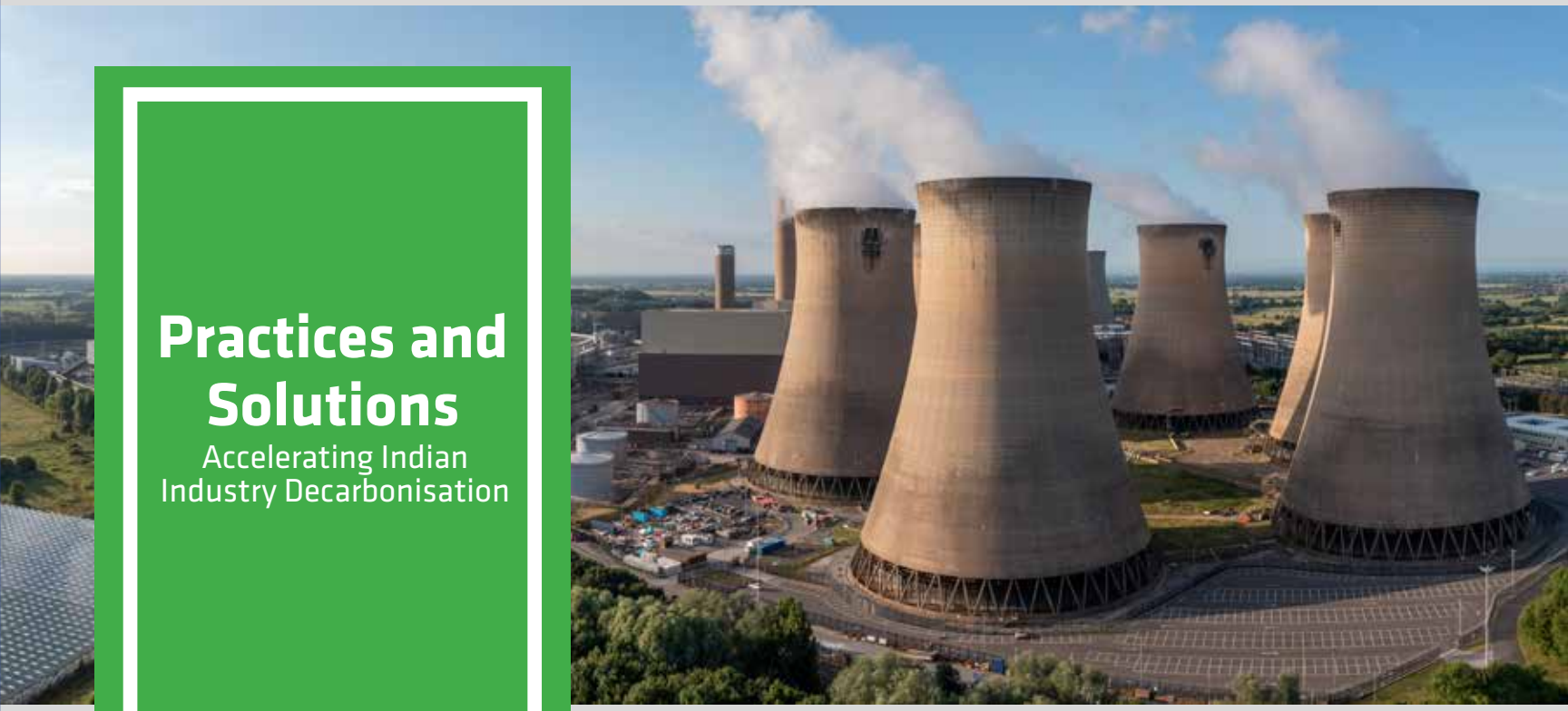
THE ENERGY AND RESOURCES INSTITUTE

Creating Innovative Solutions for a Sustainable Future

Industry Charter for Near ZERO Emission by 2050

Practices and Solutions

Accelerating Indian Industry Decarbonisation



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Practices and Solutions Accelerating

Indian Industry Decarbonisation

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SAP SE
Schneider Electric India Private Limited
Shree Cement Limited
Steel Authority of India Limited
Sterlite Power Transmission Limited
Tata Chemicals Limited
Tata Steel Limited
UltraTech Cement Limited

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ABOUT INDUSTRY CHARTER FOR NEAR ZERO EMISSIONS BY 2050

TERI's 'Industry Charter for Near Zero Emissions by 2050', instituted in 2020, is a coalition of like-minded industries bound in their pledges to reduce emissions, and united in their belief in the role of industries in achieving the Paris Agreement goals.

The coalition shares best practices, facilitates outreach and communicates technology and business models on industrial decarbonisation among charter signatories and other key stakeholders like the government and financial institutions.

KEY MESSAGES

Businesses, as non-state actors, are increasingly committing to climate targets and actions. The industrial sector contributes ~ 30% of the total greenhouse gas (GHG) emissions, and their role in decarbonising economies forms an important pillar of countries' action on climate change.

Collaborations and partnerships via United Nations-led 'Race to Zero', the Breakthrough Agenda, and other sectoral-based initiatives could significantly help rally non-state actors to work on climate action. Industry Charter for Near Zero Emissions by 2050, of which TERI serves as a secretariat, aims to highlight the intention, direction, and the action of the industry, especially the hard-to-abate sectors, on climate change.

The Indian industry values the proposition of mitigating the climate crisis and is working collectively towards this goal

Businesses in India are increasingly coming forward as partners and collaborators, capable of mitigating the climate crisis induced as a consequence of anthropogenic activities. As part of responding to the climate crisis, businesses, as future-oriented entities, are leveraging the opportunities such that climate change mitigation can lead to decarbonisation.

Hence, for the industry, decarbonisation is not merely a climate crisis mitigation tool but an effective development agenda to propel India's growth in the coming decades.

Industry-led climate directions in this 'critical decade' can help India on the pathway of becoming net zero by 2070

As partners in the growth story of India, including the country's efforts towards leading a sustainable lifestyle, directions devised by the industries and businesses in both short and medium terms will play a crucial role in strengthening India's ability to become net zero by 2070.

By projecting a pathway towards sustainability momentum in this 'critical decade', businesses can help fulfil future goals on climate change by initiating steps on decarbonisation via adoption of renewable energy, low-carbon solutions, and energy-efficient technologies.

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Sustainability momentum across profits, people, and planet has ignited confidence in the capital markets

Climate change-induced effects at the micro (operational) level of a company do get reflected at the macro level with climate change being recognised as a potential risk by the company board members.

Incorporation of climate-related risks into public company disclosures sends a strong signal to the capital markets and other institutional financial sectors about the companies' recognition and their need to combat climate change.

Building upon intentions and directions, industries are actively working to decarbonise industrial emissions

Businesses are translating their climate intentions and directions into concrete actions by undertaking decarbonisation efforts including measures to reduce emissions from energy use, promote circular economy practices and R&D ecosystem.

Conducive policy environment and collaboration are critical enablers to accelerate the availability and scalability of decarbonisation technologies

For the Indian industry to lead the decarbonisation drive, conducive policy prescriptions are essential as they aid the innovation and R&D ecosystem in the country. Likewise, forging cross-sectoral partnerships play a key role in deploying decarbonisation techniques at large and help domestic industries remain internationally competitive.

Steady market demand for low-carbon and greener products will help sustain decarbonisation

Moving beyond policy-driven supply mechanisms of greener industrial products, there is a need to simultaneously enhance the incorporation and usage of low-carbon products into sectors such as construction and other infrastructural sectors, for instance, roads. Sustained demand outlook for greener products will provide stability to the growth plans of companies.

Not only in India but globally as well, the heavy industry is playing a crucial role in lending help to combat climate change. Certain restrictions and challenges are, however, preventing companies from scaling and replicating their decarbonisation efforts. Some of the shared challenges faced by companies include lack of financial support and enabling policy and regulatory drivers, resource constraints, and low penetration of decarbonisation technology.

DECODING DECARBONISATION

Gauging drivers, enablers, and strategy of decarbonisation at the company level

Representatives of the Indian heavy industry are increasingly forthcoming with their decarbonisation targets and commitments. Combatting climate change will require all stakeholders to come on-board, especially the industrial sector that contributes ~ 30% to the total GHG emissions, and take necessary measures to avert a 'climate emergency'.

Understanding companies' climate action determinants can help amplify and accelerate industrial climate action.

Leadership of industrial executives is moving the needle on decarbonisation of companies and industries

Cognisant of the future development requirements, and the risks posed by climate change to the sustainability of companies, and the Indian economy at large, many industry leaders are coming forth to set ambitious decarbonisation targets.

Given the large infrastructural requirements of India, it has to be ensured that additional capacity generation need is both clean and green. Both adaption and mitigation of climate change assume significance for the agri-food sector where even a minute impact on crop productivity could have far-reaching consequences on food production, this could subsequently affect the people's health.

Policy push for manufacturing green products is critical to industrial decarbonisation

Stable and constant policy support and incentives ensure that manufacturing 'green' products remains sustainable. Such a support system provides clarity to the industrial makers.

Industrial players are aligning their decarbonisation targets with National Strategic Plans

Iron and steel industry leaders are increasingly aligning (or even pledging further carbon emissions' reductions) with the Ministry of Steel's Steel Policy 2017 that has set targets of reducing GHG emissions in the iron and steel sector by 2030.

