are generated in one of the following ways:

1. **As process emissions, where the combustion or transformation of raw materials that go into the steel making process result in the emission of carbon dioxide;**
2. **Emissions from combustion sources on site burning fossil fuels such as coal and natural gas; and**
3. **Indirect emissions from the consumption of electricity that has been generated in other places.**

There are three main production routes for which emission intensities are provided by worldsteel.

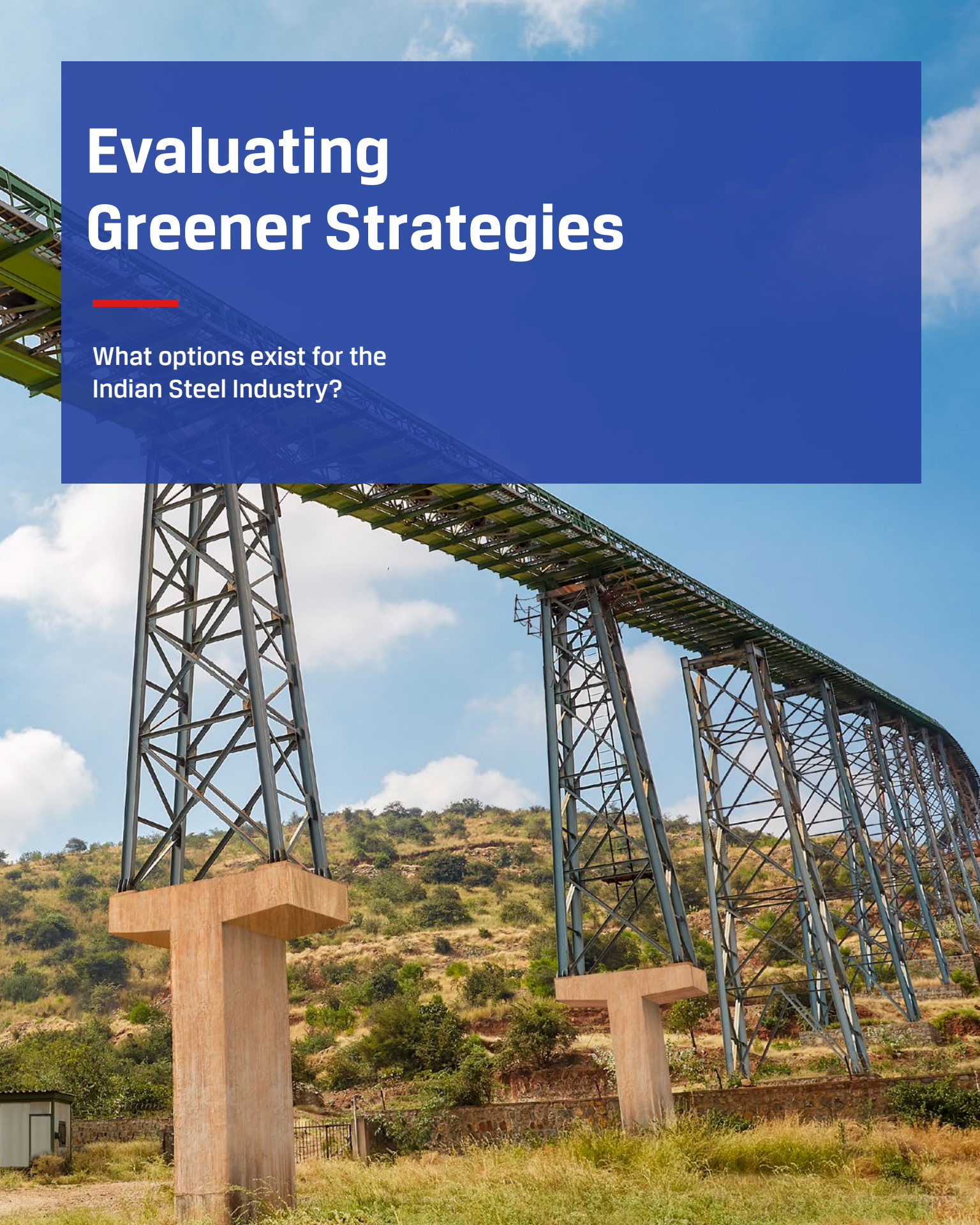
Global Average CO_2 emission intensities of main production routes:

Parameter	GHG Intensity (tCO_2/tcs)	Percentage of Global Production by Production Method
Global Average	1.91	
BF-BOF	2.32	71%
Scrap based EAF	0.67	22%
Natural Gas Based DRI-EAF	1.65	7%

Source: IEA - Iron and Steel Technology Roadmap
https://worldsteel.org/steel-topics/sustainability/sustainability-indicators/
https://www.iea.org/data-and-statistics/charts/global-crude-steel-production-by-process-route-and-scenario-2019-2050

Evaluating Greener Strategies

What options exist for the Indian Steel Industry?



The steel sector in India has been an integral part of our country's emergence as a self-sufficient, developing economy.

The sector has grown rapidly over the course of the last thirty years from a total capacity of 22 million tonnes (MT) in the financial year of 1991-92 to becoming the world's second largest steel producing country with an annual output of crude steel, in the 'in the financial year 2021-22, equal to 120 MT and a capacity of 154 MT. The demand for steel is expected to grow further.

300 MT in 2030 • • • • • **500 MT** by 2047

The 300 MT per year production capacity was set out under the National Steel Policy (NSP), unveiled in 2017 and, within the Vision 2047, there is an expectation that the capacity will quadruple from current levels to about 500 MT by 2047 in order to meet the nation's ever-growing demand for steel.

Against this backdrop, it is essential that Indian steel manufacturers such as ourselves innovate in order to transition away from carbon - a process we are calling 'Decarbonization'. And it makes good business sense too.

We need to innovate and significantly reduce our carbon footprint not only to make our activities more environmentally sustainable, but also to ensure we continue to have a viable business model that allows us to maintain and develop our strategic position in the future and so ensure the business continues to be economically sustainable.

But there is a challenge.

As we have seen in the previous section of this report, steel is a hard to abate sector, and carbon dioxide emissions from the Indian steel industry are expected to increase massively and reach 837 million tonnes over the next thirty years in a business-as-usual scenario. This re-emphasizes the challenge that India faces in balancing the competing pressures of climate change and economic development, as discussed earlier. And it is a challenge that is complicated further by India's commitments under the Paris Agreement, where its previous commitment (to reduce its emissions intensity by 33-35% by 2030 from the 2005 levels) has been revised upwards, following COP26, to 45% by 2030. We also need to be mindful of measures being taken by others to tackle climate change. For example, the EU Commission has introduced the world's first carbon border tax in the form of Carbon Border Adjustment Mechanism (CBAM) on imported goods. This tax will be levied in a phased manner from 2026 and will require non-EU companies exporting to Europe, like JSW Steel, to pay the same price for their carbon footprint in Europe as European companies. This will likely have a significant economic impact on steel companies in India who export to the EU. Given the scale of carbon dioxide emissions associated with steelmaking, the expectations for growth in the sector to support the nation's ongoing economic development, and the many other external pressures outlined above, the challenge for the Indian steel industry may appear to be insurmountable.

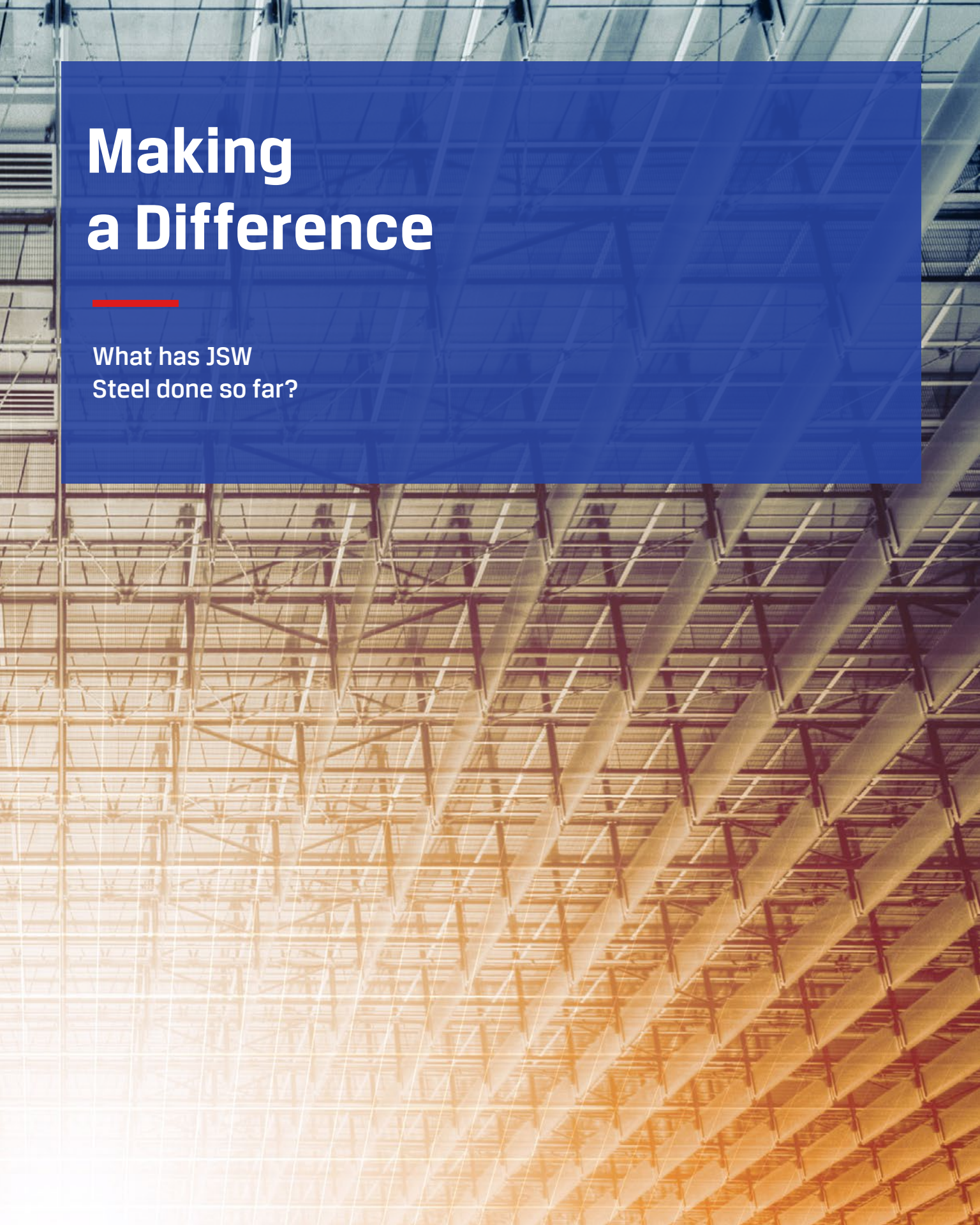
But we at JSW Steel don't believe that.

Of course, we are under no illusions as to how difficult a journey lies ahead, but we, like many across the steel industry in India, have confidence that, by pursuing the range of initiatives we have outlined later in this report, we will able to contribute towards the sustainable reduction in carbon emissions that the steel sector has to achieve. Additionally we are ready to take bold decisions on new technologies and rapidly build out enabling infrastructure, supported by domestic policy and international finance.

We at JSW Steel have been conscious for some time of the increasing threat of climate change and of the need to tackle our greenhouse gas emissions. Over the last decade, we have undertaken a large number of initiatives that have, collectively, resulted in a significant reduction of 30% in our emissions intensity from our baseline value of 3.39 tCO_2 /tcs in financial year 2005-2006 to 2.36 tCO_2/ tcs in financial year 2022-2023.

