MODULE 4:
ENERGY EFFICIENCY DATA ANALYTICS
1. ENERGY PRODUCTIVITY INDICATORS
2. GAP ANALYSIS
3. E I MAS
ENERGY PRODUCTIVITY INDICATORS

EE Performance Indicators

Country economic data/statistics
- Economy scale indicators:
  - Economy aggregate energy productivity: GDP/domestic
  - Energy production + energy imports - energy exports
- Sectoral scale indicators:
  - Sectoral value add/total energy consumed by the sector
- Sub-sector scale indicators:
  - Sub-sectoral value add/total energy consumed by the sub-sector
- Unit specific energy consumption
  - Plant energy consumption/physical unit produced
ENERGY PRODUCTIVITY INDICATORS

EE Performance Indicators for Industries

Level 1
Total industry energy sector energy consumption per total industry

Level 2
Total industry energy sub-sector energy consumption per unit sub-sector physical output

Level 3
For each process type energy consumption per unit of physical output

Level 4
Plant specific energy consumption at department/section/equipment level
Benchmarking of Sectoral Energy Efficiency

- Benchmarking is the process of accounting for and comparing a metered industrial facility’s current energy performance with its energy baseline or with the energy performance of similar types of industry. The United Nations Industrial Development Organization (UNIDO).

- benchmarked the energy efficiency potential for 26 industrial sub-sectors globally by looking at sector specific indicators of performance in terms of energy per unit of output (UNIDO 2010) (refer Table on the next slide).

- The study broke down the results in developing and developed countries and also presented figures for the global average, the lowest found in the sample and the achievable performance using Best Available Technology (BAT).
### Table: Specific Energy Consumption in Industry – India and the World

<table>
<thead>
<tr>
<th>Sector</th>
<th>Unit</th>
<th>Industrialized Country</th>
<th>Developing Country</th>
<th>Global Average</th>
<th>Best available Technology</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum refineries (2003)</td>
<td>Energy Efficiency Index (EEI)</td>
<td>0.7 – 0.8</td>
<td>1.3 – 3.8</td>
<td>1.25</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>High Value (HVC)</td>
<td>Gj/t HVC</td>
<td>12.6 – 18.3</td>
<td>17.1 – 18.3</td>
<td>16.9</td>
<td>10.6</td>
<td>17.1</td>
</tr>
<tr>
<td>Ammonia (2007)</td>
<td>Gj/t NH3</td>
<td>33.2 – 36.2</td>
<td>35.9 – 46.5</td>
<td>41</td>
<td>23.5</td>
<td>37.5</td>
</tr>
<tr>
<td>Methanol (2006)</td>
<td>Gj/t MeOH</td>
<td>33.7 – 35.8</td>
<td>33.6 – 40.2</td>
<td>35.1</td>
<td>28.8</td>
<td>40.2</td>
</tr>
<tr>
<td>Aluminium Smelting (2007)</td>
<td>MWh/t</td>
<td>14.8 – 15.8</td>
<td>14.6 – 15</td>
<td>15.5</td>
<td>13.4</td>
<td>16</td>
</tr>
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<tr>
<td>Alumina Production</td>
<td>Gj/t alumina</td>
<td>10.9 – 15.5</td>
<td>10.5 – 24.5</td>
<td>16</td>
<td>7.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Iron &amp; Steel (2005)</td>
<td>Gj/t clinker</td>
<td>1.6 – 1.4</td>
<td>1.4 – 2.2</td>
<td>1.45</td>
<td>1</td>
<td>1.55</td>
</tr>
<tr>
<td>Clinker (2007)</td>
<td>Gj/t clinker</td>
<td>3.3 – 4.2</td>
<td>3.1 – 6.2</td>
<td>3.5</td>
<td>2.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Lime</td>
<td>Gj/t lime</td>
<td>3.6 - 13</td>
<td>5 - 13</td>
<td>--</td>
<td>--</td>
<td>5.6</td>
</tr>
<tr>
<td>Glass (2005)</td>
<td>Gj/t melt</td>
<td>4 - 10</td>
<td>6.8 - 7.8</td>
<td>6.5</td>
<td>3.4</td>
<td>6.8</td>
</tr>
<tr>
<td>Brick making (2000s)</td>
<td>Gj/kg fired brick</td>
<td>1.5 - 3</td>
<td>0.75 - 11</td>
<td>--</td>
<td>--</td>
<td>3 - 11</td>
</tr>
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<tr>
<td>Pulp &amp; Paper</td>
<td>EEI (heat &amp; electricity)</td>
<td>0.93 – 1.73</td>
<td>0.43 – 2.29</td>
<td>1.31</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>Textiles - Spinning</td>
<td>Gj/t yarn</td>
<td>3.5 – 3.6 (ring yarn)</td>
<td>3.5 – 3.6 (ring yarn)</td>
<td>--</td>
<td>--</td>
<td>3.57 (ring yarn)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.57 (open end)</td>
<td>0.5 – 7.5 (other)</td>
<td></td>
<td></td>
<td>2.5 (other)</td>
</tr>
<tr>
<td>Textiles - Weaving</td>
<td>Gj/t cloth</td>
<td>11 – 65</td>
<td>5 - 43</td>
<td>--</td>
<td>--</td>
<td>27 – 32.4</td>
</tr>
</tbody>
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## Benchmarking of Sectoral Energy Efficiency

