How are Indian industries doing: historical perspective and future outlook

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Figure 10.1. A schematic illustration of industrial activity over the whole supply chain. Options indicated by the circled numbers: (1) Reducing energy requirements of processes; (2) Reducing emissions from energy use and processes; (3) Reducing material requirements for products and in processes; (4-5) Reducing demand for final manufactured products and for their use.

Industrial emissions = (energy/material X emissions/energy + process_emissions/material) X material/product X product/service X (New_demand_for_service + Replacement_demand_for_service)
<table>
<thead>
<tr>
<th>Service</th>
<th>Avoid</th>
<th>Shift</th>
<th>Improve</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport</strong></td>
<td>➢ Accessibility  ➢ Mobility  ➢ Integrate transport &amp; land use planning  ➢ Smart logistics  ➢ Tele-working  ➢ Compact cities  ➢ Mode shift from car to cycling, walking, or public transit</td>
<td>➢ Electric two, three, and four wheelers  ➢ Eco-driving  ➢ Electric vehicles (various kinds)  ➢ Smaller, light-weight vehicles</td>
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<td><strong>Buildings</strong></td>
<td>➢ Shelter  ➢ Passive house or retrofit (avoiding demand for heating/cooling)  ➢ Change temperature setpoints</td>
<td>➢ Heat pumps, district heating, combined heat and power</td>
<td>➢ Condensing boilers  ➢ incremental insulation options  ➢ Energy efficient appliances</td>
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<td><strong>Industry</strong></td>
<td>➢ Clothing  ➢ Appliances  ➢ Long lasting fabric, appliances, sharing economy, eco-industrial parks, circular economy</td>
<td>➢ Virgin material to recycled materials, new materials for buildings and infrastructure</td>
<td>➢ Use of low carbon fabrics  ➢ New manufacturing processes and equipment use</td>
</tr>
</tbody>
</table>

Creutzig, F, Roy, J, Lamb, WF et al. (17 more authors), Nature Climate Change, Commentary 2018
What Indian industries are doing?
Changing Energy Intensity

Decomposition of energy demand-Indian manufacturing industries

Based on Annual Survey of Industries, India 1973-74 – 2010-11
Dasgupta and Roy (2017)
Transformational changes in process technology
Pace of process change – not similar for all industries

Cement

Source: Dasgupta and Roy 2017

Steel

Source: Dasgupta and Roy 2017
Catching up with BAT
Energy efficiency performance of Indian industries vis-à-vis world

Source: Dasgupta and Roy 2017
1. Driving force behind undertaking actions

- Exportability
- Consumer demand
- Price consideration
- Influence of policy pathways
- Competitiveness

Source: Chakraborty & Roy 2012
Energy Conservation Awards (since 1991)

- Participation (voluntary) increased from 123 units in 1999 to 773 in 2012
- Investment energy conservation in 2012 = INR. 1948 Crores
- Monetary saving achieved in 2013 = INR. 2886 Crores in 2013
- A payback period of 8 months

Electrical energy saving in terms of equivalent avoided Capacity in MW

Bureau of Energy Efficiency, Government of India, 2014
Costs associated with the energy efficiency measures (USD$_{2010}$/tCO$_2$)

- achieving near-zero emission intensity levels in the industry sector would require additional realization of long-term step-change options and these options are associated with higher cost.

Behavoural Response

Inter-factor substitutability of inputs and own price elasticity of energy input

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<tr>
<td>Capital- Labour</td>
<td>Complement</td>
<td>Substitute</td>
<td>Complement</td>
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<tr>
<td>Capital - Material</td>
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<td>Capital-Energy</td>
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<tr>
<td>Own price elasticity of energy</td>
<td>-0.22</td>
<td>-0.60</td>
<td>-0.74</td>
<td>-1.22</td>
</tr>
</tbody>
</table>

- Technological progress evolved to substitute energy input, especially by material inputs
- But, this along with a technological bias towards material input seeks attention
- Own price elasticity of energy input is negative with an increasing magnitude
- Price based intervention is expected to be effective to pull down the energy use further with far reaching implications towards reduction of emission as well.

Emergence of Policy framework

• National Enhanced Energy Efficiency Mission (for large energy intensive industries)

• Energy Certificates Market under PAT (like EU-ETS)

• Coal Cess (INR 400/ton of coal~ $6/ton)
What more?
New Potential
Response of Indian industries to global climate goals:

- Results from GCAM with detailed industry sector for India

- How Indian industries are expected to respond if a uniform global CO$_2$ price is implemented to meet a cumulative emission mitigation target to achieve the 2 degree goal?

- The policy consider – a global carbon price uniformly prevailing across nations and across sectors.
Results from GCAM

Source: Dasgupta, Roy et.al (2017)
Potential beyond energy intensive industries

Industries other than energy intensive industries covered under PAT – big role to play

Source: Dasgupta, Roy et.al (2017)
Implications for power generation

Long run green growth in industry requires large scale electrification

Projected consumption of fuel use for electricity generation in Indian in 2050: comparison of Reference scenario and green growth policy scenario

Source: Dasgupta, Roy et.al (2017)
Installed capacity: share of different fuels in March, 2017

Coal: 59%
Gas: 8%
Nuclear: 2%
Hydro: 14%
RES: 17%
Wind: 10%
Biomass: 2%
Solar: 4%
SHP: 1%

Source: Central Electricity Authority of India, 2017
Share of different fuel and technology in generation in 2017

- Coal: 76%
- Gas: 4%
- Nuclear: 3%
- Hydro: 10%
- RES: 7%
Installed capacity share of different fuel and technology
Reference Scenario in 2050
Share of different fuel and technology in generation
Reference Scenario in 2050
Installed capacity share of different fuel and technology
NDC Scenario in 2050
Share of different fuel and technology in generation
NDC Scenario in 2050
Natural Gas as transition fuel

• As the average quality of Indian coal is low, the import of high-quality coal has become indispensable

• Increasing the share of natural gas in power production diversifies the import dependency of India

• Together with the increase in sources and decrease in market concentration energy security may in fact increase
Natural Gas Supply in India

• After 2012 the production of natural gas in India has declined consistently due to geological uncertainties (Ministry of Petroleum & Natural Gas, GoI, 2017)

• LNG import in future is expected to be approximately 78 BCM annually by 2030 (Petroleum & Natural Gas Regulatory Board, 2013)

• Three LNG terminals in the west coast and two in the east coast of India have been commissioned

• Government has taken initiatives in development of nationwide grid for the transportation of natural gas (Petroleum & Natural Gas Regulatory Board, 2013)
Thank you

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http://juglobalchangeprogram.org/