A quick word about the term 'emissions intensity'. We regard 'emissions intensity' as a particularly relevant and material metric to use to monitor our carbon emissions because it captures the need to balance our role in supporting the economic and social development of India with the imperative of improving our carbon footprint. Our emissions intensity is measured in tCO_2/ tcs (which is tonnes of carbon dioxide per tonne of crude steel produced).

How have we achieved this substantial reduction in our emissions intensity over the last fifteen years? In the next chapter, you will see a few of the projects that have contributed:



Making a Difference

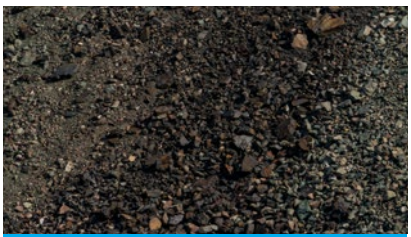
What has JSW Steel done so far?

30%
reduction

in our emissions intensity from our baseline value of 3.39 tCO_2 /tcs in financial year 2005-2006 to 2.36 tCO_2 /tcs in financial year 2022-2023.

Gas based power plants to utilize waste gases generated from steel operations resulting in reducing coal consumption

Power generated by using off-gases from the process that would otherwise have been flared replaced a significant quantity of electricity that would otherwise have been generated using coal.



Ore Beneficiation Plants to improve the Iron (Fe) Burden by reducing slag generation and thereby reducing solid fuel rate

Higher alumina and silica content in the Fe burden in Blast furnaces increases the flux consumption thereby leading to higher fuel rates and reduced productivity. This can be avoided through beneficiation of Iron ore, thereby leading to reduction in emissions and energy consumption.

Steam generation from waste heat recovery at Sinter Plant

When the hot sinter is prepared for cooling, the heat energy from the sinter is recovered in the form of steam which is then used to run turbines for electricity generation.

Installation of Top Pressure Recovery Turbines (TRT's) at Blast Furnaces

The heat and pressure of the top gas of the blast furnace is used to drive a turbine generator which generates electricity. After the pressure is recovered, this blast furnace gas is further used as a fuel in the process and in captive power plants.

Installation of Coke Dry Quenching Systems at Coke Ovens

Replacement of wet quenching of coke with dry quenching has two benefits. It avoids huge amounts of water consumption for cooling of coke and the heat energy from the coke is recovered in the form of steam which is then used to run turbines for electricity generation.

Pulverized Coal Injection in Blast Furnaces

In the past, reactions within the blast furnace were stimulated by injecting heavy oil, as auxiliary fuel, along with the blasts and oxygen. The heavy oil was replaced by pulverized coal after the oil crisis. Furthermore, there is a significant amount of coke reduction due to high Pulverised Coal Injection thereby leading to reduction in GHG emissions.

Product Sustainability

JSW Steel has been using Life Cycle Assessment (LCA) as a tool to study the environmental footprint of our products including Global Warming Potential. We have developed a high-strength steel with a lower or equivalent footprint across its life-cycle.

This has led to lower steel consumption in various end use applications resulting in the reduction of Global Warming Potential in the value chain. We received a GreenPro certification for our JSW Neosteel TMT bars and 14 categories of Roofing Sheets. Notably, we have also attained a significant milestone as the first manufacturer to receive the prestigious GreenPro ecolabel for our **'Automotive Steel'** products.

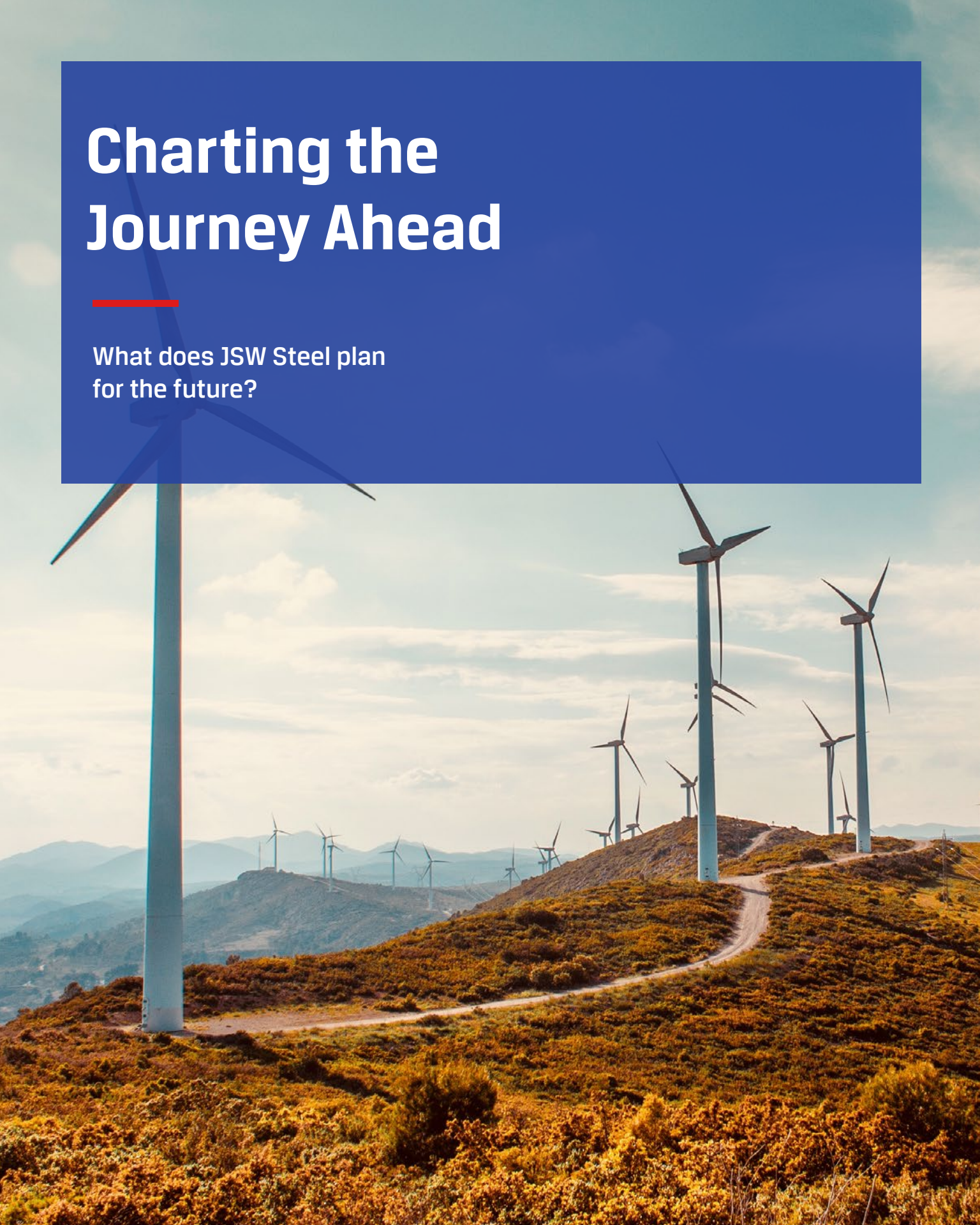
Our active involvement in developing the GreenPro Automotive Steel standards exemplifies our thought leadership and unwavering commitment to fostering sustainable practices in the industry. In addition to the GreenPro certification, JSW Steel has also obtained Environmental Product Declarations (EPDs) –Type III eco-labelling for all 14 finished products from our three integrated steel plants and for all the finished products from our three downstream plants. The use of EPDs empowers us to effectively communicate quantified environmental information to customers, providing reliable, standardised, and comprehensive insights into the product's lifecycle.

An automated solar power plant at Vijayanagar

JSW Group has been exploring all possibilities to generate and use green power. JSW Steel has started utilising solar power with the commissioning of 225 MW Renewable Solar power at Vijayanagar by JSW Renewable Energy Vijayanagar Limited, a subsidiary of JSW Energy Limited. Currently, JSW Steel Vijayanagar is utilising solar power for its operations resulting in reduction of steam coal consumption. The solar plant is situated at Thimalapura village, Bellary district, approximately 20 km from the JSW Steel Plant of Vijayanagar. This has enabled us to supply 400 KV through a dedicated transmission corridor. The plant at Thimalapura village is one of the largest captive solar power plants installed to supply power to any steel manufacturing unit in the country. The plant has been installed during FY 2021-22 on approximately 1,000 acres of land. The plant is well automated with the use of the Supervisory Control and Data Acquisition (SCADA) system and provides access to the power generated with control across multiple locations. The plant was set up in a safe manner, in compliance with all EHS norms of the JSW Group without any Loss Time Injury and also helped avoid emissions with the usage of 45 MW in steel operations.

Charting the Journey Ahead

What does JSW Steel plan for the future?

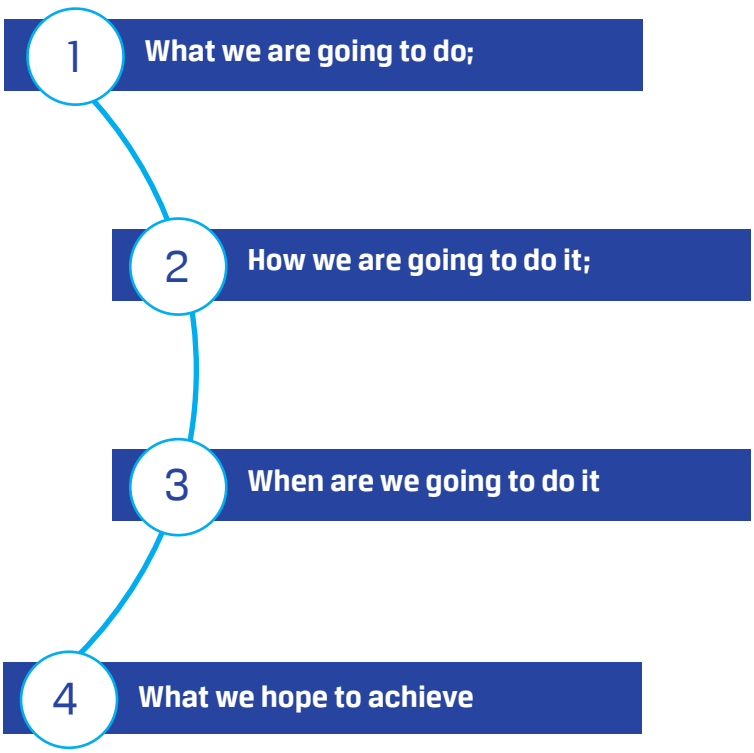


We're proud of the successes we have achieved to date, but we know that there is still so much more to do. We also know that, in order to be successful in our aim of reconciling economic growth and climate change, we need to adopt a long-term strategy.

That strategy, which we have called our Decarbonization Pathway, will encompass the three aims we spoke of earlier:

- goal of net zero by 2050 regarding greenhouse gas emission reductions;
- mitigate the many impacts of climate change that so many of us are already having to contend with; and
- help individuals and communities adapt to the changed and increased threats that they now face.

Our Decarbonization Pathway outlines the following:



In our future Climate Action Reports, in relation to our Decarbonization Pathway, we will clearly and unequivocally indicate the following:

- did we do what we were going to do, when and how we said we were going to do it?
- did we achieve what we hoped to achieve?

