“Enabling Energy Transition towards Low-Carbon Pathways: TERI’s Activities”

27th July, 2018 | Lawrence Berkeley National Laboratory (Berkeley Lab)
Electricity Demand in India by 2030

Sector-wise demand of Electricity (in TWh)

Source: TERI Analysis
India’s Solar Transition / Electricity Transition

Price/ Tariff Trends

Power Generation in India (By 2030)

Source-wise Power Generation in India (By 2030)

Source: TERI Analysis
**CASE FOR TRANSPORT ELECTRIFICATION**

AC Electric Bus total cost bid without Subsidy INR/ km lower than of Diesel Bus today:

- Diesel Bus = INR 60-80/ km; Electric Bus (AC) = INR 30-55/ km (without Subsidy)

**Note:** Daily distance travelled = 170-200 kms. Cost includes capita repayment at 10% interest, electricity, O&M costs & battery replacement for purchased buses in year 8. FAME subsidy is excluded in these estimates.

*Gross Cost Contract (GCC) & Outright Purchase (OP)*

**2-W Running Cost (INR/km) of TVS Scooty Pep vs. Hero Maxi Electric**

- Li-ion with Subsidy: 0.66
- Li-ion without subsidy: 0.83
- Lead Acid with Subsidy: 0.66
- Lead Acid without Subsidy: 0.74
- Petrol variant: 1.67

**Note:** Daily distance travelled = 40 kms; Battery replacement costs are included.

Source: TERI Analysis
# Electrification of the Industry Applications

Switch from thermal heating to electricity in industrial processes:

- Fuel switching can be explored in a number of other sectors e.g. foundries, forging, secondary steel, chemicals, textiles, food processing, etc.
- Switch over would depend upon availability of suitable technologies (including detailed design & engineering solutions), comparative prices of fuels, finance etc.

## Case study of a typical forging furnace:

Switch over from furnace oil (FO) firing to Induction billet heater:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity of FO furnace</td>
<td>400 kg. per shift</td>
</tr>
<tr>
<td>Capacity of induction billet heater</td>
<td>45 kW</td>
</tr>
<tr>
<td>Investment</td>
<td>INR 22 lacs.</td>
</tr>
<tr>
<td>Avoided FO consumption</td>
<td>93 kl/ Year</td>
</tr>
<tr>
<td>Electricity consumption with</td>
<td>1,78,000 kWh per Year</td>
</tr>
<tr>
<td>induction heater</td>
<td></td>
</tr>
<tr>
<td>GHG reduction potential</td>
<td>270 t CO₂/ Year</td>
</tr>
</tbody>
</table>

Source: TERI Analysis
NEED FOR TRANSITIONING TO LOW CARBON INDUSTRIES

- Many large industry sub-sectors undertaking steps to reduce their energy intensity:
  - Few are already equivalent to global standards e.g., cement, fertilizer
- Opportunities to further reduce Specific Energy Consumption (SEC) levels exist in several units in both large industries and MSMEs;
- A major challenge is to transit from fossil fuels to low carbon energy sources for thermal (process) energy requirements in ‘Hard-to-abate’ sectors such as iron & steel, cement, etc.
  - No commercially available zero carbon technologies globally; few are under development
  - Need for long-term collaborative R&D with global players
  - Huge capital investment and long gestation periods
POSSIBLE STEPS TOWARDS LOW/ ZERO CARBON EMISSIONS – CEMENT INDUSTRY

1. Improve efficiency through modernisation and adoption of EE measures – Reaching global best levels
   - Reduce SEC-Thermal: From 725 kcal/kg clinker to 660 kcal/kg clinker
   - Reduce SEC-Electrical: From 80 kWh/t cement to 65 kWh/t cement
2. Meet all electrical energy needs through RE sources
3. Meet thermal energy requirements for combustion through electric route (fully/ partially) – to be explored
4. Remaining CO₂ emissions only from calcination

Alternate routes:
1. Carbon Capture, Utilization, and Storage (CCUS)
2. Explore/ Research and switch over to alternate materials that avoid CO₂ generation (e.g., Timber for housing, new chemistry, other options ??)
POSSIBLE STEPS TOWARDS LOW/ ZERO CARBON EMISSIONS – IRON & STEEL INDUSTRY

1. Improve efficiency through modernisation and adoption of EE measures – reaching global best levels
   - Blast Furnace (BF)/ Basic Oxygen Furnace (BOF) Route - Reaching to SEC level of 5.5 Gcal/ tcs (giga calories per tonne of crude steel)
   - Electric Arc Furnace (EAF)/ Induction Furnace (IF) route through RE sources – Increase production to the extent possible; increase circularity

2. Use of hydrogen for iron ore reduction as a substitute for coke/coal
   - Hydrogen through biomass route or electrolysis of water

3. Meet thermal energy requirement through RE based electricity and/or, off-gases generated in the process
Freight Transport

Technological choices are not yet clear:

- LNG Trucks?
- Long Distance Electric Trucks?
- Aviation (adoption of Bio-Fuels)

- Technology development
- Economically viable
PROMOTING ENERGY EFFICIENCY

Innovative business models need to promote:

- Energy efficient appliances at Household-level, mainly Air Conditioners;
- Industrial energy efficiency;
- Energy efficient Electric Vehicles (including Charging Infrastructure);
- Energy efficient Pump-sets (including Solar pumps) for Agricultural applications, and
- Building energy efficiency (promoting ECBC & GRIHA)
CONCLUSION & WAY FORWARD

- Decarbonization of Indian electricity sector is now inevitable;
- Promoting energy efficiency through innovative Business Models for large scale adoption of energy efficient technologies & practices;
- Electrification of Buses & Two-Wheelers: Challenges – Charging Infrastructure;
- The techno-economic viability of electric heating vis-à-vis fossil fuel based heating should be explored in selected energy intensive industry processes, and
- Decarbonizing ‘hard-to-abate’ sectors such as Steel / Iron & Cement – Research on technologies is needed.