Technical Session on “Hard-to-Abate Sectors: Decarbonization in Action”

Perspectives from Industry Implementers and Solution Innovators

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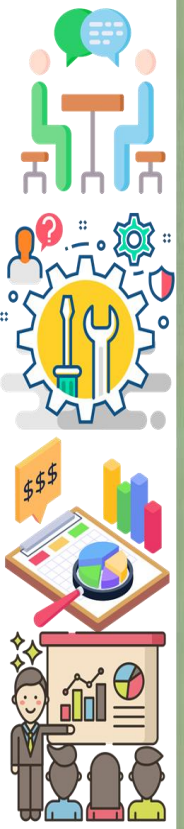
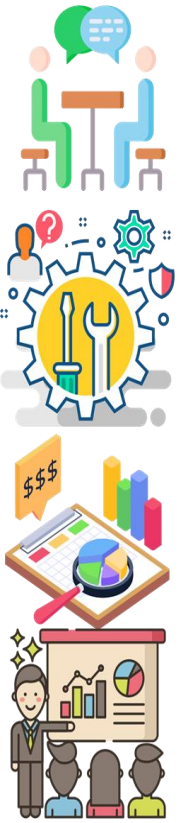
India’s Roadmap to Energy Transition



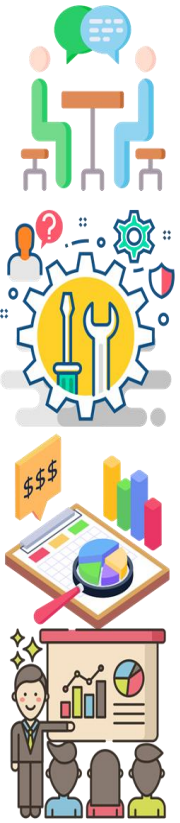
- Meeting 50% of electricity demand from RE by 2030
- Reducing 45% of carbon emissions by 2030 from 2005 level
- Reducing 1B tonnes of total carbon emissions by 2030
- Install Fossil-free & RE capacity of 500 GW by 2030
- Achieve net-zero emissions by 2070

India’s Net Zero progress



- India’s NDC (Nationally Determined Contribution) goals on climate change have pledged **50% RE by 2030 and net-zero emissions by 2070**.
  - As per CEA data (June 30, 2025), India’s total installed capacity = 484.8 GW
  - India’s thermal energy (coal, lignite and gas) installed capacity = 242.0 GW
  - India’s non-fossil fuel installed capacity (RE, large hydro, and nuclear) = 242.8 GW
- **India has reached 50% of total installed capacity from non-fossil fuel sources, 5 years ahead of schedule.**
  - Renewable energy = 184.62 GW (38%).
  - Large hydro = 49.38 GW (10%).
  - Nuclear energy = 08.78 GW (2%).
- As per **National Electricity Plan**, India’s expected installed capacity by **2031-32**:
  - **Total installed capacity (2031-32) = 900.40 GW**
  - **Low Carbon installed capacity = 665.02 GW**
    - Nuclear energy installed capacity = 19.68 GW
    - Large hydro installed capacity = 62.18 GW
    - Solar installed capacity = 364.57 GW
    - Wind installed capacity = 121.90 GW
    - Small hydro installed capacity = 54.50 GW
    - Biomass installed capacity = 15.50 GW
    - Pump storage installed capacity = 26.69 GW

Indian Power Sector Decarbonization challenges



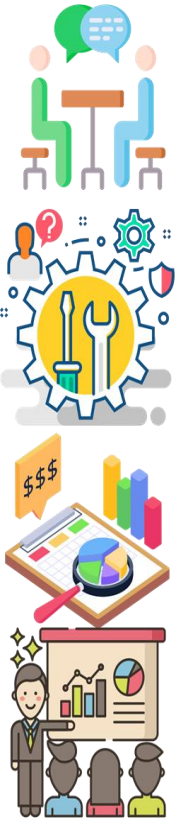
Energy Demand and Supply	• Investments needed to strengthen grid infra to connect new RE systems and create transfer capacity.
Financial & Institutional barriers	• India's market in RE, energy storage and low-carbon technologies will be > USD $80 billion by 2030. • Institutional and policy support needed to access low cost, long-term financing.
Policy and Regulatory Issues	• Subsidy policy should balance energy transition and equity, ensuring affordable energy, offset job losses in fossil-fuel sector by creating alternatives e.g. reskilling of workers in clean energy.
Technology & Infrastructure	• Upgrading ageing infrastructure and obsolete technology, clean energy capacity expansion, indigenization, capital investments in smart grids, metering, energy storage and EVs.