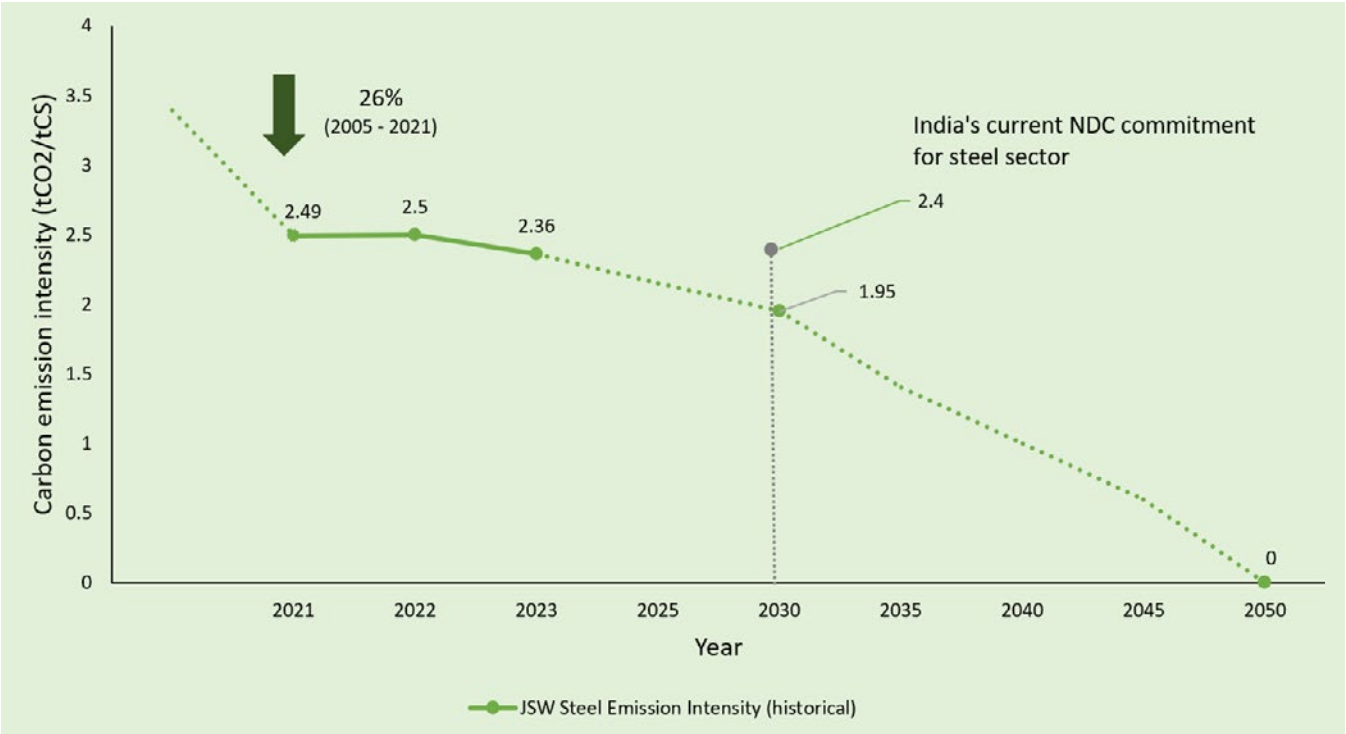
Emissions Intensity

JSW Steel contributed to around 14.9% of India's steel emissions in 2022 and our emissions intensity currently stands at 2.36 tCO_2/tcs based on the financial year 2022 - 2023.*

*Source: https://www.ceew.in/publications/how-can-india-decarbonise-for-net-zero-steel-industry

https://www.jsw.in/sites/default/files/assets/industry/steel/IR/Financial%20Performance/Annual%20Reports%20 %20STEEL/JSW%20Steel%20Integrated%20Report%202021-22.pdf

Carbon emission target



Our 1.95 tCO_2/tcs target is derived from the (IEA) Iron and Steel Technology Roadmap, published in 2020. This roadmap sets out a Sustainable Development Scenario (SDS) that details ambitious emissions reduction pathways for both the global and the Indian iron and steel sector, targeting net-neutral in carbon emissions by 2050 which is aligned with India's COP26 net zero commitment. The SDS aligns to the Paris Agreement in aiming to hold the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels, and in pursuing efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels. Under the SDS, the sectoral direct emission intensity of crude steel production in India needs to fall over 60% by 2050 on the path to net zero in 2070. Our 2030 target is based on following the trajectory needed to reach a derived emissions intensity of zero by 2050, taking into account both direct (Scope 1) and indirect energy (Scope 2) emissions.

Emissions Intensity

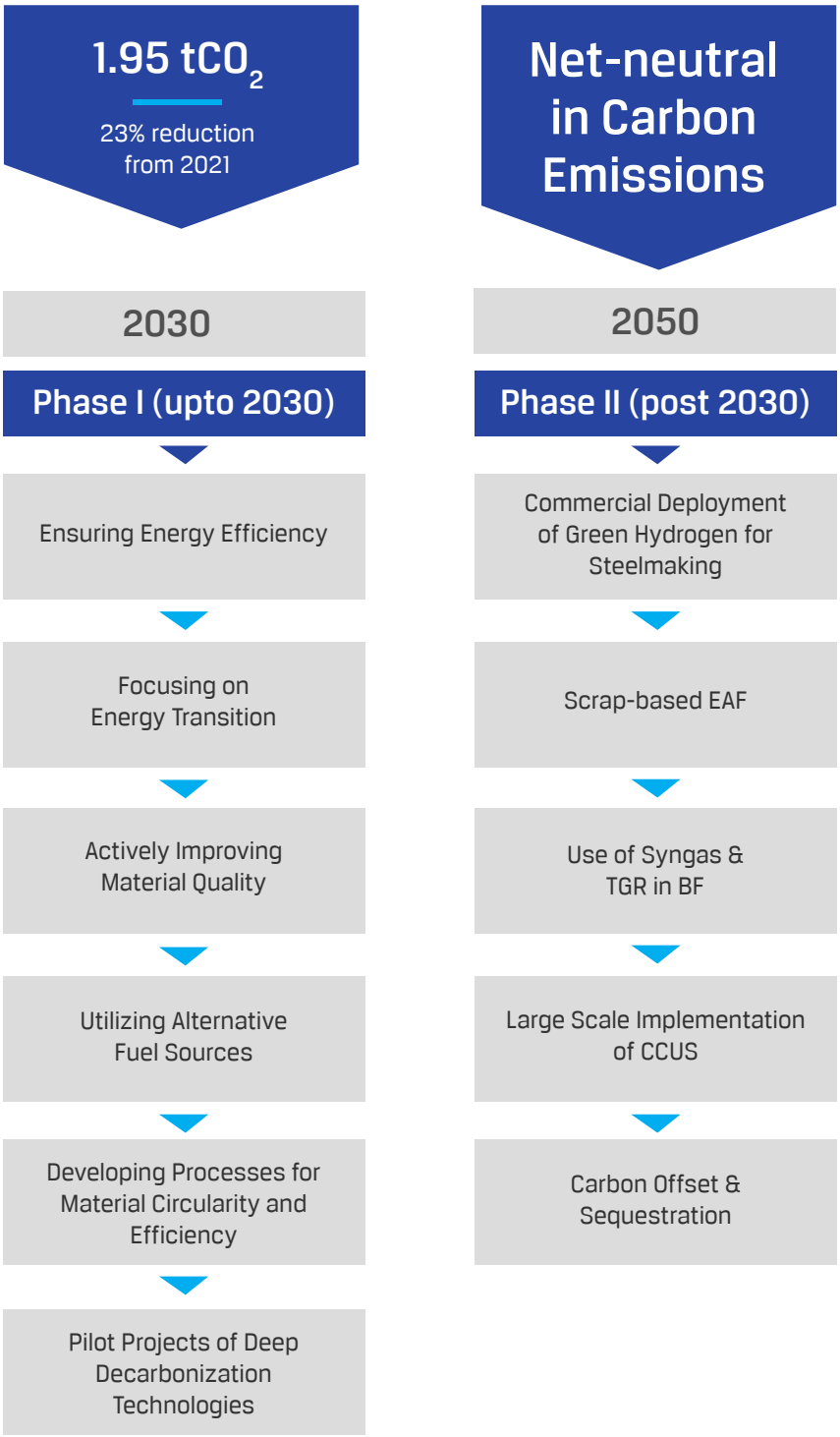
JSW Steel will achieve net neutral in carbon emissions for all operations under our direct control by 2050.

By harnessing innovative technologies, making strategic investments, and adopting conscientious practices, we are resolutely dedicated to minimizing our environmental impact and advancing towards a greener, more sustainable future. We will continue to evaluate and analyze carbon emissions across our entire supply chain, quantifying and addressing them wherever feasible to reduce our overall environmental impact.

Our Decarbonization Pathway

To provide with the necessary guidance to help explore the mitigation options and innovation opportunities that we've incorporated into our Decarbonization pathway, we've engaged with a range of technology companies, academia, and companies from other sectors. Using the knowledge we have gained, we've divided our Decarbonization pathway into two phases, with Phase 1 beginning in 2020 and ending in 2030 and Phase 2 covering the period from 2030 onwards.

Our Decarbonisation Commitments



Phase 1: 2020 - 2030

Phase 1 represents a short-term horizon to achieve decarbonization where most decarbonization technologies are not yet fully embedded in India. However, this does not imply an absence of efforts to develop strategies that contribute to overall climate change mitigation.

Rather, Phase 1 also acts as the foundation for further decarbonization initiatives which will take place during Phase 2. These strategies include the improvement of process and energy efficiency, energy transition to renewable sources, usage of alternative fuel sources, ensuring the use of improved raw material quality, and enhancing material circularity.

Phase 2: 2030 onwards

Phase 2 represents a medium to long-term horizon where a more focused transition towards net-zero takes place and deep Decarbonization is achieved.

In this phase, JSW Steel will primarily focus on four technological pathways the first being the use of 'green' hydrogen in steel manufacturing, the second being carbon capture, usage and storage (CCUS), the third being the increase in usage of scrap-based EAFs and the fourth being using syngas and TGR in blast furnace.

JSW Steel has already begun pilot projects at selected sites for the implementation of all of these technologies.

We at JSW Steel have always believed in engaging with a variety of partners in order to enrich our own knowledge and understanding across a range of issues, and decarbonization is no exception.

