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Insights from the steel sector decarbonization road-map workshop in India

Somya Joshi, Gökçe Mete, Girish Sethi (TERI), Arupendra Nath Mullick (TERI)

Relevance and context of the road-map workshop

Steel is an integral part of the modern world. It is present in everything from major infrastructure to buildings, cars and kitchenware. Yet steelmaking is highly emissions intensive. Nearly 2 billion tonnes of steel produced every year[1] generates around 8% of global CO2 emissions.[2]

Today, most crude steel is produced by reducing iron or using coal. The industry's blast furnaces are highly energy-intensive and rely on fossil carbon as a fuel and reduction agent,[3] making the iron and steel industry the largest industrial sector in terms of energy consumption.[4] For each tonne of steel produced in the conventional blast furnace-basic oxygen furnace route, between 1.5 and 3 tonnes of CO2 are released into the atmosphere.[5] In this industry, the presence of process emissions and the need for high temperature heat account for the majority of emissions and make it hard to abate.[6]

Global demand for steel is projected to increase by more than a third by 2050.[7] Even technologies driving the energy transition require a substantial amount of steel. Wind turbines, for example, need steel for around one-fifth of the weight of the materials used to construct them, and more than three times as much concrete as other materials.[8] Current process technologies are not in sync with the Paris Agreement's commitments and objectives but the expected increase in demand for steel makes it imperative to decarbonize the industry. Process emissions must fall by at least 30% by 2030 to bring the steel industry in line with a 2050 net-zero trajectory.[9]

To reach net-zero emissions from steel, two major decarbonization routes exist. The first is the demand management route. This requires circular business models that enable efficient collection and recycling of scrap steel, and implementation of more efficient building designs. The second is the energy efficiency route, for instance by using coke dry quenching for steel production. However, achieving net-zero emissions by 2050 from steel will require major shifts in production methods using deep decarbonization technologies, detailed below: [10, 11]

1. Shifting to direct reduction of iron (DRI) ore using natural gas and hydrogen
2. Electricity-based methods (Electric Arc Furnace)
3. Advanced coal-based methods using carbon capture and storage

Demand for steel is expected to increase as population growth, industrialization and urbanization in emerging economies continues. India is currently the world's second-largest steel producer, and third-largest steel consumer. According to The Energy Resource Institute's analysis, crude steel capacity in the country will increase from a current level of 142 million tonnes per annum (MTPA) to 245 MTPA by 2030 and 528 MTPA by 2050. However, this growth will have significant energy, environmental, resource and economic consequences. It is, therefore, vital to discuss the pathways to decarbonize the steel sector to ensure that India stays on track to meet its emissions targets while ensuring socio-economic well-being.

One approach to build momentum and overcome inertia around transition is using road maps, which provide a predetermined goal or target associated with a desirable future and which set out possible pathways, strategic plans, actions, and policies required for reaching that point. Underscoring the need for definitive road maps to decarbonize the steel sector in India – one of the largest emitters of greenhouse gases – stakeholders, industry representatives and experts participated in a hybrid road-map workshop organized by The Energy and Resources Institute (TERI), the LeadIT Secretariat, India's Ministry of Environment, Forest and Climate Change (MoEFCC), and the Strategic Partnership for the Implementation of Paris Agreement (SPIPA) project implemented by GIZ and the EU. The workshop took place in New Delhi on 12 April 2022. What follows are key sectoral insights and policy recommendations that emerged from this co-creation workshop.

Key sectoral insights

A green transition for the Indian steel sector would need to include:

- energy efficiency
- resource efficiency
- process transition
- energy transition
- deep decarbonization.

India's Ministry of Steel is preparing a Vision 2047 document in line with requirements for green steel production. The knowledge co-production sessions involving stakeholders

from government, industry and civil society led to an understanding that the Indian hard-to-abate sectors will transition towards meeting their sustainability targets via the three macro trends of development, digitalization and decarbonization. Two potential routes towards decarbonization include the hydrogen-based DRI production route and the smelting reduction-blast oxygen furnace carbon capture utilization and storage (SR-BOF CCUS) route. Significant costs to the SR-BOF CCUS route may be added due to the costs of CO2 infrastructure, including storage and sequestration.

