Hard-to-Abate Sectors: Decarbonization in Action

Exploring the challenges and solutions for decarbonizing the world's most carbon-intensive industries and BHEL's role in driving this transformation.

What Are Hard-to-Abate Sectors?

Industries characterized by:

Energy-Intensive

Steel, cement, chemicals, heavy transport (shipping, aviation, trucking), and refining

Process Complexity

High levels of CO_2 emissions from both energy use and chemical reactions

Infrastructure Necessity

Essential to modern life but technically challenging to decarbonize

Why Are They Called 'Hard-to-Abate'?

Fossil Fuel Dependency

High energy density fuels (coal, oil, gas) are deeply embedded in production processes

Process Emissions

CO_2 released not only from energy use but also from chemical reactions (e.g., cement calcination)

Limited Electrification

Efficiency gains and electrification alone cannot fully eliminate emissions

Technology Gaps

Require breakthrough technologies like carbon capture and alternative fuels

What Technologies Contribute to Their Emissions?

Fossil Fuel Combustion

Coal, natural gas, and oil burned for high-temperature heat and power generation

Chemical Processes

CO_2 released as byproduct (e.g., limestone decomposition in cement manufacturing)

Heavy Transport

Shipping, aviation, and trucking reliant on diesel, jet fuel, and bunker fuel

Legacy Infrastructure

Current industrial facilities often incompatible with low-carbon alternatives

Many of these emission sources require fundamental process changes, not just incremental efficiency improvements.

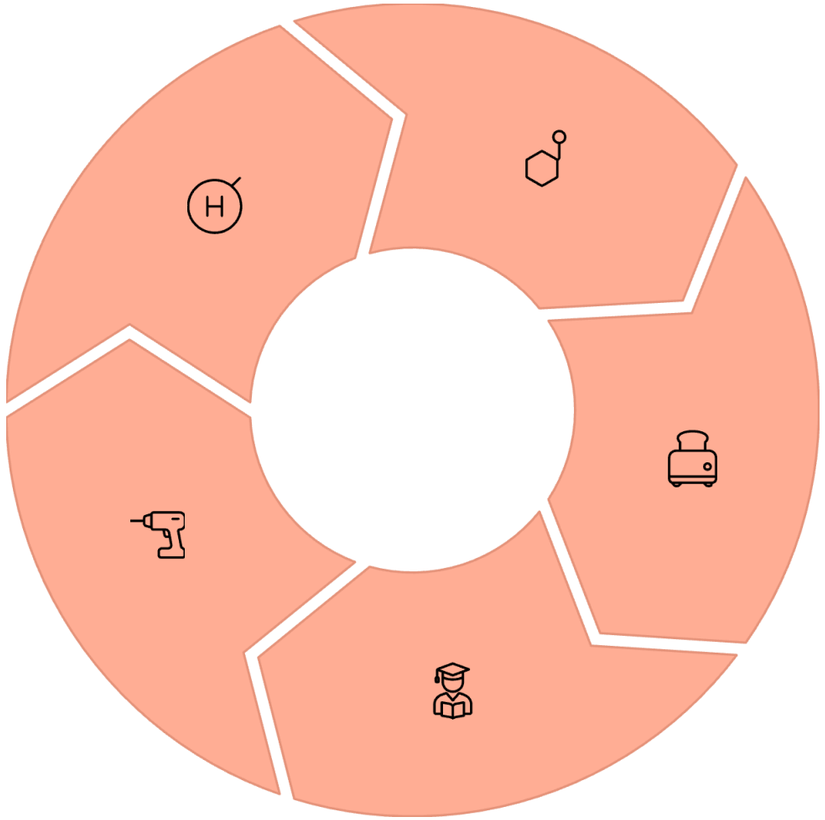
Emerging Technologies to Reduce Carbon Emissions

Clean Hydrogen

Low-carbon fuel and feedstock alternative for steel, chemicals, and transport

Industrial Hubs

Clustered approach to scale solutions and reduce infrastructure costs



CCUS

Carbon Capture, Utilization, and Storage to trap and permanently sequester CO_2

Electrification

Converting industrial heat processes to use renewable electricity

Alternative Materials

Low-carbon clinker, green steel, and sustainable chemical feedstocks

These technologies work together to address the unique challenges of hard-to-abate sectors, with different applications for each industry.