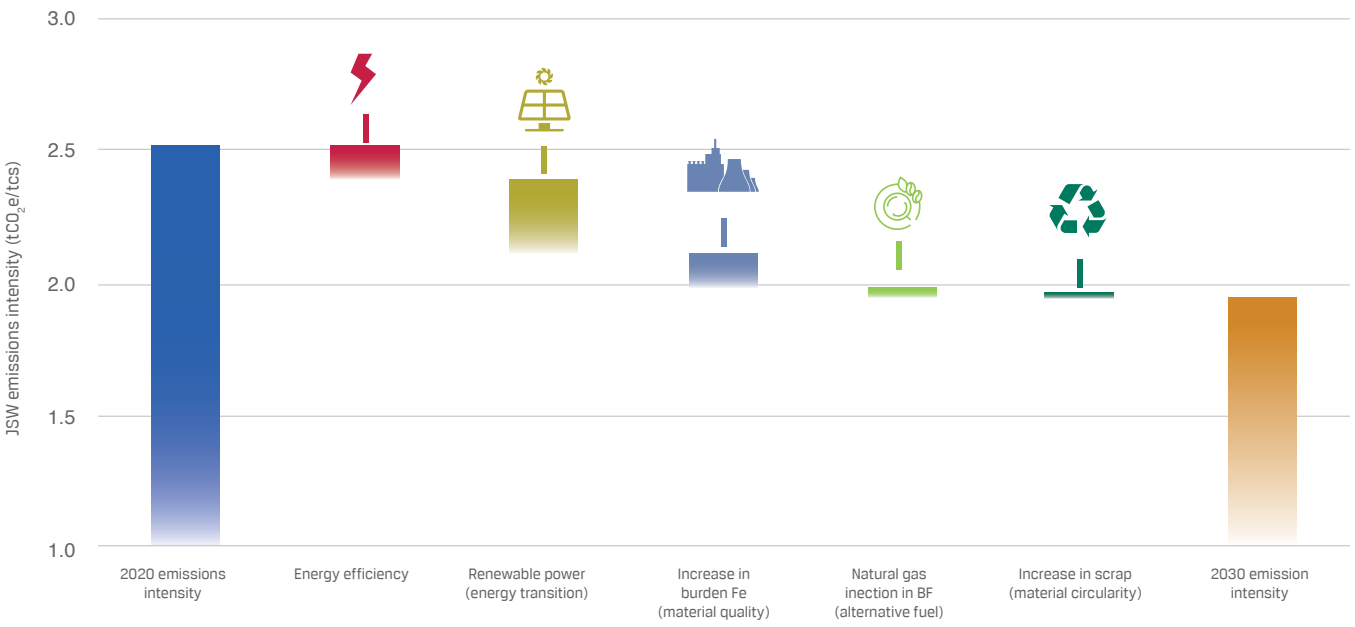
We have already established a range of working relationships with technology companies, academia, cross sector organizations, and government bodies, looking at both the six key areas of our Phase 1 strategy and the two technological pathways (green hydrogen and CCUS) that are the focus of our longer-term Phase 2 strategy.

For Phase 1, we are partnering with Boston Consulting Group (BCG) to accelerate our journey towards meeting our emission targets.

This collaboration is clearly focused on applying digital data gathering process and analytics to track, measure, simulate and enhance JSW Steel's environmental performance. In the process, BCG will also focus on upskilling our employees and enhancing the sustainability culture across our manufacturing operations.

This transformative initiative will play a critical role in scaling-up our sustainability and climate action initiatives. We are engaging with Industry experts to develop the road map for decarbonization of the Indian steel industry,

Enablers for Phase 1



Ensuring Energy Efficiency

JSW Steel has always adopted Best Available Technologies (BAT) to maximise process and energy efficiency in existing assets, and to minimise additional emissions from new infrastructure - examples of this include Coke Dry Quenching (CDQ) for coke oven waste heat recovery and use, top pressure recovery turbine for BFs, and many others.

As part of the energy efficiency element of our Decarbonization Pathway, we aim to take what we've learned from our many successful projects and replicate these technologies at our other plants.

In addition to the projects within the energy efficiency element of our Decarbonization Pathway, we also aim to utilise the worldsteel Association's 'Step Up' programme as a means of identifying and implementing further improvements in the operations of each of our steelmaking facilities.

STEP UP Operational Efficiency

The worldsteel Association's 'Step Up' programme is a review and benchmarking process which aims to support improvements across four key efficiency areas:

1. Optimal raw materials selection and use;
2. Energy efficiency and minimising waste;
3. Improving yield;
4. Process reliability

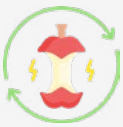
We at JSW Steel have participated in Step Up at our Vijayanagar plant and have plans to extend it to all other locations.

What is the Step Up Process?

Site performance is analysed in the following areas against top performers' data submitted for the past one or two years, with a focus on:

Optimal raw materials selection and use

The quality of iron ore and coking coal has a direct impact on energy intensity and CO_2 emissions. Measures, such as beneficiation of ore and coal at the source, switching to carbon-lean or hydrogen-containing fuels, and increasing scrap use in the basic oxygen furnace are just a few of the measures that can significantly improve operational performance.



Energy efficiency and minimising waste

Energy efficiency is a crucial component of resource efficiency and there are several tested and proven improvement measures available: heat or energy recovery from solid and gas streams, coke dry-quenching, Cogeneration units, electricity savings (aiming toward self-sufficiency), and many more.

Improving yield

Improving yield leads to increased output from the steelmaking processes. It is directly linked to a reduction in energy intensity and raw material use.

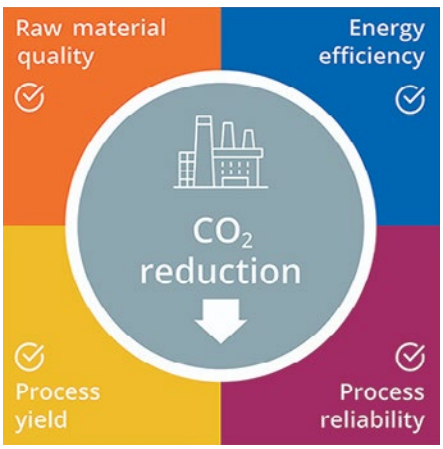
Process reliability

Improving a steelmaking plant's maintenance ensures process reliability, which reduces losses in quality and process time, thereby reducing energy use per tonne of steel.

worldsteel has a global database of CO_2 performance covering all process routes. The core of the Step Up philosophy is to support underperforming plants to enable them to improve their efficiency to a level commensurate with top performers.

Step Up: A four-stage efficiency methodology

Supporting the transition towards a carbon-neutral economy



Focusing on Energy Transition

How we source our electricity will play a key role in decarbonizing both ourselves and the wider steel sector in India. At present, the electricity we consume at our steelmaking plants comes from two sources:

- Captive power plants (these are electricity generating units physically connected to our steelmaking processes); and
- Electricity purchased from the Indian national grid.

Within our captive power plants (where we have capacity to generate over 1,000 megawatts (MW)), almost half of this generation comes from waste gases and heat generated from our steelmaking operations, utilizing many of the energy efficiency technologies mentioned earlier.

However, this does mean that the remaining half of the electricity we generate in our captive power plants is generated by burning coal. Furthermore coal-based power remains the predominant source of electricity in India and therefore the fuel behind the electricity we import into our steelmaking plants from the grid. This means that the coal associated with our own electricity generation and the coal associated with the electricity we import represent major components of our emissions intensity, which is why we have committed to:

Reducing our consumption of coal-based electricity at our steelmaking plants by 2030 by transitioning to electricity that is generated from renewable sources.

Actively Improving Material Quality

The efficiency of a blast furnace is very dependent upon the quality of the iron ore that goes into it. For example, a 1% increase in the alumina content of what goes into a blast furnace (the 'burden') increases the amount of coke that is needed (a significant source of carbon emissions) by 2.2% and decreases overall productivity by 4%. Unfortunately, the quality of iron ore grades are declining, with the levels of alumina and/or silica contamination steadily increasing, and likely to continue to do so in the future. To combat this, JSW Steel has allocated USD 470 million to set up plants which will undertake a process called 'beneficiation', helping to improve the quality of the ore and the content levels of iron going into the blast furnaces. Of course, we recognize that any new facilities that we build to undertake the beneficiation process will themselves use power and contribute their own carbon emissions, but even with the carbon emissions of these plants taken into consideration, we are confident that this intervention will result in a 23% reduction in our emissions intensity by 2030.

Utilising Alternative Fuel Sources

The use of natural gas in blast furnaces has been gaining prominence in recent years as it helps in reducing the coke consumption required to produce each tonne of hot metal. (In blast furnace iron making, partially replacing coke with injected natural gas can save between 35 and 37 kg CO_2 for every tonne of hot metal produced. In light of this saving, JSW Steel plans to utilise the injection of natural gas in blast furnaces as a partial replacement for coal.

However, we recognize two issues with this strategy. **Firstly,** whilst less carbon polluting than coal, the burning of natural gas still represents a significant contributor to our emissions intensity; **Secondly,** India has limited natural gas supplies and imports are expensive.

That is why JSW Steel has established a gas-based direct reduced iron (DRI) plant which runs primarily on 'COREX' gas. COREX gas is generated in the smelting reduction process and these off-gases contain significant amounts of carbon monoxide along with trace amounts of hydrogen which can be utilized (after processing) as a reduction gas within DRI production, therefore reducing the need to use natural gas.

Developing Processes for Material Circularity and Efficiency

At JSW Steel, we follow a 'Zero Waste to Landfill' model to manage our waste.

To ensure what we call 'material circularity and efficiency', we use scrap metal as part of our raw materials mix primarily in what is called a basic oxygen furnace (BOF), where it acts as both a cooling agent that absorbs excess heat from the exothermic decarbonization process, and also as a source of iron units.

In the next few years, JSW Steel is committed to increasing our scrap metal usage by 10% from existing levels.

Another example of material circularity is provided by JSW Steel's approach to Blast Furnace Slag. The cement and concrete industry are heavily dependent on the production of clinker as a key ingredient for cement production.

However, the calcification and combustion processes required for this clinker production releases a substantial amount of CO_2. (Partial) substitution of clinker in cement production or (partial) substitution of cement in concrete production reduces these CO_2 emissions, especially if material is used which is seen as a waste from other processes; and, traditionally, Blast Furnace Slag has always been considered as a waste in the steel making process.

It is worth highlighting the fact that the origins of JSW Cement lie in this philosophy of material circularity, utilizing the Granulated Blast Furnace Slag (GBFS) from the iron and steel sector in cement manufacturing and thereby reducing the carbon footprint of another 'hard to abate' core sector. The cement manufactured by JSW Cement using Blast Furnace Slag has one of the lowest carbon footprints in the world.

Enablers for Phase 2

As mentioned previously, Phase 2 of our Decarbonization Pathway involves and longer-term focus on two technological pathways, the first being the use of 'green' hydrogen in steel manufacturing and the second being carbon capture, usage and storage (CCUS).

Usage of Green Hydrogen in Steel Making

Hydrogen gas for use within the steelmaking process can be generated in a number of different ways. The manner of its generation process then defines how that type of gas is referred to:

- **Green Hydrogen:** Green hydrogen is produced by splitting water into hydrogen and oxygen using renewable electricity.

- **Blue Hydrogen:** It is sourced from fossil fuels. The emission or the by-products such as CO_2 and CO are stored. Blue hydrogen can be made from natural gas through the process of steam methane reforming combined with CCS.

- **Grey Hydrogen:** Grey hydrogen is made from natural gas through the process of steam methane reforming, without CCS, so CO_2 is emitted to atmosphere.

- **Brown, or black hydrogen** is manufactured through coal gasification and leads to significantly higher GHG emissions than other fuels.

Within steelmaking, hydrogen can be utilized in two key parts of the process:

1. Partial replacement of coke in blast furnaces;
2. Hydrogen-based direct reduction of iron (DRI).

These are outlined in more detail in the following sections.

Partial replacement of coke in blast furnaces

JSW Steel is currently exploring the possible application of green hydrogen injection in blast furnaces, even though there is recognition that there are constraints on this technology. In traditional blast furnaces, hydrogen can be used as a replacement for coke within the iron ore reduction process, the singular advantage being that where a by-product used to be carbon dioxide (CO_2), that by-product is replaced by water (H_2O). However, the hydrogen reaction is endothermic (in comparison to the exothermic reaction associated with coke) and because of this it requires an additional source of energy for carrying out the reaction. This means that whilst the introduction of hydrogen does result in an overall reduction in carbon emissions associated with this route of steelmaking, 'hydrogen blending' (as it is called) can only serve as a transitional strategy as technical process constraints put an upper limit on the amount of blending that can occur without equipment modifications, particularly for blast furnaces which have a minimum coke requirement.