Global (sectoral) partnerships-driven agenda are aiding decarbonisation efforts through knowledge sharing and technology exchanges

A critical factor binding companies together to transform their industries is the creation of industry associations. For instance, the Global Cement and Concrete Association (GCCA) developed a '2050 Net Zero Roadmap' and set out a vision for the signatory and non-signatory companies to drastically reduce their GHG emissions by 2030, and produce net zero concrete by 2050.

Other factors that leading companies need to adopt in order to fulfil net zero (and decarbonisation) commitments include technological advancements in the field of CCUS. Increasingly, customer demand and awareness for sustainable products, and climate risks-driven new businesses opportunities are pushing the industry players to adopt to sustainable pathways.

BUSINESSES AND THEIR DECARBONISATION COMMITMENTS

JSW Cement Limited

Reduce Scope 1 and 2 GHG emissions intensity by 15% by FY 2026

Yara Fertilisers India Limited

Reduce Scope 1 and 2 Absolute Emissions by 30%

Tata Motors Limited

Committed to RE 100

JSW Steel Limited

Reduce CO_2 emissions intensity to 1.95 tonne/ tonne of crude steel

Danfoss Industries Private Limited

Become Carbon Neutral

Tata Chemicals Limited

Committed to reduce carbon emissions by 30%

Henkel Adhesives Limited

Climate Positive Operations

Emerson Electric Company

Reach net zero across own operations for Scope 1 and 2 Emissions

Reduce Scope 3 Emissions by 25% with baseline of 2021

Steel Authority of India Limited

Reduce CO_2 emissions intensity to 2.30 tonne/ tonne of crude steel (t/tcs)

Vedanta Limited

Reduce 25% absolute emissions reduction on baseline of FY 2020/21

Shree Cement Limited

Reduce Scope 2 GHG emissions by 27.1% per tonne of cementitious materials from base year 2019

SAP SE

Committed to achieve net zero along the value chain in line with 1.5C

Siemens

Own production facilities and buildings worldwide to achieve net zero carbon footprint

FL Smidth Private Limited

Become carbon neutral in own operations by 2030

Schneider Electric Limited

For own operations become net zero emissions

UltraTech Cement Limited

To reduce Scope 1 GHG intensity by 27% by 2032 from the base year of 2017

To reduce Scope 2 GHG intensity by 69% by 2032 from the base year of 2017

Mahindra and Mahindra Limited

Reduce Scope 1 and 2 GHG Emissions by 47% on every equivalent product unit

Reduce Scope 3 GHG Emissions by 30% per sold product unit

Businesses and their Decarbonisation Commitments

2035

Jindal Steel and Power Limited
Reduce carbon emissions to >2.0 t/tcs

2038

Oil and Natural Gas Corporation
Achieve net zero across Scope 1 and Scope 2 emissions

2040

Greenko
Become net zero

Dalmia (Bharat) Cement Limited
Become carbon neutral

Schneider Electric Limited
Achieve carbon neutrality in end-to-end supply chain (including Scope 3 emissions)

GAIL (India) Limited
Achieve 100% reduction of Scope 1 and 2 GHG emissions

Achieve 35% reduction of Scope 3 GHG emissions

2045

Tata Consulting Engineers Limited
Net Zero

Tata Motors Limited
Net zero greenhouse gas emissions

Tata Steel Limited
Net neutral in carbon emissions

2050

Yara Fertilisers India Limited
Become climate neutral

BASF India Limited
Achieve net zero CO_2 emissions

Vedanta Limited
Achieve net zero emissions

Toyota Kirloskar
Reduce 90% global average CO_2 emissions from 2010 baseline

Completely eliminate all CO_2 emissions from entire vehicle life cycle and achieve zero CO_2 worldwide

Shell Group of Companies
Become net zero emissions energy business

BP
Become net zero

Schneider Electric Limited
Achieve net zero emissions

JSW Cement Limited
Committed to net zero emissions

Cement Industry

With growing urbanisation, the need for cement use in the Indian economy will also increase. As per an analysis carried out by CRISIL (2021), the Indian cement industry is expected to add ~ 80 million tonnes of capacity through 2024. The rise in the demand outlook for the cement industry is backed by a rise in infrastructural investments, with the government focusing on development of roads and construction of low-income homes.

Though the carbon emissions' intensity of the Indian cement industry is lower than the global average, large increases in capacity addition mean that the industry will need to decarbonise its operations to reduce future emissions.

Some of the levers identified by the cement and concrete industry for decarbonisation are outlined here:

Fuel switch by enhancing the share of alternative fuels such as hazardous industrial waste and biomass.	Incorporating circular economy practices by focusing on waste minimisation through use of fly ash and steel slag in the clinkerisation process.	Investments in low-carbon technology	Energy efficiency

UltraTech Cement Limited

Identified Strategy and Enablers

- UltraTech Cement contributes to climate actions by integrating low-carbon strategy and scaling up investments in the development of innovative products and services, improving energy efficiency, increasing the share of renewable energy and by switching from fossil fuels to alternative materials.

Shree Cement Limited

Identified Strategy and Enablers

Shree Cement has committed to become carbon neutral by 2050.

- As part of its carbon-neutral strategy, Shree Cement has initiated actions to reduce emissions by using efficient technology, renewable energy, installing waste heat recovery (WHR) systems, and mitigating residual carbon using carbon capture and storage (CCS) technology.
- Alternative raw materials comprised 26.84% of the total raw material consumption at Shree Cement for FY 2020/21.
- Alternative fuel made up 6.03% of the total 2.66 MT of the fuels consumed in FY 2020/21. The company will continue to enhance the use of alternative fuels within their kilns, and introduce an effective feeding system for utilising alternative hazardous fuel and biomass.

JSW Cement Limited

Identified Strategy and Enablers

JSW Cement's CO_2 emission intensity for FY 2020/21 was 216 kg/tonne compared to the global average of 608 kg/tonne. JSW Cement is committed to net zero by 2050.

- The company has set various goals for decarbonisation of its processes including reaching RE100 by 2050, increasing thermal substitution rate by 30% by 2030 and transitioning to EV for committed vehicles under EV 100.
- Additionally, the company will utilise waste derived resources to create a circular economy pathway.

Dalmia (Bharat) Cement Limited

Identified Strategy and Enablers

Dalmia (Bharat) Cement is committed to be a carbon-negative company by 2040.

- Some of the levers the company is working on and has made a noticeable progress include reduction of water consumption, improvements in energy productivity, blended cement production, use of low-carbon transport such as electric vehicles and use of alternative fuels.
- The company has identified 40 megawatt (MW) green power generation through waste heat recovery from the exit gases in their plants.
- Enhance the use of sustainable biomass and alternative fuel to replace 100% fossil fuels by 2035.

Heidelberg Cement India Limited

Identified Strategy and Enablers

Increase thermal substitution rate (TSR)

- Increase the percentage of TSR in Narsingarh plant (Madhya Pradesh) by installing the AF feeding system in various phases
- Increase the percentage of TSR in Yerranguntla (Andhra Pradesh) and Sitapuram (Telangana) plants by upgrading the existing facility.

Increase renewable energy

- Increase future renewable footprint by generating 10 MW of electric power in a phased manner.
- Planned share of renewables: 5 MW in Narsingarh; 2 MW in Imlai (Madhya Pradesh); and 1 MW in Sitapuram (Telangana) by 2024

Enhance the share of alternative fuel to 19.7%, including biomass of 8.2% by 2030.

- Feeding facilities at Narsingarh (Madhya Pradesh) for line 2 and 3 kilns to achieve 15% substitution rate in three phases.
- Adopt applicable technology for alternative fuels and raw materials (AFR) feeding/ transport facilities at Sitapuram (Telangana) to reach 21% substitution rate.
- Upgrade AFR feeding facilities and pre-processing to reach 24% substitution rate at Yerraguntla (Andhra Pradesh).

Steel Industry

In India, ~60% of steel is utilised in the infrastructural and the construction sectors , with the rest of the output forming a crucial input to the capital goods industry. With infrastructure in India continuing to witness high-growth rates, the steel output will have to keep pace with the rising demand. As part of Steel Vision 2047, the Ministry of Steel has set a target to produce 300 million/tonnes steel per annum.

With climate change casting shadow on the development of countries, decarbonisation of the economy is extremely crucial to sustain the growth trajectory of countries, especially developing countries like India. To avert climate change, it is important to decarbonise the steel sector, hard-to-abate sector, which contributes ~7% to the total GHG emissions in India.

Against this backdrop, the set of levers identified by the industries for decarbonisation are:

Adoption of best available techniques (BATs) such as coke dry quenching for waste heat recovery.	Improving energy efficiency	Enhancing the share of renewable energy	Incorporating circular economy practices by maximising scrap usage	Future adoption of carbon capture, utilisation, and storage (CCUS) techniques and production of green hydrogen

Steel Authority of India Limited

Identified Strategy and Enablers

Phase I: The decarbonisation process at SAIL took momentum during its Modernisation and Expansion (MODEX) programme in 2008 wherein a number of energy saving clean technologies were introduced across all its plants that led to significant (>19%) reduction carbon footprint.

Phase II: SAIL intends to curtail carbon emissions by implementing energy-efficient techniques, enhance energy efficiency of the existing units by retrofitting/revamping, phasing out hard-to-abate old energy-intensive units, improving raw material quality in use along with study of development and acclimatisation of break through iron making and carbon capture facilities.

