Green Steel in India

Mains: *GS III – Economic Development*

Why in News?

India is accelerating steel decarbonisation through the National Mission on Green Steel, financial support and green-hydrogen pilots to curb future coal-based emissions amid rising steel demand.

What is the Current Status of India's Steel Production?

- **Steel share** – It accounts for nearly ***12%*** *of India's total greenhouse gas emissions.*
- India produced around *160 million tonnes (MT) of steel in FY 2025–26*, making it the world's second-largest producer.
    - India aims to increase crude steel capacity to 300 MT by 2030–31, 400 MT by 2035–36.
    - Achieving **Net Zero by 2070** requires substantial decarbonisation of steelmaking.
- India's steel emission intensity is around **2.55–2.65 tCO_2e per tonne of crude steel**, considerably above the global average of about **1.85 tCO_2e**.

Steel as Hard-to-Abate Sector
• **Conventional BF-BOF Route** – The Blast Furnace–Basic Oxygen Furnace (BF-BOF) route: - Uses coking coal to generate high temperatures and remove oxygen from iron ore. - Produces large quantities of CO_2. - Remains the dominant global steelmaking route. • In India - **43%** of crude steel → BF-BOF - **22%** → Electric Arc Furnace (EAF) - **35%** → Electric Induction Furnace • The share of BF-BOF capacity could rise to **56% by 2030**, creating a risk of long-term carbon lock-in.

> *A hard-to-abate sector means an industry where cutting greenhouse gas emissions to zero is very difficult, expensive, or slow.*

What are the available Cleaner Alternatives?

- **Electric Arc Furnace (EAF) –** It uses electricity to melt steel scrap and has less than

half the emissions intensity of BF-BOF globally.
    - Its effectiveness depends on availability of quality scrap, availability of clean electricity.
- **Direct Reduced Iron (DRI) + EAF –** It reduces iron ore without melting it in a blast furnace and can initially use natural gas and eventually shift to **green hydrogen**.
    - It is considered particularly relevant for India because of limited domestic scrap availability.
- **Green Hydrogen –** Hydrogen produced using **renewable electricity** and it can replace fossil fuels in the reduction of iron ore.
- It can potentially enables **near-zero-carbon steel production** when combined with renewable electricity.
- **Recycling –** Greater use of steel scrap can:
    - Reduce dependence on iron ore.
    - Lower energy consumption.
    - Reduce emissions.
    - Support circular economy principles.

What Government Initiatives are taken in this regard?

- **National Mission on Green Steel –** Targets reduction of steel emission intensity from **2.55–2.65 to 2.2 tCO_2e/tonne** by 2029–30.
    - For example, Green Steel Certification Scheme identify steel as green based on measurements.
- **Green Hydrogen Pilots –** The Ministry of New and Renewable Energy has supported **three pilot green-hydrogen projects** for low-carbon steel production.
    - Industrial projects are also testing green hydrogen in DRI-based steelmaking.

What are the Emerging Challenges associated with Green Steel Production?

- **Limited Scrap Availability –** India lacks sufficient high-quality scrap to rapidly shift entirely towards scrap-based EAF production.
- **Green Hydrogen Cost –** Green hydrogen remains expensive and its large-scale availability is uncertain.
- **Renewable Electricity Requirement –** Large-scale electrification of steelmaking requires abundant and reliable **low-carbon electricity**.
- **Coal-based Investment Lock-in –** New BF-BOF plants and furnace relining can create long-lived carbon-intensive assets.
- **Limited demand–** Low-carbon steel is currently more expensive, while demand for green steel remains limited.
- **Natural Gas Dependence –** Using natural gas as a transition fuel can reduce emissions compared with coal but creates:
    - Import dependence.
    - Price and supply risks.
    - Geopolitical vulnerabilities.
    - Risk of stranded gas infrastructure.
- **International Trade Pressure –** The **EU's Carbon Border Adjustment Mechanism (CBAM)** increases pressure on Indian steel exporters to reduce their

carbon intensity.

What could be done?

- **Prioritise DRI-EAF** over new BF-BOF capacity wherever feasible.
- Avoid unnecessary **relining of young blast furnaces** where alternative investments are viable.
- Scale up **green hydrogen** production and reduce its cost, expand renewable-energy capacity dedicated to industrial decarbonisation.
- Develop a stronger **scrap collection and recycling ecosystem**.
- Create domestic demand for green steel through **green public procurement** and infrastructure projects.
- Ensure a **just transition** for workers and regions dependent on coal-intensive steelmaking.

What lies ahead?

- India's expanding steel demand presents both a climate challenge and an investment opportunity.
- Rather than repeating trajectory of thermal power, India can redirect upcoming investments towards EAF, DRI and eventually green-hydrogen-based steelmaking.
- Early technological choices can prevent carbon lock-in, improve India's competitiveness under emerging carbon-trade regimes.

Reference

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