Hydrogen-based direct reduction of iron

"Hydrogen Direct Reduced Iron" (H2 DRI) is another technology that substitutes hydrogen for a carbon emitting material, this time the coal or natural gas used for DRI production. In a DRI furnace, the iron ore is heated but not to the point of melting.

Hydrogen then passes over the hot ore, combining with the oxygen liberated from the iron oxide to form water and leaving relatively pure iron behind. It is estimated from various research studies that the blend of hydrogen in natural gas-based DRI can go up to as high as 30% without any major process changes, resulting in a similar reduction in carbon emissions. With this in mind, JSW Steel is already exploring the opportunities to set up pilot projects in India to demonstrate the feasibility of green hydrogen usage
in DRI production.

We have already initiated a pilot project to construct at green hydrogen facility, capable of generating 3,800 tonnes of hydrogen, at our Vijayanagar plant.

> JSW Group is uniquely placed to lead on green hydrogen topic as we have significant interests in steel, cement, and renewable energy. As the IH2A work group lead for steel and cement, we will bring other industry majors and the government together to build consensus for a common path towards hydrogen commercialization in the steel and cement sectors. Green steel and hydrogen product exports can be a national strategy for taking leadership in the global hydrogen value chain by embedding hydrogen in the industrial supply chain. This is a leadership opportunity.
>
> **Prabodha Acharya**
> Chief Sustainability Officer, JSW Group

Scrap-based EAF

Scrap-based Electric Arc Furnaces (EAF) are emerging as a promising solution for steel manufacturers looking to reduce their carbon footprint. JSW Steel is actively exploring ways to decarbonize its production processes and is considering increasing its usage of scrap-based EAFs.

Traditionally, steel production has relied on blast furnaces that use coal and coke as their primary raw materials, resulting in significant greenhouse gas emissions. EAFs, on the other hand, use scrap steel as their primary raw material, which results in a significant reduction in greenhouse gas emissions. By increasing the use of scrap-based EAFs, the company can reduce its reliance on fossil fuels and transition towards a more sustainable production process. The shift towards scrap-based EAFs not only has less impact on the environment but is also cost effective. EAFs require lower capital investment compared to traditional blast furnaces, resulting in lower production costs. Additionally, the use of scrap steel as the primary raw material is cheaper than using coal and coke.

Use of Syngas and TGR in BF

One of the approaches that JSW Steel is adopting is the use of Syngas and Top Gas Recycling (TGR) in its blast furnace operations. Syngas is a gas mixture containing carbon monoxide and hydrogen that is produced from the gasification of coal or biomass. It can be used as a fuel or as a reducing agent in the steel production process. On the other hand, TGR is a process where the top gas from the blast furnace is recycled and used as a reducing agent. The combination of Syngas and TGR in blast furnace operations can significantly reduce carbon dioxide emissions.

The use of Syngas and TGR is also cost-effective. The reduction in carbon dioxide emissions can lead to savings in carbon credits and taxes, resulting in lower production costs. Furthermore, the use of Syngas and TGR can also lead to energy savings, resulting in lower energy costs. Moreover, the use of Syngas and TGR can enhance the overall efficiency of blast furnace operations. The use of Syngas can increase the amount of hot metal produced per tonne of coke, resulting in higher productivity. Additionally, the use of TGR can improve the blast furnace's thermal efficiency, leading to lower fuel consumption and reduced operating costs.

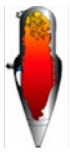
Carbon capture, utilisation and storage

Over the past years, discussions around CO_2 capture technologies have been revolutionising the industrial market through tremendous technological innovations. Presently at the development stage, many steel companies are set to imbibe the CCUS technology into their operations and have been committing to decarbonization. Steel plants are ideal for carbon capture methodology as most of their emissions can be captured from their process-gas and offgas. This captured carbon can be re-purposed. This enables producers to keep their costs low while making substantial progress towards decarbonization. This technology is set to transform the functioning of the steel industry. CCU/CCUS will play an important role in enabling a circular carbon economy.

CCU at JSW Steel

Carbon capture	Implemented carbon capture and utilisation (CCU) technology at JSW Salav Works
Key Benefits	• CO_2 purity level of up to 99.5% • Scalable across the energy system and enables emission reduction

The CCU process



CO & H2

are passed though iron ore pellets & lump ore to facilitate the reduction process

Waste gas recovery

Carbon-rich waste gas is recovered and sent to absorber which treats it counter current with g.v. solution forming rich solution

HP & LP regenerators

Rich Solution is treated in the Regenerators seperating G.V. Solution and Carbon Dioxide which is then passed on for further processing

CCUS
Carbon capture & storage

CO_2 is then captured, stored and transported for its usage in the food & beverages industry

99.5%
Purity of CO_2

100 TPD
Production capacity

Costs and Investments

India would need cumulative investments of USD 10.1 trillion to achieve net-zero emissions by 2070, according to an independent study released by the CEEW Centre for Energy Finance (CEEW-CEF).

The time scale of realization of these technologies are highly dependent on three factors – costs, regulatory frameworks to accommodate and facilitate the use of these technologies, and technology and innovation itself to make such projects economically viable.

When we focus on the steel sector - in the Sustainable Development Scenario, material efficiency and technology performance improvements are able to contribute for the 90% emission reductions till 2030. In fact, 20% of the direct cumulative emissions till 2050 are estimated to be reduced through technology performance improvements. In the long term beyond 2030, CCUS and Green Hydrogen based DRI are expected to play a huge role in decarbonization. This means that there is a total additional investment in core process equipment (including, for example, pelletisers, blast furnaces and electric arc furnaces) that is needed to achieve substantial CO_2 emission reductions in the iron and steel sector. The cumulative capital investment in core process equipment between 2021 and 2050 in the Sustainable Development Scenario is estimated to be USD 1390 billion.

The increase in investment costs grows over time, with the required capital investment in the 2041 to 2050 period being about 60% higher in the Sustainable Development Scenario than the Stated Policies Scenario. These material efficiency savings are not without cost. While it is difficult to assess the precise cost of material efficiency measures, it is estimated that an additional USD 200 billion could be required cumulatively to 2050.

That said JSW Steel plans to invest $1 billion to reduce carbon emissions across operations through various initiatives.

It was the first steel company in the world to raise $1 billion through the issue of two US dollar-denominated Sustainability Linked Bonds of 5.5 years and 10.5 years. The proceeds from the issue will be used for funding capex plans as well as for refinancing of debt.

The issuance comprised two tranches of 5.5 years and 10.5 years, each for an amount of $500mn. The 10.5-year tranche was issued as a Sustainability Linked Bond (SLB) where the company has committed to a target of achieving ≤1.95 tonnes of CO_2 per tonne of crude steel produced, by March 2030, representing a 23 per cent reduction from its 2020 levels.

Working Collaboratively

We at JSW Steel have always believed in engaging with a variety of partners in order to enrich our own knowledge and understanding across a range of issues, and Decarbonization is no exception.

We have already established a range of working relationships with technology companies, academia, cross sector organizations, and government bodies looking at both the key areas of our Phase 1 strategy and the technological pathways (green hydrogen and CCUS) that are the focus of our longer-term Phase 2 strategy.

JFE

Technological collaboration with JFE Steel Corporation

IH2A
INDIA HYDROGEN ALLIANCE

Steel and cement lead at IH2A (a Hydrogen alliance)

LARSEN & TOUBRO

Joint venture with Larsen & Toubro (L&T) to develop CCUS technologies

MoU with IIT Bombay

SMS group

MoU with SMS Group

Meeting Our Goals

How will we make sure we deliver?

We at JSW Steel are committed to the realisation of the aims and strategies outlined in this Climate Action Report.

To support that commitment, and to ensure that those who are tasked with the delivery of our Decarbonization Pathway have the tools, the resources and the support they need to deliver success, we have in place the following mechanisms to ensure our metrics and strategy are supported, governed and kept up to date:

1. **The JSW Sustainability Framework**
2. **Our Climate Change Governance Structure**
3. **Our Risk Management Framework**

The details of each of the above mechanisms are presented under the Annexure section of this report.

Thank You

We have produced this initial Climate Action Report at a time when the world is seeing an uncertain geopolitical and economic environment with cross-border tensions and constrained supply chains. Amid these uncertainties, India stands out with its vibrant economy, demonstrating its resilience in a volatile world, and strengthening its position in the global economy.

In the light of the uncertainties, it is easy to allow the threat of climate change to slip quietly into the background, to allow our focus on the need to make fast and substantial reductions in our carbon emissions to become lost. But that is something that we, and the generations that will come after us, cannot allow to happen.

We must ensure that climate change, and the impacts it is already having on our nation and on the wider world, continues to be at the very forefront of our thinking, positively influencing our choices and decisions.

The recent years have been characterized by periods of reflection and growth, where we have witnessed both the resilience of human endeavor and the collective spirit of innovation in dealing with the worst pandemic in living memory ever. Just as challenges have been met with resolve and optimism, so too we approach the issue of climate change with a sense of determination and possibility.

Through unwavering commitment, proactive strategies, innate problem solving capabilities, agile responses and, just as important, the belief in our ability to effect positive change, we stand poised to mitigate the impacts of climate change and forge a path towards a brighter future.

We thank you for taking the time to read our first Climate Action Report.

We hope you found it not only engaging and informative, but also true to our aim of being open, honest and accessible. In it, we have outlined in detail our strategy to help tackle climate change through our Decarbonization Pathway, and we again reaffirm the readiness of our JSW Steel Team to face the many challenges that lie ahead upon this journey.

Annexure

Alignment with Task Force on Climate-related Financial Disclosures (TCFD)

Keeping in view the goal of transitioning into a greener and climate resilient business while also ensuring greater transparency through enhanced climate disclosures, JSW Steel committed to support the TCFD recommendations in March 2021. Alignment with the TCFD recommendations across its four pillars allows us to better understand possible implications of climate change and make informed decisions with respect to current and forward-looking decarbonization strategies. The subsequent sections provide an outlook on the JSW Steel's alignment with the TCFD recommendations across its four pillars.

Sustainability Framework

We at JSW Steel thoroughly acknowledge the impact of our business on both the local environments in which we operate and the wider, global environment. In addition to that, we have also realised that our business has the potential to impact the lives of people, both positively through employment opportunities and negatively by putting their overall well-being at risk. With this in mind, at JSW Group level we have developed a Sustainability Vision that guides our social, ethical and environmental responsibilities, including those relating to climate change.

"It is our Vision here at JSW that we are able, both now and in the future, to demonstrably contribute in a socially, ethically and environmentally-responsible way to the development of a society where the needs of all are met, and to do so in a manner that does not compromise the ability of those that come after us to meet the needs of their own, future generations."

To fulfill our Sustainability Vision we have created a Sustainability Strategy, based on seven key elements:

Leadership: Throughout our organization, we provide our leaders with the skills and knowledge that will systematically enable them to oversee the implementation of our Sustainability Strategy and then ensure that it remains operational and effective.

Stakeholder engagement: Each part of our business is regularly required to identify and subsequently engage with a wide range of people and organizations that have an interest in our activities – our stakeholders – with the aim to gain an understanding of their varied needs and expectations from us and accordingly build our strategy to fulfil them.

Communication: Frequent and effective communication, both within our business and with our stakeholders, is seen as critical to ensure that everyone understands the significance of our Vision and Strategy.

Planning: Each of our sites are required to gain a thorough understanding of which and to what extent a particular sustainability issue affects them, guiding each site to develop an appropriate approach to manage the relevant issues.

Improvement: Our Strategy requires our sites to explore all the potential opportunities for improvement, which could include but is not limited to improvements in efficiencies or reducing wastes; improvements in how we operate, especially in our processes; improvements in our products or improvements in our work engagement with our suppliers.