- SAIL has set target of 2.30 tonne/tonne of crude steel t/tcs for specific CO_2 emission by 2030 in-line with the Nationally Determined Contribution NDC target of the Ministry of Steel

Phase III: In Deep Decarbonisation Phase 3, that is, beyond 2030, SAIL will undertake decarbonisation through gradual shift to alternate steel making, adoption, and propagation of hydrogen steel making, availing full renewable energy generation, produce advanced high strength steel via implementation of CCUS.

- SAIL is committed to meet the net zero target by 2070 as per the country's enhanced ambition announced at COP26.

JSW Steel Limited

Identified Strategy and Enablers

Phase I represents a short-term horizon (2020–30) and will act as the foundation for further decarbonisation initiatives, and includes strategies such as improving energy and process efficiency through BATs, undertaking energy transition by eliminating fossil fuel-based thermal power by 2030, use of alternative fuel sources such as natural gas injection in blast furnaces BFs, improved quality of raw material and increased usage of scrap.

Phase II is a medium to long-term horizon (2030–50) where a more focused transition towards net zero takes place and deep decarbonisation is achieved. In this phase, JSW Steel will primarily focus on two technological pathways—CCUS and green hydrogen in steel manufacturing. JSW Steel has already begun pilot projects at selected sites for the implementation of these technologies.

Challenges for setting net zero target

India is the second-largest producer of steel in the world and the steel production capacity is expected to triple, reaching 300 MT by 2030. To cater to the demands of a developing nation, India needs to expand its steel production and this expansion is expected to happen through the blast furnace – basic oxygen furnace (BF–BPF) route predominantly. Hence, emissions are going to rise significantly.

Moreover, less emission-intensive scrap-based route is not feasible in India due to unavailability of scrap.

Adding to this, most of the deep decarbonisation technologies are not yet commercially feasible. The Indian steel companies are aware of the challenges for decarbonisation but still have taken the challenge to decarbonise by adopting many measures. JSW is well aligned to India's target of net zero by 2070.

Oil and Gas Industry

Some of the identified levers of the oil and gas industry in India include the following.

- **Energy efficiency**
- **Energy conservation through reduction in natural gas flaring**
- **Internal carbon pricing mechanisms**
- **Carbon capture, utilisation, and sequestration (CCUS) technologies**

GAIL (India) Limited

Identified Strategy and Enablers

- GAIL (India) Limited has the total installed renewable energy capacity of 130.26 MW, out of which 118 MW is wind power and 12.26 MW is solar power.
- All the major installations of GAIL (India) Limited are ISO 50001 certified for energy management system.

Oil and Natural Gas Corporation Limited

Identified Strategy and Enablers

- ONGC's goals of attaining a sustainable future primarily rest on the pillars of enhancing the share of renewable energy and increasing invest in technologies that can sequester carbon through enhanced oil recovery.
- The ONGC Energy Strategy 2040 envisions 10 gigawatt (GW) + of offshore wind power generation for mitigating energy transition risks.

Power Industry

Some of the levers identified by the power industry include:

- **Energy efficiency**
- **Promoting resource efficiency via waste minimisation**

Avaada Energy

Identified Strategy and Enablers

- In the short-term, majority of the multi-national companies (MNCs) and other organisations access green energy and become a partner in their journey of green energy.
- Become a successful member of energy storage, battery manufacturing, and green hydrogen groups in India and worldwide in the medium term.
- The long-term strategy is to level up R&D for longer maintenance of solar plants and innovate new technologies to create efficiency in the implementation of the projects.

Sterlite Power Transmission Limited

Identified Strategy and Enablers

- Sterlite Power has identified energy management as an effective enabler for energy conservation and emissions management.
- Concerning waste management, Sterlite Power's endeavour is to apply the '3R waste management approach' wherever possible– Reduce, Reuse and Recycle. They manage waste by tracking waste-related data, including waste generation and disposal.
  - » Across their manufacturing plant sites, there is 100% fly ash utilisation from the thermal generation unit.

PRACTICES AND SOLUTIONS

Energy Efficiency

Energy efficiency offers a way to decouple rising energy demand and related carbon emissions from improving energy access and pursuing economic growth

Effective demand-side management of energy via promotion of energy-efficient appliances can lead to effective energy conservation. Additionally, electrification of certain industrial processes can also reduce the total energy demand, resulting in mitigation of carbon emissions and monetary savings.

Government initiatives can play a key role in adoption of energy-efficient technologies

The installation of LED bulbs spearheaded via the public scheme of UJALA Programme is a successful case study where government intervention enabled adoption of an energy-efficient appliance, resulting in mitigating carbon emissions, and (potential) monetary savings.

For Indian industry, the Performance, Achieve, and Trade (PAT) scheme is currently the key policy to drive efficiency gains. It has been extended to the sixth cycle, increasing coverage of industrial energy use. The expansion of PAT to less energy-intensive sectors paves the way for obtaining the largest energy saving potential. PAT VI cycle has projected the total energy savings of about 26 million tonnes of oil equivalent (MTOE), translating into avoidance of 70 million tonnes of CO_2 by March 2023.

Jindal Stainless Steel

Pilot Project for Oxygen Enrichment in Reheating Furnaces | Hisar, Haryana | **Practice**

Description

LSHS (low sulphur heavy stock) or LDO (low drop-out regulator) is used as fuel in heat treatment furnaces. An initiative to switch over from liquid fuel to gaseous fuel was undertaken to improve furnace efficiency and reduce CO_2 emission. Further, a trial was carried out to use oxygen enrichment in heat treatment furnace to reduce combustion air requirement, leading to minimising flue gas losses. The estimated reduction in gaseous fuel consumption is about 3%.

Jindal Stainless Steel invested a sum of INR1.5 crore for the pilot project and accrued the following benefits:

320 tonnes / annum reduction in fuel consumption	**889** tonnes of CO_2 emission reductions	**INR 2.29** crore of annual monetary savings

Schneider Electric India Private Limited

How EcoStruxure for Metals Enables Sustainable Electrical Network Modernisation | Arcelor Mittal, Belval, Luxembourg | **Solution**

Description

Arcelor Mittal wanted to modernise its ageing electrical installation in a sustainable way to increase safety and maintain high production levels. Arcelor Mittal was therefore looking for solutions to reduce downtime risks, improve safety, and enable energy monitoring. It also searched for a company capable of modernising its medium voltage (MV) power network in line with the steel manufacturer's sustainability commitments. The project included retrofitting unused but outdated MV switchgear and disposal of old parts in compliance with environmental regulations.

As part of the EcoStruxure services provided by Schneider Electric, Arcelor Mittal was able to successfully:

Save estimated **15%–20%** cost on the new installations	Reduce **187** CO_{2e} emissions	Reduce **5%–10%** estimated downtime reduction	Save **28** tonnes of material

Heidelberg Cement Group

Cement Production with Climate – Neutral Fuel Mix | United Kingdom | **Solution**

Description

In September 2021, a cement kiln at the British Ribblesdale plant of HeidelbergCement's subsidiary Hanson UK was successfully operated on a net zero fuel mix as part of a world's first demonstration.

In the project led by the UK Mineral Products Association (MPA) and with support from the UK's Department for Business, Energy and Industrial Strategy (BEIS), Hanson UK has thus for the first time successfully used a mix of 100% climate-neutral fuels, including hydrogen, for commercial-scale cement production.

In the trial, the proportion of fuels in the cement kiln's main burner was gradually increased to a wholly net zero mix made up of tanker-delivered hydrogen as well as biomass components (meat and bone meal) and glycerine, generated as by-products of other industries.

If fully implemented for the whole kiln system, nearly **180,000 tonnes** of CO_2 could be avoided each year at Ribblesdale alone in contrast to using fossil fuels, such as coal.

Steel Authority of India Limited

Technology Landscaping Vision 2030 – Higher Efficiency and Lower Carbon Footprint | **Solution**

Description

As part of Technology Landscaping Vision 2030, SAIL has initiated several energy-efficient projects such as:

- Coke dry cooling plants of 1 million tonnes per annum (MTPA) capacity
- High-volume blast furnaces with top pressure recovery turbines (TRT) of 5580 m3 , with waste heat recovery (WHR) from stoves and torpedo ladles for hot metal transport
- Basic oxygen furnace (BOF) gas recovery converters
- Alternative routes of iron making like Midrex/Finex as a long-term measure as scrap balance for BOF/ EAF
- Introduction of thin slab casting and direct rolling

As part of the Technology Landscaping Vision 2030, SAIL's initiatives can potentially reduce **33,000 tonnes** of CO_2 (reduction potential is indicative on production of 20 MT of crude steel)

Schneider Electric India Private Limited

Digital Transformation in the Cement Industry with EcoStruxure | Gansu Qilianshan Cement Group Limited, Zhangxian, China | **Solution**

Description

The challenge faced by Qilianshan and the rest of the cement industry in China was how to produce better quality cement products more efficiently, using less energy and at a lower cost. To realise their smart manufacturing ambitions, Qilianshan enlisted Schneider Electric to implement a comprehensive EcoStruxure upgrade of their technology that would optimise their energy usage, beginning with pilot projects at two plants–Zhangxian and Hongda Building Material.