Decarbonization of Power, Heating and Transport

1. **Green Hydrogen → National Green Hydrogen Mission**
   - Key to drive energy transition in transport, industry and power generation
   - Annual target of 5 Million MT of green H_2 requires 135 GW of RE capacity to power the electrolyzers
   - Policy initiatives, mass production of electrolyzers and affordable RE can bring down the cost of green H_2
   - India aiming to be a global hub for production, use and export of green H_2
2. **Biofuels → National Policy on Biofuels**
   - India targeting 20% bioethanol blending with petrol by 2025
   - Aims to intensify use of biofuels in energy and transport
   - Biomass such as agricultural wastes, forest residues and urban bio-wastes can be turned into low-cost, low-carbon fuels, using biomass gasification, anaerobic digestion and bioethanol production
3. **Electric Vehicles → FAME-II scheme**
   - Fossil-fuel dependent transport sector accounts for 37% of global CO_2 emissions
   - Critical materials (e.g. Li, Co and Ni) for EV batteries have supply and environment concerns
   - EV charging infrastructure would need aggregating platform to connect EV owners to charging stations
   - High-speed EV charging infra, powered by RE, will be needed in both dense and remote, rural areas

Case Studies

NTPC's Net Zero & Sustainability Initiatives



- **Challenge**: NTPC has committed to achieving 60 GW of RE capacity by 2032.
- **Approach**: Work with NITI Aayog, Sustainable Energy for All (SEforALL), CII-IGBC and other stakeholders to align with India's climate goals.
- **Solutions implemented** (Source: NTPC, PIB):
  - As of August 2025, NTPC has installed RE capacity of 2.3 GW and an additional 3.9 GW under execution.
  - NTPC has commissioned 242 MW of floating solar capacity across operational sites- Ramagundam (100 MW, India's largest), Kayamkulam (92 MW), Simhadri, and Kawas
  - At Vindhyachal Power Station, NTPC has installed a carbon capture unit capable of sequestering 20 tonnes of CO_2 per day. Captured CO_2 is combined with green hydrogen, produced by PEM electrolyzer, to synthesize methanol (Target: 10 TPD).
  - Fly ash utilization increased to 98.77% in FY25 through "Waste-to-Wealth" initiatives, for manufacturing of bricks, cement, and road construction.
- **Technologies**: Real-time emission tracking, Carbon Capture, Biomass co-firing & Low-carbon technologies
- **Business Benefits** (Source: NTPC, PIB)
  - NTPC avoided 18 million tonnes of GHG emissions from non-fossil fuel generation, with further half a million tonnes emission reduction annually, once new solar projects are commissioned.
  - Creation of new green business verticals in RE generation, Carbon circularity & Green Methanol (Methanol 15 % blend in petrol reduces pollution by 33% & diesel replacement by methanol by more than 80%).
  - Ash utilization has reduced landfill impacts, through circular economy principles

UK Water Utilities: Net Zero by 2030

- **Challenge**: A voluntary target has been set for utilities to achieve 'Net Zero' by 2030, across the UK water utilities, who aim to achieve the Net Zero 2030 deadline, in compliance with OFWAT (UK water regulator) regulations.
- **Approach**: Adopt a comprehensive approach to minimise carbon emissions across the entire water supply chain by reducing energy consumption, adopting sustainable practices and investing in technologies that promote environmental sustainability, circular economy and eco-friendly operations.
- **Solutions implemented**:
  - Solutions encompassing wastewater treatment to energy-efficient processes
  - Recovery of bio-resources from wastewater treatment for Waste-to-Energy biogas plants
  - Integration of RE sources to generate electricity for captive power requirements and industrial heating.
- **Technologies**: Digital Twin, AI/ ML, Cloud computing, IIoT & IT-OT integration
- **Business Benefits** (Source: OFWAT, Water UK)
  - Scottish Water: **Waste-to-Value** biogas initiatives resulted in 14,000 tCO2e of emission reduction annually.
  - Anglian Water: **Energy efficiency measures** set to reduce our power demand by 26 GWh/annum, equivalent to 9,700 tCO2e of emission reduction in 2025.
  - Thames Water: Reduced operational emissions by 68% from 1990 levels, with a 4-fold strategy towards net zero by 2030- Reduce, Decarbonize, Captive RE and CO_2 sequestration.

Google: Energy & GHG Emissions Management

- **Challenge**: Google's need to manage energy consumption and its environmental impact
- **Approach**: Multifold carbon neutralization strategy
- **Solution implemented**:
  - Adopt aggressive energy efficiency initiatives.
  - Purchase significant amounts of renewable energy
  - Buy carbon offsets in lieu of GHG emissions not eliminated.
- **Strategy:**
  - Google partnered with over 40 carbon offset projects to offset more than 16 million tCO2e.
  - Google purchases a total of 2.6 GW of RE, equivalent to emission savings by taking off 1.2 million cars off the road.
- **Business Benefits**
  - In 2016, Google celebrated 10 years of carbon neutrality, promising to purchase enough RE to meet 100% energy demand.
  - Data Center Energy Management: Google's DCs power Search Engine, Gmail, and YouTube for billions of subscribers 24/7.
  - Google operates 14 DCs in four continents and each DC boasts of servers, networking equipment, and cooling systems designed for maximum energy efficiency and minimal environmental impact.
  - Google became the first company in 2013 to have a multi-site ISO 50001 Energy Management System (EMS) certification.

Thank you!

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