Monitoring: Our Strategy places significant emphasis on identifying, from site to group, the key performance measures through which we, and our stakeholders, can monitor our progress.

Reporting: Regularly sharing information on our performance, including at a local site level and using international standards such as the Global Reporting Initiative (GRI) as well as International Integrated Reporting ⟨IR⟩ framework published by the International Integrated Reporting Council (IIRC), and is seen as key in fulfilling our commitment to "demonstrably contribute" to ensuring greater transparency.

We at JSW Steel have ensured that this Sustainability Strategy has been implemented consistently throughout our business, and we will continue to ensure that it functions effectively across all our operations.

As part of this framework, we have identified 17 key focus areas, one of which is Climate Change. Within each of these 17 focus areas we have defined our specific aims and ambitions in a Policy and then underpinned that Policy with a Technical Standard that defines how each issue is to be managed and improved.

Environment	Social	Governance
Climate Change	Social Sustainability	Human Rights
Energy	Supply Chain Sustainability	Business Ethics
Water Resources	Employee Well Being	
Resources	Indigenous People	
Waste	Cultural Heritage	
Water Waste		
Air Emissions		
Bio Diversity		
Sustainable Mining		
Local Considerations		

We have a dedicated policy for climate change which has core pillars as –

1. Preventing the causes of climate change;
2. Mitigating and adapting to the impacts of climate change; and
3. Creating resilience to climate change.

Climate Governance

Climate action is an organizational priority for JSW Steel and, this gets reflected in our climate governance structure. The top-down structure is constituted of a core group of senior-level executives, who are responsible for defining and guiding the company's climate action strategy.

JSW Steel's corporate governance structure is aligned to its climate governance structure, and individual representatives from each level of our corporate governance structure actively participate as well as influence climate-related discussions and strategy.

All business decisions within JSW Steel are taken after carefully examining global and national climate change and sustainability developments.

CORPORATE GOVERNANCE FRAMEWORK

TRANSPARENCY AND OPENNESS

BOARD OF DIRECTORS

Balanced Board of Executive and Non-Executive Independent Directors with a diverse range of expertise and experience

- Provides strategic direction and evaluates performance
- Ensures the long-term interest of the stakeholders that are being served

BOARD COMMITTEES

- Audit
- Nomination and Renumerations
- Business Responsibility / Sustainablility Reporting
- Stakeholder Relationship
- Risk Management
- Project review
- Corporate Social Responsibility
- Hedging Policy Review
- JSWSL ESOP
- Finance
- Share allotment
- Share/debenture transfer
- JSWSL Code of Conduct Implementation

Under the guidance of the Board and its committees, JSW Steel drives performance by adopting various policies on key domains such as corporate governance, sustainability and CSR. Respective information on the policies is available at: jsw.in/investor-relations-steel.

MANAGEMENT REPORTING TO THE BOARD

- Executive Committee
- Operations Committee below the Executive Committee

KEY CORPORATE FUNCTIONS

- Finance
- Risk
- Operations
- Sustainability
- Sales and Marketing
- Legal
- Information Technology
- Safety
- Human Resources
- Commercial

Board Oversight

At the board level, the Business Responsibility/ Sustainability Reporting Committee and the Risk Management Committee are the primary committees responsible for reviewing climate-related matters during their biannual board meetings. These committees have open channels of communication with each other allowing them to collaborate as and when necessary. These committees report to the Board of Directors during the board meetings to review the company's performance and approve any planned activities (including financial approvals). Additionally, the Corporate Social Responsibility (CSR) committee is also involved in supporting the implementation of low carbon strategies in the company.

Business Responsibility/Sustainability Reporting Committee

The board has constituted the Business Responsibility/ Sustainability Reporting Committee to monitor and manage climate change and sustainability related strategy and performance of the company. The Business Responsibility/Sustainability Reporting Committee is headed by a Non-Executive Independent Director and includes two more Non-Executive Independent Directors and three Executive Directors. The committee is primarily responsible for the following:

1. Adoption and implementation of National Guidelines on Responsible Business Conduct (NGRBC) in business practices of JSW Steel

2. Responsible for development and progress achieved with respect to the policies linked to the nine key principles of the National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business

3. Review the progress of business responsibility initiatives undertaken at all steel and mining plants under the purview of the nine sustainability policies (including review of 2030 low carbon and sustainable development plans)

4. Review business responsibility report (now revised to BRSR) and present it to the board for approval. Additionally, the committee guides and reviews climate change and sustainability disclosure frameworks and standards which includes CDP, Dow Jones Sustainability Index (DJSI), Global Reporting Initiative (GRI), Integrated Report (IR) and TCFD

The Business Responsibility/Sustainability Reporting Committee meets biannually with a pre-decided agenda. During the period 2020, 2021 and 2022 some of the key climatic themes that were covered by the committee in the meetings included:

- Review and approval of sixteen policies including nine sustainability/climate-related policies

- Use of internal carbon price (ICP) to reduce financial implications due the EU Carbon Border Adjustment Mechanism (CBAM)

- Review of 2030 low carbon and sustainable development goals, interventions planned along with estimated costs of implementing these interventions

- Alignment of interventions planned as part of low carbon and sustainable development roadmap with global benchmarks

Risk Management Committee

The Risk Management Committee of the board is responsible for conducting periodic reviews of risk assessment and mitigation processes ensuring effective risk control through a defined risk management framework. Additionally, the committee is also responsible for reviewing major risks for the company and proposed action plans.

The Risk Management Committee is headed by a Non-Executive Independent Director and includes two more Non-Executive Independent Directors and three Executive Directors. It has constituted sub-committees which are the Capex Risk Evaluation Committee to evaluate the risks associated with capex proposals including mergers and

acquisitions and Locational Committees which include the Corporate Committee and plant level committees to further review risks at location level. Currently, there are three Locational Committees representing each integrated steel plant.

The risks are identified by plant level committees and the corporate committee which are then reported to the Risk Management Committee biannually. The board's Risk Management Committee reviews the risks presented to them advising on any new potential business risk.

Corporate Social Responsibility Committee

Apart from the Business Responsibility/Sustainability Reporting Committee and the Risk Management Committee, the CSR Committee of the board also participates in climate-related matters in the company. JSW Foundation which is responsible for carrying out the CSR activities of the Group has their CSR team located at each operational facility and supports the sustainability team in designing and implementing initiatives that support JSW Steel's low carbon agenda outside the boundary of our operations such as carrying out afforestation and water conservation/harvesting activities outside operational boundary.

Management Oversight

The Executive Committee supported by the Climate Action Group (CAG) and corporate function teams is responsible for reviewing and managing climate-related matters at management level. The roles and responsibilities and key climate-related activities performed by these committees/groups are described below:

Executive Committee

The Executive Committee, comprising of the Deputy Managing Director, Head of Plants along with their direct reportees, Functional Heads supported by Chief Sustainability Officer (CSO), is responsible for closely reviewing and governing climate-related matters. Climate change and sustainability KPIs and performance of the company are discussed during the monthly Executive Committee meetings.

Climate Action Group

Based on a decision taken during an Executive Committee meeting, we formulated the CAG, in May 2020, as a central think-tank for driving unified climate actions across the company. The group is facilitated by the Corporate Sustainability Team which also acts as its secretariat and led by the Chief Operating Officer (COO). The group consists of experts from various corporate functions including sustainability, R&D, strategy, operations, sales and marketing, finance, digital, communications, supply chain and along with significant representation from operations.

The CAG is responsible for monitoring and directing our climate change performance, assessing climate-related risks and opportunities as well as designing relevant risk mitigation strategies. The group convenes every month and reports directly to the Executive Committee as well as to the board.

The key responsibilities of the CAG include:

- Compilation of GHG emissions related data and setting emission reduction targets
- Design GHG emission reduction projects
- Formulation of the climate change policy and long-term climate action plan
- Review and Analysis of climate change and Sustainability KPIs and risks for each operating unit
- Development of climate change/sustainability disclosures such as CDP, DJSI, GRI, IR, worldsteel Association and TCFD
- Keeping abreast with regulatory and technological changes

Strategy

Sustainability is at the core of JSW Steel's corporate strategy. We aim to emerge as a driving force ensuring responsible business conduct to enhance lives of communities while also conserving the environment. These sustainability efforts are reinforced by our commitment towards low carbon and sustainable development growth as well as ensuring transparency in our operations and investments. We understand the integral role that climate risks play in development of business strategy as well as decision making with respect to each project during its life cycle.

To this end, in FY2021 we conducted our first climate change risk assessment exercise using scenario analysis with an aim of better understanding climate-related risks and opportunities that our operations might face in the future. The analysis was also conducted to provide insights and guide development of our climate strategy and business planning over time. A detailed discussion on our approach and key risks and opportunities identified have been provided in the sections below.

Overview of Climate Change Scenario

We have considered various scenarios covering broad spectrum of climate outcomes to gain insights into range of risks and opportunities that we might face over time. We utilized internationally accepted scenarios from two primary sources:

Intergovernmental Panel on Climate Change (IPCC) which provides pathways for assessing physical impacts of climate change from varying degrees of GHG emission concentration in the atmosphere

International Energy Agency (IEA) which models implications of climate-related policies and technologies on energy systems globally

We used IPCC Representative Concentration Pathways (RCP) 8.5 and RCP 4.5 for assessing location-specific physical risks and IEA World Energy Outlook (WEO) 2020 Stated Policies Scenarios (STEPS) and Sustainable Development Scenario (SDS) for assessing transition risks for our operations.

IPCC scenarios:
(Physical Risks)

Business-as-usual Scenario

RCP 8.5 Scenario

Very high emissions scenario with global mean temperature expected to rise by 3.7°C (2.6-4.8°C) by the end of the century. The scenario assumes high dependence on fossil fuels and no policy driven mitigation

Optimistic Scenario

RCP 4.5 Scenario

Intermediate emissions scenario with global mean temperature expected to rise by 1.8°C (1.1-2.6°C) by end of the century. The scenario considers increased use of renewable energy and strong policy driven mitigation

WEO-2020 Scenarios:
(Transition Risks)

Stated Policies Scenario

Incorporates existing and announced climate policies (till mid-2020) including Nationally Determined Contributions from the governments across the world. The scenario provides a baseline against which additional actions are required to meet SDS climate goals.

Sustainable Development Scenario

Provides an energy sector pathway which is consistent with meeting global net-zero CO_2 emissions from the energy system as a whole by around 2070, universal access to energy and reduced air pollution

These scenarios do not forecast future states but rather hypothesize about plausible trajectory of events and model future climatic changes thereby, enabling us to assess likely climate risks. Thus, climate scenarios are viewed as tools that help us make informed business decisions while taking into consideration potential impact of climate risks. We mapped each scenario for the projected time period of 2023-2050, categorized into three horizons as follows:

Short-term: 2023 - 2025 | **Medium-term:** 2025 - 2035 | **Long-term:** 2035 - 2050

Potential impacts of both physical and transition risk factors under each scenario were evaluated over these time horizons to determine risk levels. Our 3 Integrated steel plant sites were assessed against following physical risk hazards with the below associated potential impacts.