Reduce energy consumption, save costs, optimise production, and generally improving core competitiveness through digital means.

The solutions provided by Schneider included energy management system (EMS), AVEVA's Advanced Process Control (APC), Altivar Process drives, low voltage (LV) products

The services provided by Schneider resulted in:

Standard coal consumption reduced to less than **100 kg /tonne** at Hongda plant	Improved production stability and efficiency	Reduced labour requirements	Almost **€600,000** in electricity costs saved in 2019 at Hongda Building Material

GAIL (India) Limited

Flue Gas Recovery Unit at GAIL | Vijaipur, Madhya Pradesh | **Practice**

Description

This technology recovers gas flared through dry gas seals of various compressor units in C2-C3 recovery plant at GAIL Vijaipur. The recovered natural gas is being used for low-pressure fuel demand in Utility Boiler and heat recovery steam generation (HRSGs) in the plant.

GAIL invested a sum of INR8.1 crore for the flue gas recovery unit and realised the following benefits:

320 of natural gas recovered/ month	**11,100** tonnes of CO_2 savings/ annum	**INR 12** crore of annual monetary savings on fuel cost

Other Company Initiatives: Energy Efficiency

Shree Cement Limited

- Shree Cement's power generation capacity from waste heat recovery-based power plants is the highest in the world, excluding the cement industry of China.
- The share of green power in their total power consumption is **48.2%**, one of the highest in the cement industry. They have been continuously investing in expanding their green energy portfolio and plan to install 33 megawatt (MW) waste heat recovery system (WHRS) Plant at their Nawalgarh plant and solar power plants with **106 MW** capacity at various locations.
- The company aspires to enhance usage of alternative fuels (AF) progressively, as it would increase the usage of alternative fuels and raw materials (AFR) in cement kilns, and simultaneously also leads to lower environmental impact by reduction in consumption of fossil fuels and supporting the Swachh Bharat Mission.

Sterlite Power Transmission Limited

- The Jharsuguda (Odisha) plant uniquely sources molten metal and avoids burning **2.2** million litres of furnace oil per year, reducing energy consumption and the associated environmental impact.
- Sterlite Power's Eco Max low-loss conductor has the potential to minimise **I2R** losses in the transmission line by up to 30% when compared to a conductor of the same size. This product is eco-friendly and contributes to the reduction of carbon emissions.
- Pyramid Vision Transformers (PVTs) directly tap power from additional high-voltage transmission lines and power telecom antennas on transmission tower, thus contributing to the environmental carbon footprint reduction.

Vedanta Limited

- Implementation of **160** energy-efficient projects across all business units has resulted in **3.8** million gigajoules (GJ) of energy savings.

Renewable Energy

Renewables present an opportunity to break historical patterns of energy generation in lieu of newer and cleaner energy

Enabling energy transitions is the key to reducing future GHG emissions, and is crucial for averting the climate crisis. Over the past decade, mass-scale deployment of renewable energy has accelerated structural changes in electricity systems, consequently bringing down electricity generation costs.

Development requirements mean that India will account for the largest global upcoming energy demand to be met with enhanced energy supply and capacity

As a developing economy, India will continue to witness an increase in energy demand, with the International Energy Agency's (IEA) World Energy Outlook 20222 report stating that the energy demand in the country will rise by 3% annually and with India accounting for the largest energy demand in the world. Against this backdrop being aided due to rising urbanisation and industrialisation, renewables are playing a key role in meeting the energy demand of the country.

Leveraging the renewables boom will entail investments and innovation along the power value chain

Given the lack of carbon space worldwide, renewable energy presents a huge opportunity to the Indian industry to decarbonise and clean its energy system and reduce negative externalities such as air pollution. Recognising the opportunity presented by the renewables sector, India as part of its updated Nationally Determined Contributions (NDCs) has committed to achieve 500 GW of installed electric power from renewables by 2030.

According to the World Energy Outlook Report 2022, nearly 60% of new power demand will be met by the renewable sector. To match the abundant opportunities available in the renewable electricity supply, improvements in energy storage systems are necessary to continue to attract industrial adoption of intermittent renewables.

Jain Irrigation Systems Limited

Solar Powered Pumping | **Practice**

Description

Jain Irrigation Systems Limited (JISL) has pioneered the development of complete DC (direct current) solar agriculture pump systems in India. Indeed, it is one of the few manufacturers of such pumping systems across the world.

Matching components such as solar panels, controllers, pumps, screen pipes, casing pipes, filters are all designed and manufactured in-house by JISL, this would help ensure superlative performance and durability of the pumps.

The company has developed solar pumps for different capacities, with the most popular model–5 high pressure (hp)–being used by farmers to irrigate their agricultural fields. Additionally, the company has also developed brushless direct current (BLDC) motors that are highly efficient as they work in diffuse radiation (i.e., capable of providing 365 days of service) and can last for 10 hours.

Over last few years, JISL has installed more than 11,000 solar agri pumps which are connected with an online monitoring system. These pump sets have been commissioned across six Indian states.

JISL's solar pump installations have reduced **49,604** tonnes of CO_2 emissions

Other Company Initiatives: Renewable Energy

JSW Steel Limited

- At present, 45%–50% of electricity generated is accrued through waste gases and the heat generated from operations is an environmentally friendly and cost-efficient source. This means that remaining power is being generated using coal.
- Keeping this in mind, JSW Steel has planned to increase the procurement of renewable power by 2030. The organisation aims to reduce consumption of coal-based power to zero by 2030 by transitioning to renewable energy. This will translate to about 40%–45% of power mix being sourced through renewable energy, and the balance through other technologies and non-conventional fuel.

Sterlite Power Transmission Limited

- Solar photovoltaic (PV) system of 250 kilowatt (kW) capacity has been installed at Silvassa Plant to cater to the lighting load of the plant, and generates 25,000 units per month.
- Rakholi (Dadra and Nagar Haveli) manufacturing facility has 250 kW renewable installed capacity which is 100% utilised.

GAIL (India) Limited

- GAIL (India) Limited has a total installed renewable energy capacity of 130.26 MW, of which118 MW is wind power and 12.26 MW is solar power.

Dalmia Cement (Bharat) Limited

- As part of Dalmia Cement's commitment to the RE100 campaign, the company in its units of Ginigera (Raichur, Karnataka) and Arrakonam (Tamil Nadu) had installed wind and solar energy systems that cumulatively led to a reduction of ~ 54,000 tonnes of CO_2.

Oil and Natural Gas Corporation Limited (ONGC)

- ONGC has a total installed renewable energy capacity of 184 MW, of which 153 MW is wind power, and 31 MW is solar power.
- As part of the ONGC Energy Strategy 2040, the organisation envisions 10 GW of renewable energy, plus offshore wind power generation for mitigating energy transition risks. The company is aspiring to produce 1.5 times its SCOPE 2 energy demands through renewables in the near term.
- The organisation plans to add 5 MW of solar power capacity in FY 2022/23 and is further identifying locations to install around 100 MW solar power plant in the near term.

Emerging Actions

At Indian Hotels Company Limited, we take pride in promoting renewable energy. We are pleased to enter into a long-term partnership with Avaada Energy for the purchase of solar energy and are happy with the cost-effective, timely, and quality services. We wish you all the best for a shining future.

Balakrishna T
Director of Engineering
Indian Hotels Company Limited

We are happy to be associated with Avaada Energy, as a part of reducing the carbon footprint of our Tech Parks that is also a part of our corporate social responsibility (CSR) initiative as well. We are satisfied with the services provided by Avaada Energy, we appreciate their transparency and efficiency in their dealings with us. We cherish our association with the company and continue to do the same in the future, we wish them all the best in their contribution to the Mother Earth.

Salim Jahangeer Kirmani
CEO
IBC Knowledge Park Private Limited or India Builders Group

We, at Brigade, believe in creating commercial spaces which are sustainable, ones that have a smaller carbon footprint, this is our way of giving back to nature. Avaada Energy has helped us in this achieving this by wheeling solar power into our buildings. We are satisfied with their dedicated and experienced team and look forward to working together again!

Manu R
Head Facilities
Brigade Enterprises Limited

Courtesy: Avaada Energy

Emerging Practice: Renewable Assets Management

Given the intermittent nature of renewable power, managing asset operations is a significant opportunity to maximise and generate reliable renewables output.

Technology can support maximising return on renewable energy assets through data monitoring and generation, and helping build reliable and predictive models based on a set of key performance indicators (KPIs). Companies can leverage technology for better asset management and maximising output in the following ways:

1. Standardise master data of assets
2. Automate asset operational and condition monitoring data acquisition from operational technology (OT) Systems such as SCADA (Supervisory Data and Acquisition Control) through Internet of things (IoT) connectivity.
3. Automate solar performance KPI calculations as per IEC 61724 Standards covering KPIs like performance ratio, capacity utilisation factor, inverter efficiency, energy generation, weather details, alerts, and alarms.
4. Use condition monitoring data like cell temperature, inverter component temperatures, etc. to trigger condition-based process through alerts and alarms.
5. Build predictive models to identify the potential performance, analyse the gaps, and the reasons for the gap to rigger necessary corrective actions.
6. Enable predictive maintenance of assets for reducing operation cost and increasing reliability of assets.