Preliminary assessments suggest that there is limited potential for CCUS in India. The costs of production for the hydrogen direct reduction – electric arc furnace (H2 DR-EAF) route will, on the other hand, depend on the costs of hydrogen. Green hydrogen could become competitive before 2030 in India, given the rapid declines in the costs of electrolyzers and renewable energy. Off-grid set-ups may be more suitable for the steel industry in India. Support on both the demand side and the supply side will be required to accelerate the transition of the sector. Finally, the role of scrap emerged as key driver in a circular economy of steel manufacturing. Market and cluster development for H2-based production units and CCUS, as well as deepening of Perform Achieve and Trade schemes, are a key policy recommendation.

Policy recommendations for the Indian steel sector

- There is a clear need for a better understanding of **short, medium, and long-term perspectives** of the steel industry to achieve realistic targets to decarbonize the sector. The **risk of stranded assets** (be they coal-fired blast furnaces or infrastructure such as mines) should be considered when developing the road map.

- The production of steel, cement, and other basic materials requires high-temperature heat. This heat is currently generated by fossil fuels and, to a lesser extent, fossil-based hydrogen. In steelmaking, hydrogen can replace coke as a fuel for high-temperature heat required in furnaces. Therefore, renewably sourced hydrogen, so-called green hydrogen, could significantly reduce emissions from industrial processes. Additionally, hydrogen could be used as reducing agent in steel production process, replacing the coal and natural gas that are currently used. There is significant potential to reduce emissions in the coal-based segment of the Indian DRI industry by **using renewable energy and green hydrogen.**

- There is a pressing need to d**isincentivize carbon intensive technologies to ensure investments in low-carbon technologies can be de-risked.**

- One of the most promising approaches is green public procurement in major municipalities and importers of construction materials. Worldwide, government agencies are among the top buyers of steel for major infrastructure projects. Leveraging the immense purchasing power of government agencies would trigger a thriving market for greener steel. **Incorporating the use of green steel into the tendering process for both government and private infrastructure projects** is a low hanging fruit. Green procurement guidelines should be developed for the Indian market.

- New low-carbon products are expected to come at a premium. Support from the government will be needed to **incentivize end-users to use green steel**, for example by introducing labelling standards and carbon prices. Scaling up of green steel will only be achieved once the cost of the premium goes down.
- Robust **collaboration between industry partners and research institutes** needs to be prioritized by government in order to quantify greenhouse emissions from hard-to-abate sectors and to explore pathways for decarbonization.

Next steps

- **Knowledge exchange, as well as demonstrations** of technologies like HYBRIT, were identified as a crucial next step. However, this may not be feasible for a single industry player. **Support from the Government of India will be needed to demonstrate and pilot low-carbon technologies at scale.**
- It is important to examine the d**ecarbonization of the secondary steel sector and small and medium enterprises (SMEs)**. Financial support to smaller units may not be sufficient. For SMEs, there is a need to focus on easily implementable technologies.
- Some of the most important challenges for hydrogen, such as the scaling-up of production based on renewable energy sources and the development of international certificate schemes (guarantees of origin) for its cross-border trade, need to be tackled at national, regional and international levels. For this, there is a need for **experience exchange across industry globally, and initiatives like Green Hydrogen Catapult** would accelerate action to decarbonize the steel sector outlined in this road map.
- The role that low-carbon steel can play in **building disaster resilient infrastructure** is key and should be developed as an area for future research.
- **Implementing guidelines for green procurement, enhancing consumer awareness, and the use of standards and labelling is a practical next step** to push end users to use green steel. It should be acknowledged that international cooperation is also taking place on demand-side measures, including but not limited to the Clean Energy Ministerial's Industrial Deep Decarbonization Initiative (IDDI), which focuses on creating a market for low-carbon materials through public procurement.

Conclusions

- This decade (2020–2030) is crucial for the development of pilots and demonstrations of low-carbon technologies in India.
- A **clear definition of green steel** is needed. This term may also be region specific. Green procurement guidelines should be set, as well as policies for market development and encouraging demand for low-carbon products. Government projects can take a lead in this transition.

- **Multilateral finance** will have to support industry decarbonization. Financing mechanisms for industry transitions are crucial in the Indian context due to the current costs and evaluated risk of investing in low-carbon technologies in emerging economies. **Domestic carbon markets and innovative financing instruments** can enable industry transition.
- India may be the only country that will see an increase in steel demand in the future. Support from international partners will be crucial to ensure this growth is met sustainably.

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