Physical Risks

Risk	Description	Business Impact
Water unavailability	A number of our operations are projected to be under high water stress (stress levels of 40-80% or more) in the medium to long-term owing to increasing trend in temperature and decreasing rainfall patterns coupled with rising population and increasing demand for water.	Water-related risks could translate into higher operational costs for the plants/mines required for procuring water from third party or private sources. Reduced water supply can also disrupt operations and reduce production capacity.
Extreme rainfall and flooding	For coastal districts, a high change in rainfall is projected particularly, during monsoon season which increases the exposure of operations to increased frequency of extreme rainfall and flooding events.	Heavy rainfall and flooding events can have severe implications in terms of infrastructure/asset damage, power outages and operational shutdown. It can also disrupt supply chain leading to unavailability of raw material and/or other necessary equipment thereby, resulting in production losses.
Inundation due to sea level rise	Sea level is projected to rise by 0.5 meters or more by 2100 relative to 1986-2005 level. This makes our operations located close to the coastline highly vulnerable to inundation due to rising sea levels.	Inundation of land due to sea level rise will have financial implications on our business in terms of production loss and might even lead to closure of operations in coastal districts.
Cyclones	Frequency and intensity of cyclonic storms is projected to increase over both the Arabian Sea and the Bay of Bengal, indicating increased exposure of operations in coastal districts to cyclonic events.	Cyclone landfall can result in infrastructure damage, uprooting of trees or overhead installations leading to disruption of operations. It can also impact supply chain by making ports and other transportation services inaccessible.
Negative health impacts due to heat stress	With projected increase in temperature, workers are likely to be regularly exposed to heat stress like conditions leading to adverse impacts on their health particularly, during summer season.	Exposure to excessive heat during work restricts physical capability, work capacity and productivity of workers. Regular exposure to thermally stressful environments can cause negative health impacts leading to loss of mandays and/or reduce productivity of employees.

Physical Risks

Risk	Description	Business Impact
Increase in energy consumption	With projected increase in temperature, more energy will be required for cooling to maintain indoor temperature and adequate working conditions within the facilities.	Impacts of this risk are likely to be witnessed in terms of increasing operational cost coming from increased share of energy consumed by cooling devices (or HVAC systems) for maintaining a comfortable temperature within the plant.
Negative health impacts due to vector-borne diseases	Projected increase in temperature coupled with increasing rainfall creates conducive environment for spread of water/vector-borne diseases which can adversely impact health of employees.	Adverse health impacts due to spread of water/vector-borne diseases might lead to loss of mandays and/or reduce productivity of employees.
Increased wildfires	Increasing temperature coupled with scanty rainfall put mining operations under increased risk of being impacted by wildfires in the surrounding forests.	Spread of wildfire from neighboring forest areas to the mining site can damage infrastructure, assets as well as threaten human life.

Plant Wise Risk

Plants	Risks	Business-as-usual Scenario (RCP 8.5)			Optimistic Scenario (RCP 4.5)		
		Short	Medium	Long	Short	Medium	Long
VJN	Water unavailability						
	Increase in energy consumption						
	Negative health impacts (heat stress)						
	Exrtreme rainfall and flooding						

Key Outcomes and Proposed Mitigation:

JSW Vijaynagar operations are projected to become increasingly vulnerable to water stress and unavailability under both scenarios in the medium to long term. As part of short term adaptation action, JSW Vijaynagar carried out detailed water studies through CII – Triveni Water Institute. This study was aimed to develop shop wise water balance and identify projects to conserve water and increase water efficiency in the system.

Plants	Risks	Business-as-usual Scenario (RCP 8.5)			Optimistic Scenario (RCP 4.5)		
		Short	Medium	Long	Short	Medium	Long
Dolvi	Water unavailability						
	Increase in energy consumption						
	Negative health impacts (heat stress)						
	Negative heatlh impacts (vector-borne diseases)						
	Extreme rainfall and flooding						
	Inundation of land due to sea level rise						
	Cyclones						

Key Outcomes and Proposed Mitigation:

JSW Dolvi operations are projected to be exposed to extreme rainfall and flooding, including inundation of land due to sea level rise in both scenarios in the medium to long term. The results of the initial study will be used to further deep dive into the risks at the asset/operation level with an objective to validate the existing design, maintenance programs, and other engineering controls and identify potential controls that may be required to mitigate the impacts.

Plants	Risks	Business-as-usual Scenario (RCP 8.5)			Optimistic Scenario (RCP 4.5)		
		Short	Medium	Long	Short	Medium	Long
Salem	Water unavailability						
	Increase in energy consumption						
	Negative health impacts (heat stress)						
	Extreme rainfall and flooding						

Key Outcomes and Proposed Mitigation:

JSW Salem operations are projected to become increasingly vulnerable to water stress and unavailability under both scenarios in the medium to long term.

We propose to conduct a detailed water study at JSW Salem similar to what was carried out at JSW Vijayanagar with an objective to identify projects to conserve water and increase water efficiency in the system.

Risk Levels: Low Medium High

Transition Risks

To assess climate-related transition risks and opportunities, we have carried out analysis of changes in policies and regulations, market, consumer perceptions and low carbon technologies on our operations under the two WEO-2020 scenarios (classified as business-as-usual and optimistic scenarios). We have identified the following transition risks and opportunities at an organisation wide and assessed the impacts till the year 2050.

Policy and Regulatory Risks	Description	Business Impact
Carbon Border Adjustment Mechanism (CBAM)	The European Commission has announced introduction of a CBAM under the European Green Deal programme of environmental measures. As part of this mechanism, European Commission aims to levy a border tax on import of carbon intensive products (including iron and steel) from other countries to avoid risk of carbon leakage.	Given that we engage with international markets and export our products to Europe, introduction of EU CBAM will increase our operating costs and reduce profit margin of the products exported to Europe.
Renewable Purchase Obligation (RPO)	India has adopted a target for adding 175 GW of renewable energy capacity by 2022 and 500 GW by 2030. To achieve this target, the government has introduced mechanisms like RPO which mandates electricity distribution companies and businesses to purchase/ produce a specified quantity of their electricity requirements from renewable energy sources.	Given the rapid transition towards renewable energy, we might witness rise in mandatory renewable energy purchase requirements under RPO in the short to medium-term, leading to increase in operating costs.

Market Risks	Description	Business Impact
Increasing demand for low carbon steel	In the coming decades, the demand for low carbon steel is expected to grow with increasing number of customers/industries requiring products that will enable them to reduce lifecycle emission for their products.	Delayed reduction in GHG emissions can impact our ability to capture growing demand for low carbon steel in national and international markets.

Transition Risks

Reputational Risks	Description	Business Impact
Enhancing sustainability performance and climate action	With growing awareness amongst investors, customers and public, a company's climate change performance and its disclosures play a role in shaping its reputation amongst various stakeholders.	Being one of the major steel producing companies in India, our reputational capital amongst investors, market and other stakeholders is inherently tied with climate change and environmental performance. Failure to demonstrate enhanced climate action and/or disclose relevant climate change information can have an adverse impact on our reputational stand.

Opportunities

Market Opportunities	Description	Business Impact
Rising demand for electrical steel sheets with increasing Electric Vehicles (EVs) uptake	Going forward, increase in adoption of EVs will provide market opportunities to steel industries to meet growing demand for electrical steel sheets which are used in EV motors.	Our ongoing and efforts and collaboration with international markets to manufacture electrical steel sheets provides us the opportunity to gain a head start and competitive edge in the market for capturing increasing demand for electrical steel sheets in the future.
Development and/or expansion of low emission steel products	Shift in consumer preferences towards clean and low carbon products provides opportunities to companies to diversify their revenue streams by capitalizing early on rising demand for low carbon products and services.	With continued decarbonization efforts, we will have the opportunity to increase revenue streams by capturing a share of low carbon steel markets both regionally and globally.
Transition towards clean energy and low carbon economy	Steel is a critical input required for development of clean energy infrastructure therefore, its demand is projected to grow particularly, in the power sector.	Increasing push towards use of clean energy technologies and infrastructure provides us opportunities to generate additional revenue and increase market share by capturing the growing steel demand.

Resource Efficiency Opportunities	Description	Business Impact
Increased utilization of steel scrap	Supported by policy action, availability of steel scrap is expected to increase in the country which will make scrap-based steel production as one of the most cost-effective steelmaking routes for reducing carbon and energy intensity.	Domestic availability of steel scrap at competitive prices provides opportunities for JSW Steel to set-up and/or expand scrap-based steel production capacity to cost effectively reduce carbon footprint and energy consumption, increasing our production of low carbon steel.

Opportunities

Resource Efficiency, Energy Source, Market and Product and Services Opportunities	Description	Business Impact
Reducing impacts of carbon pricing using ICP	Incentivizing low carbon investments through ICP can act as a cross-cutting opportunity for companies to decrease their emission footprints, reduce financial implications of climate-related policies, or diversifying revenue streams by exploring new low carbon markets.	Adoption of ICP in business decision making will enable us to reduce the costs associated with carbon emissions, making operations future ready for upcoming climate-related regulations and policies as well as opening up additional avenues for revenue such as low carbon steel markets

Transition Risks and Opportunities

Risk Category	Risks	Stated Policies Scenario			Sustainable Development Scenario		
		Short	Medium	Long	Short	Medium	Long
	Carbon Border Adjustment Mechanism						
	Renewable Purchase Obligation (RPO)						
	Increasing demand for low carbon steel						
	Challenges in adopting breakthrough technologies						
	Enhancing sustainability performance and climate action						

Risk Category: Policy and Regulatory Risks; Market Risks; Technology Risks; Reputational Risks

Opportunities Category	Opportunities	Stated Policies Scenario			Sustainable Development Scenario		
		Short	Medium	Long	Short	Medium	Long
	Rising demand for electrical steel sheets with increasing Electric Vehicles (EVs) uptake						
	Development and/or expansion of low emission steel products						
	Transition towards clean energy and low carbon economy						
	Increased utilization of steel scrap						
	Reducing impacts of carbon pricing using ICP						

Opportunities Category: Market Opportunities; Resource Efficiency Opportunities; Resource Efficiency, Energy Source, Market and Product and Services Opportunities

The results of scenario analysis indicate that failure to comply with emerging climate-related policies and regulations particularly, carbon pricing and EU CBAM are most significant risks for JSW Steel. While these policy and regulatory risks are material under both business-as-usual and optimistic scenarios, their impact increases significantly under the optimistic scenario particularly, in the medium and long-term.

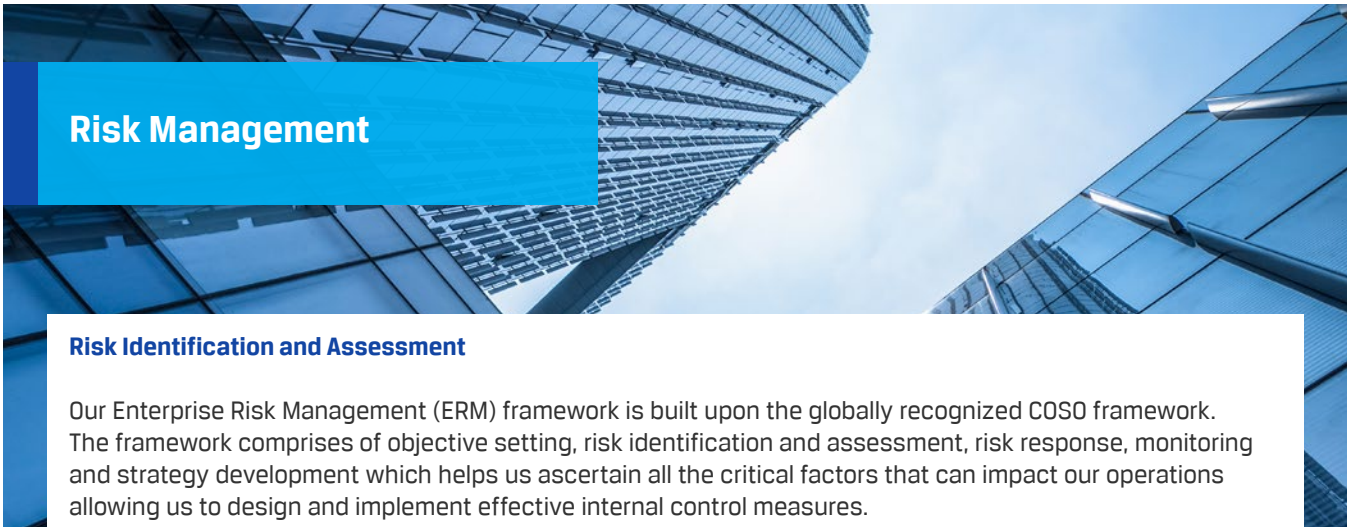
Key Outcomes and Proposed Mitigation:

1. We have developed a 2030 low carbon and sustainable development roadmap to accelerate transition towards green and climate resilient business. Through implementation of this roadmap, we will be working towards addressing a significant part of transition risks that are likely to be witnessed in this decade.