Courtesy: SAP SE

Circular Economy

Transitioning from a linear 'take-make-dispose' to a circular model can help fulfil climate, economic, and ecological ambitions

Circular economy represents a cleaner and a more efficient model of production process to the alternative linear model of 'take-make-dispose' currently in use. A report from the Ellen MacArthur Foundation (2016) highlighted that a circular economic pathway could deliver climate, economic, and ecological benefits for India. The 2016 report projected that India could generate $624 billion worth of annual value and reduce GHG emissions by 44% from the current development pathways.

Sectors with higher share of economic activity such as agriculture, construction and steel offer huge potential to implement circular economic approaches

Increasingly, industries are looking towards the circular economy model to generate monetary savings and overcome resource deficiencies. In India, NITI Aayog and the Ministry of Environment, Forests and Climate Change (MoEFCC) have identified a range of industries such as automobiles, agriculture, electronics, construction and the steel sectors as having high potential of circularity on account of the large challenges they currently pose or may pose in the future.

JSW Cement Limited

Improving Thermal Substitution Rate | Nandyal, Andhra Pradesh | **Practice**

Description

Under the UN Energy Compact signed in 2022, JSW Cement has set a target of reaching 30% thermal substitution rate by 2030.

As a part of decarbonisation endeavours, the organisation has adopted waste co-processing as an essential method to reduce fuel emissions. As a result of adopting the 'waste co-processing model' at its Nandyal (Andhra Pradesh) plant, the organisation had made significant progress of increasing the thermal substitution rate from 4.2% in FY 2020/21 to 7.1% in FY 2021/22.

Over the past few years, JSW Cement has proactively engaged in co-processing liquid hazardous waste from pharmaceutical industries, plastic waste, and biomass waste such as rice husk. In FY 2021/22, ~35,000 tonnes, including ~9,000 tonnes of biomass waste were processed, resulting in ~70% increase in thermal substitution rate, amounting to a recorded and improved rate of 7.1%.

To increase its co-processing capabilities, the organisation has upgraded all the necessary installations related to alternative fuel (AF) preparation (shredder), transportation and the liquid/solid feeding system.

Further, JSW Cement has signed a memorandum of understanding (MoU) with Punjab Renewable Energy Systems Private Limited (PRESPL) in March 2022, to ensure long-term supply of biomass waste.

Apart from reducing net emissions, the co-waste processing model has helped conserve natural resources, and cut down overall environmental impact by reducing emissions. We are also providing an alternate source of livelihood/ income to farmers by procuring their biomass waste to meet our requirements.

By improving the thermal substitution rate at their Nandyal unit, JSW Cement reduced **~40,000 tonnes** of CO_2 emissions, and **~15,000 tonnes** of coal consumption (as fuel).

Dalmia Cement (Bharat) Limited

Installation of Chlorine Bypass System for Green Fuel Maximisation | **Practice**

Description

Green Fuel Maximisation is found to be one of the major levers that can substitute conventional fossil fuels like coal and pet coke.

Developing countries face waste management challenges in the guise of a rising population and massive production of waste, and non-availability of adequate landfill sites, in turn creating a problem for society and the environment. It is urgent for India to sustainably manage its solid waste, and as the second-largest producer of cement, the country can lead the path of utilising waste having a calorific value for its cement production (in cement kilns).

Incineration of waste in the cement kiln is one of the best methods in the world of utilising waste for cement production. As the fourth-largest cement producer in the country, with a vision to become carbon-negative by 2040, Dalmia ensures that the waste is eradicated and eliminated in the most scientific way.

Simultaneously, disposing of waste in the cement kiln requires technological intervention/improvement to consume a high quantity of waste in the kiln. The waste with calorific value can be used in a cement kiln, i.e., it can replace the quantity of conventional fuel being used. Hence, the use of alternate fuels is one of the levers for the carbon-negative commitment of the company.

On the path of commitment to becoming carbon negative and enhancing the use of alternative fuels, Dalmia commissioned the first-of-its-kind chlorine bypass system in India.

The chlorine bypass system is a unique technology that eliminates chlorine contained in the fuel, which is the main cause of coating trouble, from the kiln preheater system efficiently. This enables the kiln with a steady operation utilising a large

amount of chlorine-rich waste material. As a result of the process, there has been an increase in alternate fuel consumption and a reduction of conventional fuel.

Through the bypass system, the organisation achieved approximately 16% TSR (thermal substitution rate) on a consistent basis over the months.

However, the organisation was unable to go beyond 16% thermal substation rate (TSR) due to chlorine limitation in a hot meal and clinker (more than Bureau of Indian Standards (BIS) prescribed limit. Thus, the chlorine bypass system is one of the solutions, where chlorine is released as a bypass gas, thus limiting the overall chlorine in the system. As a result, the organisation enhanced AF (alternate fuel) feeding and, in the July 2022 exit figure, a TSR rate of up to 36% was attained.

Investing in the chlorine bypass system is a key step in the journey towards reducing carbon footprint of Dalmia Cement.

For the installation of the chlorine bypass system, Dalmia Cement (Bharat) Limited incurred an investment expenditure of INR29 crore. With the use of higher alternative fuel, we are able to avoid **96 kg CO_2/tonne** of clinker with respect to the baseline figure of **43 kg CO_2/tonne** of clinker production.

Jain Farm Fresh Foods Limited (JFFFL)

Fuel Switch Project | Chittoor, Andhra Pradesh | **Practice**

Description

Jain Farm Fresh Foods Limited (JFFFL) owns a three unit fruit-processing plant in Chittoor district of Andhra Pradesh.

The plant had two boilers each in Unit I and II that were operated on furnace oil to generate steam. This steam was utilised within the plant for food processing. However, the steam demand at the fruit-processing plant increased, resulting in the need to install additional boilers in both units at the Chittoor plants.

The steam demand prior to the installation of new boilers was 4950 kg/h for Unit I and 6350 kg/h for Unit II, which was later raised to 9,000–10,000 kg/h for both the units.

Instead of adding new fossil fuel-based boilers, the project involved installation of 10 total hydrogen petroleum (TPH) solid fuel (briquettes + mango stones)-fired boiler in Unit I and a renewable technology-based boiler with 10 TPH capacity in Unit II. The initially installed boilers were continued, however for standby purpose only. The new boilers are run on biomass (briquettes and mango stones) for generating steam. A part of the biomass requirement is met through in-house availability of mango stones that are generated during the plant operations. While the remaining requirement for biomass is met via locally procured biomass briquettes.

In the absence of the biomass-fired boilers, JFFFL would have sourced its residual energy requirement from fossil fuels. The implementation of the project activity helps in avoidance of fossil fuel combustion, aids the mitigation of greenhouse gas emissions. Through this project initiative, JFFFL aims to encourage the adoption of less carbon intensive and renewable energy technology in the food-processing industry.

Through the initiative of fuel switch, JFFFL reduced **7430 tonnes** of CO_{2e} emissions in the year 2021.

Emerson Electric Company

Waste Heat Recovery in Wonder Cement Limited | **Solution**

Description

Cement plants are working towards sustainability by improving their fuel and power efficiency, increasing use of renewable energy and deploying waste heat recovery (WHR) power plants. The WHR power plants use the waste heat generated through exhaust hot gases for power generation. With this, most of the waste heat is reused and recycled in the form of energy, hence reducing the dependency on coal and improving air quality as less flue gases of high temperature are being emitted. The power generated from waste gases leads to lower consumption of fossil fuels and reduced CO emissions. Emerson's Ovation automation software and technologies help with decarbonisation efforts at Wonder Cement Limited plant through lower emissions and increased operation and maintenance (O&M) savings. The technology, process expertise, and long-term support could ensure the most efficient and cost-effective integration of low-emission energy assets. The Ovation system features state-of-the-art monitoring, control, and diagnostic functionality to optimise sustainable energy generation operations.

Other Company Initiatives: Circular Economy

Shree Cement Limited

- The company utilises agriculture waste (crop-residue) in their Ras Power Plants, and scaled its usage to more than 100 MT per day with the aim to double its usage further by December 2022. Use of biomass as renewable source of energy helps in reducing CO_2 emission as well as enabling income to nearby farmer's community.
- Shree Cement Limited invested for the enhancement of their waste utilisation capacities with state-of-the-art technologies from Denmark and Italy, to be commissioned by FY 2022/23

Tata Steel Limited

- Tata Steel signed a memorandum of understanding (MoU) with the Government of Punjab to set up a 0.75 million tonne per annum (MTPA) steel plant in Ludhiana with a scrap-based electric arc furnace (EAF).
- This greenfield investment is a part of Tata Steel's commitment to invest in circular economy and transition to low-carbon steel making to achieve net zero carbon emissions by 2045.

Emerging Practice: Embedding Circularity in Production

Companies need to re-design their business models to embed circularity in their operations; and help close the loop, whereby products are not merely used longer and more intensively but actively reused.

Alignment with the following action areas can help companies actively invest in circularity:

1. Embed circularity in product design and development by sourcing materials which are recyclable, biodegradable, and usable. Additionally, there is a need to invest in product life-cycle analysis through traceability and accountability of the footprint of the raw materials used in manufacturing process.
2. Compliance with regulatory mechanisms is an opportunity for companies to invest in sustainability innovations.
3. Embed circularity in the end-of-life of products by engaging in dismantling and segregation of product components, and sourcing the segregated product components back into the supply chain as recycled parts. Further, extending financial incentives to customers will help enhance the demand viability of the product and generate awareness about the availability and affordability of sustainable products.