De-carbonization : Indian Perspective

National Commitments & Targets

- **Net Zero by 2070**
- **2030 Targets**
  - Reduce **emissions intensity of GDP by 45%** (from 2005 levels).
  - Achieve **50% cumulative electric power installed capacity from non-fossil sources**.
  - Create an additional **carbon sink of 2.5–3 billion tonnes of CO_2 equivalent** through forest and tree cover.

Policy Frameworks & Schemes

- **Renewable Energy Expansion**: Target **500 GW non-fossil capacity by 2030**.
- **Hydrogen Mission (2021)**: Push for **Green Hydrogen hubs**, storage, and exports.
- **Carbon Credit Trading Scheme (2023)**

Sectoral Focus

- Pilots in **green steel, green cement, and CCUS**
- **National Bio-Energy Mission**
- **National Green Hydrogen Mission**
- **FAME & PM e-Drive Schemes** for EV adoption

Finance & Investment

- **International Solar Alliance (ISA)** led by India.
- **Energy Transition Finance**: G20 presidency highlighted need for concessional finance.
- **Sovereign Green Bonds (2023)** issued to mobilize climate finance.
- Policy push for **Blended finance** and **Viability Gap Funding (VGF)** in storage, hydrogen, offshore wind.

How BHEL Is Driving Decarbonization

Clean Energy Solutions

Developing and deploying renewable technologies: solar, wind, and hydro power systems

Industrial Efficiency

Innovating in energy-efficient boilers, turbines, and electrification solutions

Strategic Partnerships

Collaborating on pilot projects for CCUS and hydrogen integration in heavy industries

BHEL's Contribution in Decarbonisation

Industrial Upgrades

Energy-efficient retrofits in steel and cement plants reducing emissions

Low-Carbon Clusters

Building industrial hubs with government and industry partners

Green Hydrogen

Supporting India's hydrogen roadmap with electrolyzer manufacturing

R&D Investment

Developing next-gen clean technologies tailored to Indian industrial needs

BHEL's integrated approach addresses the full spectrum of decarbonization challenges facing India's hard-to-abate sectors.

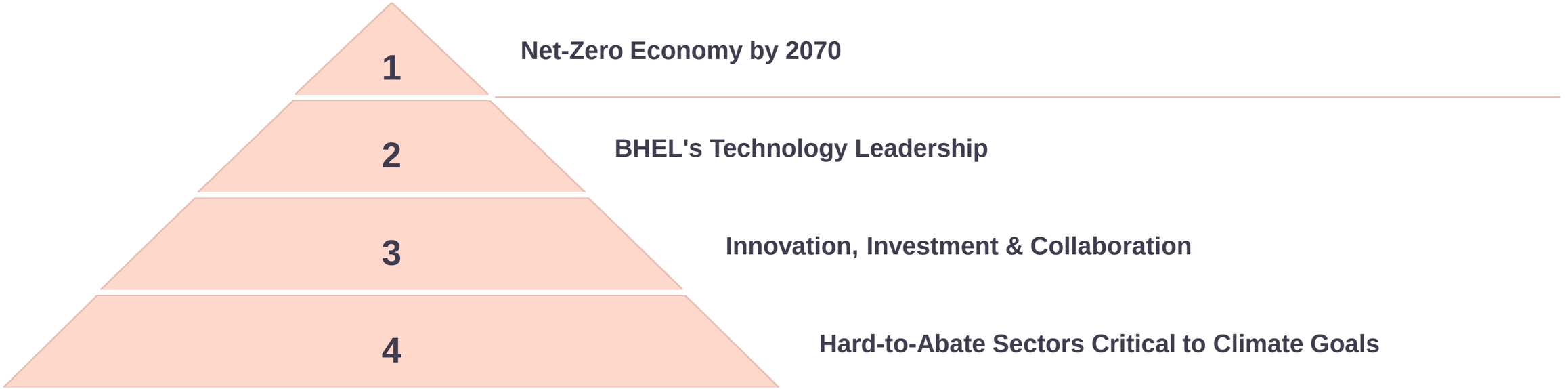
Visualizing the Transformation

From Carbon-Intensive to Clean Industry: The Path Forward

Before: Coal-dependent processes with high carbon footprint, significant air pollution, and environmental impact

After: Clean hydrogen and renewable electricity powering the same industrial processes with minimal emissions

Conclusion: Accelerating the Net-Zero Journey Together



The decarbonization of hard-to-abate sectors represents one of our greatest climate challenges—and opportunities. With BHEL's leadership and cross-sector partnerships, India can transform these industries and secure a sustainable future.