2. We have adopted a target of reducing GHG emission intensity to less than 1.95 tCO_2/tcs by 2030 for three ISPs, a target that is over and above the current decarbonization target of 2.2-2.4 tCO_2/tcs (in the BF-BOF route) adopted by the Ministry of Steel.

3. We have also adopted an Internal Carbon Price (ICP) to make our operations future ready for upcoming climate-related regulations. It will be used as a shadow price by the central CAPEX committee to assess ABPs evaluating financial viability of new CAPEX projects considering the cost of their carbon emissions. Thus, the adoption and use of internal carbon pricing in decision making will enable us to reduce the potential risks that may arise from shifts in climate policy, market and technology landscape, allowing us to gain a competitive edge in national and international markets.

4. In addition to emission reduction targets, we have also adopted company-wide sustainable development targets to reduce energy consumption, freshwater consumption, and air emissions, as well as increase waste recycling while ensuring no net loss in biodiversity around operations (refer to JSW Steel Integrated Report FY 22-23 Environment Section for more details on these targets). This will further help us in minimizing potential negative impacts of transition risks in the future.



Risk Management

Risk Identification and Assessment

Our Enterprise Risk Management (ERM) framework is built upon the globally recognized COSO framework. The framework comprises of objective setting, risk identification and assessment, risk response, monitoring and strategy development which helps us ascertain all the critical factors that can impact our operations allowing us to design and implement effective internal control measures.

The three objectives of the COSO framework considered for risk management include:

- **Operations:** Improving efficiency and effectiveness of business operations by ensuring that strong response strategies are in place to mitigate the risks
- **Reporting:** Ensuring transparency, timeliness, and consistency of financial and non-financial reporting
- **Compliance:** Ensuring compliance with all the relevant industry standards and regulations

Climate Change Risk Assessment Framework

As discussed above (under the strategy section), climate-related risks and opportunities are evaluated over short (till 2025), medium (2025-2035) and long term (2035-2050) time frames. These risks and opportunities are identified and assessed at following two levels:

- **Asset/plant level:** For identification and assessment of climate-related physical risks, location-specific climate profiles are developed for each asset to determine climate change impacts in every region of our operations. These risks are assessed based on two parameters:

1. **Probability of occurrence:** likelihood of occurrence of a given risk due to projected changes in climatic parameters at regional level
2. **Expected impact:** extent of impact that JSW Steel is likely to witness from an identified risk (function of our climate resilience at plant/facility level)

Based on probability of occurrence and expected impact levels, risks are plotted on 3X3 risk matrix to determine risk levels i.e., high, medium and low category risks. These risk levels are finalized by the Corporate Sustainability Team in discussion with the representatives from each asset/plant.

Corporate level: Climate-related transition risks and opportunities for our operations arising due to changes in climate policies, market landscape and operating environment are identified and assessed at the corporate level by the Corporate Sustainability Team. Similar to physical risks, transition risks are also classified into high, medium and low risks based on the level of impact that these risks might have on our operations.

Key risks identified and risk levels at both plant and corporate levels are discussed with the Corporate Risk Team as well as Corporate Finance Team for risk and impact finalization. Consequently, final risks and impact levels are presented to the Risk Management Committee of the board, on a biannual basis, for review.

Risk Management and Strategy Formulation

To inform the strategic outlook for sustainable and low carbon growth of JSW Steel, the key risks and opportunities identified are reviewed, monitored, and evaluated to develop risk mitigation strategies. Similar to risk identification, strategy formulation to address and manage identified climate-related risks and opportunities takes place at both corporate and asset/plant level.

1. **Corporate level strategy development:** Based on the types of risks identified, development of risk management strategies, implementation of low carbon initiatives as well as setting low carbon and sustainable development targets at corporate

level are carried out the by the CAG, the Corporate Sustainability Team and the Corporate Strategy Team.

2. **Strategy development for steel plants:** Aligned with the corporate level targets, integrated steel plants set their low carbon and sustainable development targets as part of their ABPs. Integrated steel plants also formulate their risk management strategies, business continuity plans and estimate funds required for implementation of planned strategies and targets as part of ABPs.

Risk mitigation plans developed at all levels as well as progress achieved with respect to low carbon and sustainable development targets are presented to the Executive Committee and the board for their review and approval. Our 2030 low carbon and sustainable development plan is an outcome of our risk management process.

Metrics and Targets

Monitoring resource consumption, GHG emissions, investments, and other associated climate-related metrics is central for understanding climate change performance of a company. To this end, we are continuously striving towards increased transparency of our climate-related data and enhancing our climate performance. We are also implementing innovative and sustainable measures across operations for reducing carbon footprint, energy consumption and ensuring resource optimization and circularity thereby, acting as responsible environmental stewards.

In 2020, we documented and unveiled seventeen sustainability focus areas, which guide our efforts across social, environmental, and ethically responsible business practices. We are consistently monitoring, and reporting key metrics associated with these focus areas (such as energy consumption, GHG emissions, water consumption, waste generated and recycled, air emissions and resource consumption, amongst others) to help monitor our performance.

Additionally, we have also set up 2030 low carbon and sustainable development roadmap which establishes company-wide sustainable development targets till 2030 and includes strategies, measures and investments required to achieve these targets and support our low carbon growth journey. Details on each of these parameters and targets are also provided in our annual Integrated Report.

Table: Scope 1 and 2 emissions for JSW Steel

Category	FY2018-19	FY2019-20	FY2020-21	FY2021-22	FY2022-23
(Scope 1+ Scope 2) ('000 tCO_2)	45,848.31	40,522.21	37,523.07	44,211.31	49,357.72
Specific GHG emissions (emission intensity) (tCO_2/tcs)	2.75	2.52	2.49	2.50	2.36

Greenhouse Gas Emissions

Scope 3 GHG Emissions

We track our Scope 3 emissions to gain a comprehensive understanding of the total GHG impact of our supply chain. This enables us to better manage our environmental impact and work towards reducing our overall carbon footprint. During FY 2022-23, we had a credit due to avoided emissions of about 4.71 million tCO2 in the categories of Use of sold products and Processing of sold products, as per the guidance of worldsteel.

1. Purchased goods and services
2. Upstream transportation and distribution
3. Waste generated in operation
4. Business travel
5. Employee commute
6. Downstream transportation and distribution

These categories contributed around 5.99 million tCO2 emissions. The Scope 3 emissions of all applicable categories were calculated in accordance with 'Technical Guidance for Calculating Scope 3 as Issued by GHG Protocol'.

Figure: GHG emissions trend for JSW Steel

In FY2022-23, total GHG emissions (scope 1 and scope 2) were estimated to be 49,357.72 thousand tCO_2 with emission intensity of 2.36 tCO_2/tcs. Absolute emissions increased by 11.6% while emission intensity decreased by 5.6% as compared to the previous year.

TCFD Index

TCFD Recommended Disclosures

Governance

a) Describe the board's oversight of climate-related risks and opportunities	p.54-56 (Governance at JSW), Climate Action Report
b) Describe management's role in assessing and managing climate-related risks and opportunities	p.54-56 (Governance at JSW), Climate Action Report

Strategy

a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term	p.57-63 (Strategy), Climate Action Report
b) Describe the impact of climate-related risks and opportunities on the organization's business, strategy, and financial planning	p.57-63 (Strategy), Climate Action Report
c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario	p.57-63 (Strategy), Climate Action Report

Risk Management

a) Describe the organization's processes for identifying and assessing climate-related risks	p.64-65 (Risk Management), Climate Action Report
b) Describe the organization's processes for managing climate-related risks	p.64-65 (Risk Management), Climate Action Report
c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management	p.64-65 (Risk Management), Climate Action Report

Metrics and Targets

a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process	p.66 (Metrics and Targets), Climate Action Report
b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.	p.66 (Metrics and Targets), Climate Action Report
c) Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets	p.37 (Our Decarbonisation Commitments), Climate Action Report

Acronyms

ABPs	Annual Business Plans
BAT	Best Available Technology
BF	Blast Furnace
BF-BOF	Blast Furnace - Basic Oxygen Furnace
BOF	Basic Oxygen Furnance
BRSR	Business Responsibility & Sustainability Report
CAG	Climate Action Group
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CBAM	Carbon Border Adjustment Mechanism
CCUS	Carbon Capture, Usage, Storage
CDP	Climate Disclosure Project
CDQ	Coke Dry Quenching
CEEW	Council on Environment, Energy & Water
CEEW-CEF	CEEW Centre for Energy Financing
CFO	Chief Financial Officer
CII	Confederation of Indian Industries
CO	Carbon Monoxide
CO2	Carbon dioxide
COO	Chief Operation Officer
COP26	Conference of the Parties - 26
COREX	A Smelting Reduction Process
COSO	Committee of Sponsoring Organizations of the Tread way Commission
CR	Cold Rolled
CRCA	Cold Rolled Close Annealed
CSO	Chief Sustainability Officer
CSR	Corporate Social Responsibility
DJSI	Dow Jones Sustainability Index
DRI	Directly Reduced Iron
EAF	Electric Arc Furnace
EOF	Energy Optimizing Process
ERM	Enterprise Risk Management
ESG	Environment Social Governanace
EU	European Union
EV	Electric Vehicle
Fe	Ferrous (Iron)
FY	Fiscal Year
GBFS	Granulated Blast Furnace Slag
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GI	Galvanised
GL	Galvalume
GRI	Global Reporting Initiative
GW	Gigawatts
H2	Hydrogen Gas
H2O	Water
HP	High Pressure
HR	Hot Rolled
HSM	Hot Strip Mill
ICP	Internal Carbon Pricing
IEA	International Energy Agency
IH2A	India Hydrogen Alliance
IIRC	International Integrated Reporting Council
IPCC	Intergovernmental Panel on Climate Change
IR	Integrated Reporting
ISP	Integrated Steel Plants
JMD	Joint Managing Director
KPI	Key Performance Indicator
LCA	Life Cycle Analysis
LP	Low Pressure
MT	Million Tonnes
MTPA	Million Tonnes Per Annum
MW	Megawatts
NGRBC	National Guidelines on Responsible Business Conduct
NSP	National Steel Policy
R&D	Research & Development
RCP	Representative Concentration Pathway
RPO	Renewable Purchase Obligation
S&P	Standard & Poor's
SDS	Sustainable Development Scenario
STEPS	Stated Policies Scenario
TCFD	Task Force on Financial-related Disclosure
TMT	Thermo-Mechanical Treated
TPD	Tonnes Per Day
TRT	Top Pressure Recovery Turbine
WEO	World Energy Outlook

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