The business value of circular economy and specifically those initiatives which close the loop of products through recycling include:

- Enhanced competitive advantage by offering sustainable products (that can help enhance customer retention)
- Reduced costs by reusing product components
- Reduced supply chain risks
- Reduced corporate and product carbon footprint

Courtesy: SAP SE

Low-carbon Solutions Across Supply Chains

Pressure from varied stakeholders to decarbonise is changing industrial outlook on their value chains

To stay competitive, organisations will have to work closely with their partners in the value chain, adapt to stricter legislations and pressure from key stakeholders such as investors, for effective resource management and risk mitigation. If managed well, these challenges provide an opportunity for businesses to discover innovative solutions, drive impactful action, realise efficiencies, and enhance their market share.

Operationalising sustainability and implementing low-carbon solutions through effective value chain management is not only the need of the hour but a business imperative.

Accounting and measuring the carbon footprint of value chains is essential for companies to decarbonise Scope 3 emissions

Effective decarbonisation of companies will begin by companies and industries mapping, identifying, and quantifying the carbon footprint of their upstream and downstream value chain partners. Carbon accounting tools are increasingly playing a noteworthy role in evaluating value chain footprint and provide crucial inputs for making necessary interventions.

Lanza Tech Private Limited

Bio Refinery Gas Fermentation Process | China | **Practice**

Description

LanzaTech's process converts carbon-rich gas streams to valuable products using proprietary microbes that feed on gases (rather than sugars, as in traditional fermentation).

LanzaTech's naturally occurring microbe has been optimised to economically produce ethanol and enable economic routes for jet fuel and high-value chemicals from a variety of carbon-rich gas streams, such as:

- industrial off-gases from steel and ferro-alloy mills
- petroleum refineries, petrochemical complexes, and gas-processing facilities
- syngas generated from any biomass resource, including municipal solid waste, organic industrial waste, and agricultural waste
- reformed biogas and landfill gas.

By capturing the carbon contained in gas streams, LanzaTech's gas fermentation technology platform enables production of low-carbon fuels and chemicals that serve as building blocks to indispensable consumer products such as rubber, plastics, and synthetic fibres.

LanzaTech estimates that its products reduce greenhouse gas emissions by over 70% when compared to equivalent products derived from fresh fossil resources.

The first commercial plant started in China in May 2018 and has already produced over 90 million litres of fuel-grade ethanol from steel mill emissions while diverting over 200,000 metric tonnes of CO_2 from the atmosphere. In addition, early this year LanzaTech 2nd unit started this year in China will be utilising ferro alloy mill off gases to fuel grade ethanol.

LanzaTech's commercial plant in China has produced **90 million litres** of fuel-grad ethanol from steel mill emissions, and diverted over **220,462 tonnes** of CO_2 emissions from the atmosphere.

BASF India Limited

SCOTT (Strategic CO_2 Transparency Tool) | **Solution**

Description

Effective decarbonisation of value chains can only be driven by consumer and procurement behaviour, which in turn requires visibility of carbon footprint at product level (PCF) for manufacturers.

BASF has developed a pioneering digital carbon-accounting solution (SCOTT – Strategic CO_2 Transparency Tool) which enables not only to determine PCFs at scale, but also to obtain unparalleled transparency in the sources of cradle-to-gate carbon emissions for complex integrated manufacturing set-ups and large product portfolios.

For example, SCOTT allows BASF to determine the cradle-to-gate PCF of 45,000 sales products, manufactured in more than 700 plants, in less than 1 hour calculation time, a tiny fraction of the efforts which would be required adopting conventional methods and tools.

The highly automated PCF determination leverages primary activity data and follows a methodology, which has been independently certified to be aligned with ISO 14067 and with the GHG Product Protocol and is designed to cater to the needs of the chemical and process industry.

With the aim of fostering standardisation, BASF has openly shared its PCF calculation methodology with suppliers, customers, and peers.

As part of the Together for Sustainability initiative, an industry-wide agreement has been initiated among leading global chemical and process industry manufacturers to achieve unrestricted comparability of product carbon footprints and, a level playing field within the chemical industry.

The SCOTT tool allows BASF to determine the cradle-to-gate PCF (carbon footprint at product level) of **45,000** sales products, manufactured in more than **700 plants**, in less than 1 hour calculation time, a tiny fraction of the efforts which would otherwise be required with conventional tools.

Lanza Tech Private Limited

Sustainable Aviation Fuel from Ethanol (Alcohol to Jet Technology) | **Solution**

Description

Lanza Jet's Alcohol-to-Jet (ATJ), converts ethanol to sustainable aviation fuel (SAF), creating a new market for US-produced ethanol. With support from the DOE, Lanza Tech scaled up the ATJ technology, which originated from the Pacific Northwest National Lab, and launched LanzaJet in partnership with major investors (Suncor, Mitsui, British Airways, Shell and Microsoft Climate Innovation Fund).

LanzaJet is now developing the first commercial-scale facility in Georgia. Ethanol from steel mill emissions was converted to SAF that powered a Virgin Atlantic commercial flight from Florida to London in October of 2018, the first flight ever to use CCU fuel. In October 2019, All Nippon Airways (ANA) powered a ferry flight from Seattle to Tokyo also using steel mill derived SAF.

Other Company Initiatives: Low-carbon Solutions Across Value Chain

Capgemini Technology Services India Limited

Capgemini recognizes that the biggest impact they can have is through working to help their clients manage their sustainability challenges. Hence, in 2019, Capgemini announced their commitment to help clients save 10 million tons of CO2e by 2030.

Capgemini has established a sustainability framework to help their clients define and achieve sustainability commitments across their entire value chains while driving growth and competitiveness. It supports them in three main ways:

Commit: Help organizations define their net-zero strategy, establish the underlying organization, embark all relevant stakeholders internally and externally while adjusting their business models.

Act: Help clients operationalize their strategy by designing more sustainable products and services, refining their operations and supply chains to reduce their environmental footprints, and by switching their legacy IT capabilities to sustainable IT.

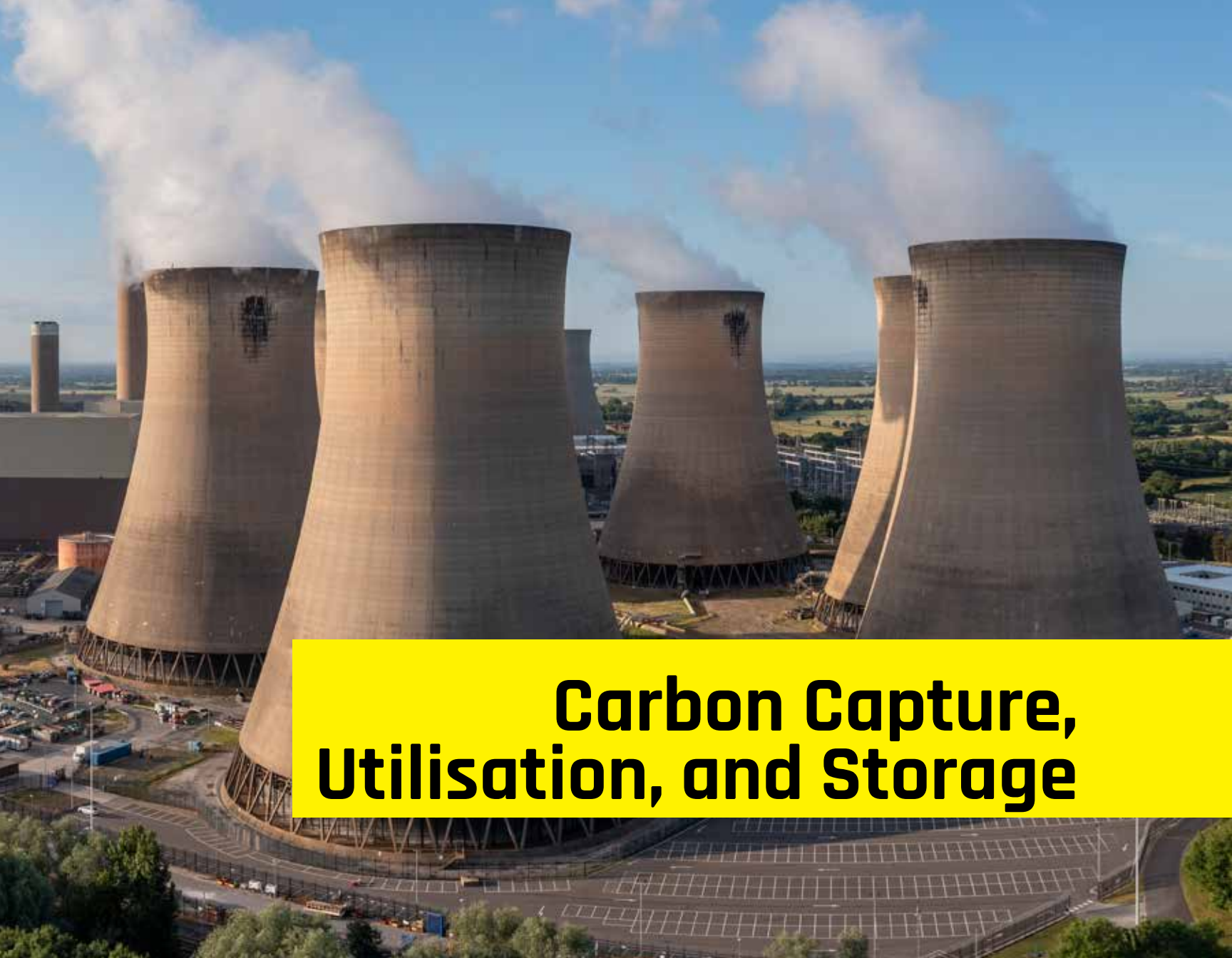
Monitor and Report: Model, track and anticipate the evolution of any organization's greenhouse gas emissions through sustainability data hubs and by leveraging innovative technologies.