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<tr>
<td>Cast Iron</td>
<td>kWh/t melt</td>
<td>950 (cupola)</td>
<td>780 – 850</td>
<td>--</td>
<td>520</td>
<td>780 – 900</td>
</tr>
<tr>
<td></td>
<td></td>
<td>525 – 715 (electric)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cast/ alloy steel</td>
<td>kWh/t melt</td>
<td>525 – 715 (electric)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cast aluminium</td>
<td>kWh/t melt</td>
<td>600 – 1250 (fuel fired)</td>
<td>735</td>
<td>--</td>
<td>500</td>
<td>735</td>
</tr>
<tr>
<td></td>
<td></td>
<td>440 – 590 (electric)</td>
<td>590</td>
<td>--</td>
<td>570</td>
<td>--</td>
</tr>
<tr>
<td>Cast copper</td>
<td>kWh/t melt</td>
<td>400 – 1100 (electric)</td>
<td>590</td>
<td>--</td>
<td>400</td>
<td>590</td>
</tr>
</tbody>
</table>
Prioritisation through GAP analysis

• The priorities should be to focus on improving the performance of inefficient and large energy consuming industries.

• Gap analysis is a benchmarking process that accounts for and compares a plant’s current energy performance with that deploying Best Available Technologies (BAT).

• GAP analysis begins with first collating information from public sources on the pattern of sub-sectoral energy consumption at the regional, country and local levels.
Data Sources GAP analysis

- Information available in the public domain
- Indicators and data from country experience
- Measured plant energy consumption data
- Qualitative and plant design name plate data

GAP Analysis
GAP Analysis Steps

Step 1
Indexing industry units on SEC; high-low analysis to identify GAPs

Step 2
Application of sensitivity analysis to contrast units from BAT performance

Step 3
Determining overall potential for improvement
Target Setting

**Historic SEC reduction trend**
- Past trends in SEC reduction within industrial units as well as the average performance of the sub-sector as a whole as a result of implementation of energy efficiency measures. This acts as a reference for future phase wise reduction targets.

**Target setting with respect to relative performance**
- Unit specific targets to be provided relative to the current positioning of the unit within the sub-sector. Unit with highest SEC gets largest target and vice-versa. SECs need to be normalized to address extraneous factors, if applicable.

**Timelines for energy reduction targets**
- Based on historic data on SEC reductions and gap analysis (i.e. SEC deviation from SEC-BAT) realistic timeline for achievement of energy reduction targets could be taken.
Setting Realistic Targets

1. Past Energy Efficiency Investments (Industry Trends)
2. GAP in respect to Best Available Technologies
3. Phase wise reduction targets timelines, instead of annual targets.
4. Maturity and cost of deployment of Best Available Technology (Process and Equipment's); Normalization factors
<table>
<thead>
<tr>
<th>Primary Energy Input</th>
<th>Secondary Energy Input</th>
<th>Capacity Utilization Factor</th>
<th>Raw material and product output</th>
<th>Environmental Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fuel quality</td>
<td>• Grid power purchase</td>
<td>• Impact of market demand</td>
<td>• Quality of raw materials</td>
<td>• Change in product standards</td>
</tr>
<tr>
<td>• Use of biomass as fuel</td>
<td>• Captive power generated</td>
<td>• Non-availability of raw materials</td>
<td>• Change in output product mix</td>
<td>• Change in Government Policy</td>
</tr>
<tr>
<td>• Use of byproducts as fuel</td>
<td>• Waste heat recovered</td>
<td>• Quality of power supply</td>
<td>• Change in inputs</td>
<td>• Force Majeure issues</td>
</tr>
<tr>
<td>• Non-availability of fuel</td>
<td>• Export to grid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use of renewable energy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ENERGY INFORMATION MANAGEMENT AND ANALYTICAL SYSTEMS
1 Introduction

• EIMAS could be a powerful tool to measure and compute energy performance indicators (EnPIs) that drive industrial energy efficiency projects and programs and should be a key focus area for industrial companies to establish.

• **The EIMAS offers the following benefits to its users:**
  o Access to centralized data, and strengthened and effective management information system.
  o EnPI-driven information and performance analysis.
  o Useful insights and predictive analysis to serve as metrics that improve shop floor energy performance and productivity.
  o Real-time management and optimized use and control of end-use energy in utilities and process departments.
  o Easy, quick, and timely reporting of energy performance.
Centralized Energy Efficiency Data Repository

**Benefit**

- An integrated assessment of the energy performance of the sector.
- An effective tool for monitoring and verification of energy performance trends (for example, a specific energy consumption metric, such as a unit (kilowatt-hour) per kilogram of production) at the sector, subsector, unit, department, process, and equipment levels.
- Based on normalized EnPIs, different units are ranked and compared, and gaps in specific energy consumption are identified.
- Useful in planning future policies to improve the energy efficiency of the sector as a whole.
Centralized Energy Efficiency Data Repository

EnMS at the Organisational level and Centralized EE benchmarking at the Industry sub-sector level
Questions?
Thank You

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