Emerging Practice: Product Footprint Management

Companies can drive actions on their product footprint reduction strategies by leveraging and integrating data across supply chains in the following ways:

1. Gauge environmental footprints of the varied life-cycle phases of a product by combining emission factor information from LCA database and business activity.
2. Determine emission factors basis the business transaction.
3. Embed product footprint data to purchase and transport-related decision making.
4. Leverage business networks and enable exchange of carbon footprint from suppliers, transporters and customers.
5. Get visibility in value chain emissions with material flow, financial flow and carbon emissions data overlaid to identify opportunities to decarbonise supply chain processes.

Courtesy: SAP SE



Carbon Capture, Utilisation, and Storage

Despite rising renewable energy generation, coal will remain critical for securing India's energy needs

Coal continues to secure majority of India's energy needs with ~55% of the country relying on the fossil fuel for powering its industries and the economy at large. In such a scenario of continued coal use, carbon capture, utilisation, and storage (CCUS) emerges as a powerful technology that can simultaneously prevent stranding of fossil fuel-based plants and overshooting the already constrained carbon budget.

CCUS technology presents an opportunity to ensure optimal usage of fossil fuels with minimal impact on the climate, society and economy

Leveraging this upcoming and yet-to-be scaled technology means that the public and the private sectors, led by hard-to-abate industries, will need to enhance the flow of financing to CCUS technologies. Additionally, the government must create an enabling environment that provides hard-to-abate sectors like cement and concrete and steel to pilot their demonstrations, and subsequently scale CCUS.

Within the umbrella of CCUS, conversion of captured carbon into carbon products can incentivise fossil fuel-based industries to adopt the technology

Through conversion of captured carbon into products, industries may be incentivised to pilot demonstrations of this emerging technology; and this emerging technique can become a case study and help policy makers, industries, and other stakeholders understand the benefits associated with the technology.

The subsequent section highlights CCUS practices and in-development solutions undertaken to decarbonise the industry.

Oil and Natural Gas Corporation Limited

Enhanced Oil Recovery | Koyali and Gandhar, Gujarat | **Solution**

Description

ONGC entered into a Memorandum of Understanding with Indian Oil Corporation Limited (IOCL) for CO_2 based Enhanced Oil Recovery (EOR).

Under this initiative, the CO_2 captured from the IOCL's Koyali refinery will be utilized for EOR from the depleting oil fields of ONGC in Gandhar field, near Vadodara, Gujarat.

A techno-commercial study is in progress to establish the feasibility of the project. The project has the potential for oil gain of 10% by the year 2040.

The project can sequester an estimated **5 – 6 million tonnes** of CO_2 by 2040

HeidelbergCement Group

Long-term storage of CO_2 | Brevik, Norway | **Solution**

Description

The world's first large-scale facility for carbon capture in the cement industry has been under construction at the Brevik cement plant in Norway since 2021.

The project aims to demonstrate the viability, safety and cost-effectiveness of demonstrate that carbon capture and storage (CCS) technology. By 2020 end, the Norwegian government and the parliament had approved the implementation of the project. The project aims to transport the captured CO_2 emissions to an underground storage site below by the North Sea by 2024.

The facility will use amine technologies to capture **400,000 tonnes** or **50%** of the plant's emissions annually from 2024. Currently, several feasibility studies are being conducted to scale up the technology so that up to 100% of a cement plant's CO_2 emissions can be captured and stored in the future.

Tata Chemicals Limited

Combating Carbon Emissions and Rising Carbon Prices | Northwich, United Kingdom | **Solution**

Description

In August 2021, the UK operations of Tata Chemicals successfully commissioned a carbon capture and utilisation plant (CCU). The plant captures CO_2 emitted from the gas-fired combined heat and power plant (CHP) at Winnington, Northwich, United Kingdom.

As part of the process, the CO_2 is then purified to the requirements of the European Industrial Gases Association (EIGA) Food and Beverages Grade standards, and is subsequently used to manufacture high-purity, API-grade net zero sodium bicarbonate.

The plant had achieved nearly **15 kilotonnes** of CO_2 emissions reductions in FY 2021/22, and had demonstrated a proven capacity to reduce the plants's CO_2 emissions by **40,000 tonnes** per annum (~11% of its total emissions).

The plant has benefited sodium bicarbonate business by securing CO_2 cost advantages and is specifically beneficial for businesses given the high volatility of the CO_2 market.

Industry Charter for Near ZERO Emission by 2050

Other Company Initiatives: Carbon Capture, Utilisation, and Storage

JSW Steel Limited

- JSW Steel has been engaging with a variety of knowledge partners to enrich their own understanding of low-carbon steel production. Their partners include technology companies, academia, cross sector organisations, and government bodies, and they work with them for the development of deep decarbonisation technologies like use of green hydrogen, innovative blast furnace–basic oxygen furnace (BF–BOF), and carbon capture and storage.
- A few examples of the collaborations include an agreement signed with Shell India Markets Private Limited and Larsen and Toubro (L&T) for intensive exploration and evaluation of various carbon capture, usage and storage (CCUS) technologies and their applications in the steel industry.

Jain Irrigation Systems Limited (JISL)

- The organisation has planted 300,000 trees over the last few decades. The forest patches created so far have accrued carbon to the tune of 30,000 million tonnes per annum.

Road Map for Technology Demonstrators

Developing technology road maps could help map industrial requirements besides streamlining investments for scaling up emerging technologies

Developing road maps for sectoral decarbonisation will depend on sound research and foresight and coordinated multi-stakeholder engagements. The collaborative efforts of policy makers, industrial companies along with their supply chains, and research institutions can support innovation, scale up promising decarbonisation technologies and help maintain the competitiveness of industries.

Additionally, plugging the gap between industry requirements and the supply provided through university research is essential for industry–academia collaboration, and are the most important means of developing technologies.

Large-scale deployment of best available technologies (BATs) will require a sound financing mechanism

As per NITI Aayog's India Innovation Index 2021 (2022) stated that India's gross expenditure on R&D at 0.7% of GDP stood lower than the world average of 1.8%. Scaling up financing will require enhanced contributions from the private sector, and utilisation of innovative mechanisms such as blended financing can help mobilise funds for emerging technologies.

The subsequent section highlights practices and solutions, some of which are from outside of India, but can be implemented domestically.

FL Smidth Private Limited

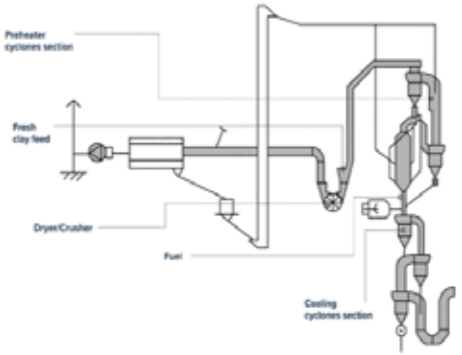
Calcined Clay: The Future of Green Cement | **Practice**

Description

Clay is found almost everywhere in the world, making it a natural solution in regions where a lack of limestone availability drives up the cost of cement. With the right treatment, clay makes for an excellent replacement for clinker, and can be easily treated by utilising equipment that cement plants already have on site, further reducing investment costs.

The following technologies and processes are involved in creating calcined cement:

1. Usage of the company's established ET dryer crusher, especially designed for materials like clay with up to 40% moisture content.
2. Using waste gases from the preheater, the feed material is dried and crushed in one operation, achieving both the required fineness and a free moisture content of just 1% by the time the clay enters the preheater.
3. From the dryer crusher, the material is fed to the 2-stage preheater/calciner system for calcination. An important aspect of



FLD Smith's Clay Calciner System

the process is that any fuel could be fired in the clay calciner, including up to 100% waste fuels.

The organisation uses the best available technologies from the cement and mining industries to optimise clinker substitution while maintaining cement quality. To further decarbonise the cement industry, F L Smidth and a series of leading industry experts have formed a new partnership called ECoClay to reduce CO_2 emission from cement production by up to 50%. The ECoClay partners aim to develop and commercialise the technology needed to replace fossil fuels in the calcination of clay by fully electrifying the process. The ECoClay partners expect to be able to commence construction of the first full-scale electric clay calcination installation by the end of 2025.

UltraTech Cement Limited

Using Artificial Intelligence (AI) to Improve Sustainability Performance | Sonebhadra district, Uttar Pradesh | **Practice**

Dalla Cement Works, an integrated unit of UltraTech, in Sonebhadra district of Uttar Pradesh along with UltraTech's Corporate Digitalisation Cell, successfully incubated the technology (proof of concept) of 'MachineMax' to digitise mining operations. The technology helps digitalise operations using AI-based activity, wireless sensors and Global Positioning System (GPS). The technology was initially deployed, for over two months, on a selected mix of Heavy Earth Moving Machinery (HEMM) like excavators, drill machines, dozers, tippers, and breakers.

Digitalising its operations enabled UltraTech better monitoring and assessment of performance of equipment. This also allowed a better assessment of asset utilisation given that HEMM is a key part of limestone mining operations.

'MachineMax' interactive user interface has helped capture real-time asset utilisation including on/off time, idle time, idle hotspots of the HEMM. The technology has provided operational insights like routes, distance travelled (in kilometers), over-speeding alerts, and fuel consumption trends essential to monitor the efficiency of HEMM operators.

With the help of this technology, the unit observed an average vehicle idling time of 10% (of the total active hours).

The technology adoption in the minimum operation has enabled increased savings on fuel and consequently helped reduce UltraTech's carbon footprint.

The cost saving due to reduced usage of fuel as well as increased reliability of HEMM and carbon dioxide (CO_2) reduction are being assessed.

Emerson Electric Company

Utilising IT to Enhance Share of Hydrogen for Green Energy | **Solution**

Emerson has partnered with the Korea Hydrogen Green Energy Network (KOHYGEN) to help ensure the safety and reliability of its pioneering hydrogen infrastructure initiative which involves setting up the world's largest hydrogen refuelling station for commercial vehicles.

The project is an important step towards the reduction of emissions, drive investments in hydrogen and accelerate transition to a net zero global economy.

Emerson will help KOHYGEN build smart and safe hydrogen refuelling infrastructure by leveraging IT-based integrated operations, using large capacity, high-efficiency charging systems and most importantly, strengthening design safety standards.

The Jeonju Pyeonghwa Hydrogen Refueling Station is the first of 35 high-capacity gas and liquid hydrogen refuelling stations KOHYGEN plans to construct across the Republic of Korea by 2025. The Station has a charging capacity of 300 kilograms per hour, which can fuel up to 15 buses and trucks per hour, or over 100 per day—12 times more than an average capacity hydrogen station.

Additionally, Emerson and KOHYGEN are collaborating on creating technical standards for future high-capacity commercial refuelling stations and similar projects.

In line with Emersons 'Greening of, Greening by, and Greening with' sustainability strategy, the company is working on a range of hydrogen projects globally, applying their expertise and innovative technologies to scale hydrogen consumption and make renewable energy a reality. Partnering with KOHYGEN is a critical step forward in diversifying the global energy mix.

In addition to deep domain experience across the hydrogen value chain, Emerson is providing core technologies, including temperature transmitters, flowmeters, pressure transmitters, programmable logic controllers (PLC) and valves, to deliver the high level of performance necessary for developing a commercially viable hydrogen charging model that can expand Korea's domestic hydrogen market and serve as a template in other countries.

Emerson Electric Company

Demonstrating feasibility of manufacturing hydrogen fuels by leveraging Emerson's digital automation system (DeltaV)

Emerson and Toyota Australia have collaborated to implement a commercial-grade hydrogen production, storage and refuelling plant at Toyota Australia. The project, supported by the Australian Renewable

Energy Agency (ARENA), adopts Emerson's automation expertise to provide the control system which will help demonstrate the technical and economic feasibility of manufacturing hydrogen fuels, including the use of renewable solar energy.

Toyota Australia will significantly reduce costs by incorporating a digital automation foundation that can help eliminate data silos, and make it easier to maintain data on, and report their sustainability performance.

As low and zero-emission vehicles capture an ever-greater share of the market, countries around the globe need to expand access to renewable fuels like hydrogen. For the Toyota Australia Hydrogen Center, Emerson's advanced DeltaV distributed control system gathers data from the plant's complex equipment to monitor production and storage of hydrogen gas and document and validate the sustainability of operations.

Other Company Initiatives: Road Map for Technology Demonstrators

GAIL (India) Limited

R&D initiatives on development of low carbon technology is the need of the hour for meeting the sustainable business goals. In line with this, GAIL is investing in emerging technologies, for the direct or indirect conversion of CO2 to valuable chemicals and energy products that have high potential market and promising benefits.

Their total expenditure on R&D and Innovation initiatives in the reporting year of FY 20222 - 23 was INR 180.71. This included INR 12.39 crore majorly spent on pursuing collaborative R&D works with various Research Institutes and INR 168.32 crore expended on carrying out innovation /developmental initiatives at various GAIL facilities.

Collaborative R&D works are carried out in association with various academic institutes, Centre of Excellences (CoE) and CSIR laboratories. These collaborative efforts are mainly focused on emerging technologies such as green hydrogen; battery technology; CO2 utilisation and waste valorisations; process optimization; pipeline integrity management and development of catalysts.

Emerson Electric Company

The automation solutions portfolio of the company provides products and solutions to hydrogen original equipment manufacturers (OEM) in the UK.

Emerson is supporting Haskel–a global manufacturer of turnkey hydrogen refuelling stations–with the aim of building 6–10 refuelling stations in one year and with CMB.TECH to help them develop marine vessels powered by hydrogen.

JSW Steel Limited

Under the R&D initiatives, the organisation has conceptualised the following projects as pilots:

- CCUS (carbon capture, usage, and storage): To capture, compress, and store CO_2 for use in steel plants.
- Use of 100% hydrogen for DRI (direct reduced iron)
- Electrolytic Fe (iron) recovery
- Usage of biofuel and ferro coke
- Usage of green hydrogen for steel making

BASF India Limited

BASF's 'Carbon Management Research and Development' programme focuses on developing technologies and processes capable of substantially reducing CO_2 emissions.

As part of the programme, the organisation focuses on base chemicals that are responsible for 70% of GHG emissions in the chemical industry, and hence forms an indispensable starting point for innovations along the value chain. Further, electrification and the creation of new processes can help produce base chemicals with almost zero emissions.

UltraTech Cement Limited

UltraTech, as part of its R&D measures, has developed premium products that extend the life of limestone deposits by reducing limestone consumption. These products also help in saving fossil energy while ensuring low-carbon emission by using industrial waste and agriculture residue.

Some of the initiatives and technologies that the organisation has invested in are below:

Installation of large-scale WHRS (Waste Heat Recovery System) projects to generate power by process optimisation during production activities.

Alternative Fuel and Raw Materials (AFR) projects to reduce the usage of fossil fuel and traditional materials in the production activities for lowering the carbon footprint.

Projects working towards increasing the use of fly ash and other alternative materials in production activities.

These projects have helped UltraTech to reduce its carbon footprint by utilising alternative recycled materials, as low CO2 binders in cement.

Additionally, the company has also invested in increasing its Renewable Energy (RE) generation capacity and committed to the RE100 by 2050 initiative.

Sterlite Power Transmission Limited

As part of business strategy, Sterlite Power has been focusing on new product designs for low loss and higher energy transfer that can result in lowering carbon emission.

JSW Cement Limited

The R&D effort of JSW Cement, based on the philosophy of circular economy, revolves around developing products and solutions with slag as a primary material. As part of product diversification strategy, JSW Cement has entered the construction chemical sector with the launch of a green product range where business operations align with a sustainability vision to contribute towards a circular economy. The three products within the construction chemical range are:

1) Krysta Leakproof: An integral crystalline waterproofing admix and a capillary waterproofing compound for concrete and mortar.
2) Duraflor: A high-quality, long-lasting, cementitious-based, non-metallic and non-oxidising concrete floor hardener, free from organic impurities.
3) ENduroplast/Ready Mix Plaster: A single component water-resistant monolith plastering / rendering mortar made from slag sand instead of river sand.

Apart from the above-mentioned products, the organisation recently launched another product Screened Slag. This product is superior to river sand because the river sand/crushed rock fines contain fossils and other irregular particles, such as clay and silt that affect quality and durability. Screened Slag meets all the requirements of IS: 383-2015. For this, JSW Cement has allocated required resources in terms of financial, human, and technical resources. Additionally, the company also adopted the usage of finish-grinding in roller-presses that help them produce high-quality slag cement.

The research and development pillar, initiated under the company's sustainability strategy, is driven at the corporate level. Under this pillar, the organisation develops products and solutions which are sustainable, low-carbon based, and innovative. The organisation is committed to engaging with top academia like IITs in India and collaborating with research networks to commercialise cutting-edge and some disruptive technologies.

Emerging Practice: Create an Accurate Corporate GHG Inventory

Investing in creating a GHG inventory can provide companies with analytical insights on the footprint of their operations, automate climate-related disclosures, improve compliance of regulations and help identify emission hotspots.

Developing a robust GHG inventory depends on the organisation, its operational boundary, calculation formula, and KPIs.

Once a robust GHG inventory scope is finalized, collecting data of the reporting emissions becomes necessary, and in this process, technology can play a crucial role in automating data collection through application programming interfacing (APIs), robotic process automation, and operational technology (OT) system integration.

Collecting and organising data forms a crucial base for companies to take evidence-based decision making by building more advanced and predictive model for emissions forecasting that can help identify emission hotspots. Additionally, companies can make informed decisions on their purchase of goods and services, outbound logistics and the entire long supply chain that will further drive investment decisions.

Courtesy: SAP SE

Industry Charter for
Near ZERO Emission by 2050

For More Information

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