Application of Japanese Low Carbon Technologies in Indian SMEs – Background, Lessons and Opportunities

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Outline

- SME sector in India
- About the project
- Results
- Opportunities for scaling up
Contribution of SME sector to Indian economy

- Accounts for half of industrial production
- Responsible for almost one-third of India’s total exports
- Provides jobs to millions of unskilled people (estimated 60 million)
- Contributes to economic growth and development, particularly in rural areas and small towns
Salient features of the SME sector

- Resource inefficient technologies still in use
- High energy consumption and emissions of greenhouse gases (GHGs)
- Adoption of Energy Efficient technologies and practices among SMEs will significantly contribute to India’s voluntary emission intensity reduction goal
Project Background

• Goal To promote low carbon technologies and practices among Indian SMEs

• Time period 4 years (May 2010 - March 2014)

• Implementation partners
  - *Indian* TERI, SMEs
  - *Japanese* IGES, Kyoto University, Japanese companies

• Coordinating government agencies
  - *Indian* Ministry of Environment and Forests (MoEF)
  - *Japanese* Japan International Cooperation Agency (JICA) & Japan Science & Technology (JST)
Pilot project

Technology selection

- Technologies selected for feasibility studies
  - Micro cogeneration
  - Energy efficient ventilation fan
  - Gas heat pump (GHP)
  - Electric heat pump (EHP)
  - Energy efficient air-conditioning system (VRV system)
  - Energy efficient lighting system (light sensor with dimmer control)
  - Amorphous transformer
  - Electric induction melting furnace
  - Compressed air system
  - Wireless energy metering and communication system
### Two hard technology systems and two best practices shortlisted for pilot demonstration

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of investigated sites</th>
<th>Pilot projects</th>
<th>Location of pilot projects</th>
<th>Type of industry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gas heat pump</strong></td>
<td>11</td>
<td>2</td>
<td>Rajkot</td>
<td>Investment casting</td>
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<tr>
<td><strong>Electric heat pump</strong></td>
<td>13</td>
<td>2</td>
<td>Anand- Ahmedabad</td>
<td>Dairy</td>
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<td>Chandigarh</td>
<td>Dairy</td>
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<tr>
<td><strong>Compressed air system</strong></td>
<td>13</td>
<td>4</td>
<td>Pune; Noida</td>
<td>Forging industry, Ink manufacturing</td>
</tr>
<tr>
<td><strong>Induction furnace</strong></td>
<td>8</td>
<td>2</td>
<td>Kolhapur</td>
<td>Sand casting</td>
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</table>

**Hard Technologies systems**

**Best Practices (Soft technologies)**
RESULTS
Results #1: Demonstration of Electric Heat Pump (EHP)

- **Application**
  - Preheating of boiler feed water & precooling of process chilled water
  - Dairy, food processing, pharmaceutical, commercial buildings
  - Pilot plants installed in Chandigarh (Punjab) and Anand (Gujarat)

- **Benefits**
  - Reduction in fuel consumption in boiler and electricity in chiller
  - Primary energy savings 30%-40%
Results #2: Demonstration of Gas Heat Pump (GHP)

- **Application**
  - Room air conditioning
  - Space cooling applications in industry and commercial buildings
  - Two pilots installed in Rajkot (Gujarat)

- **Benefits**
  - Switch from electricity to clean fuel (NG)
  - Primary energy savings around 50%
Results #3: Best practices in compressed air system

❖ Context
  ❖ Air compressors account for 20-25% of electricity in many factories

❖ Observations
  ❖ Life Cycle Cost (LCC) is significant in compressors e.g. power consumption (84%), maintenance (9%) and equipment (7%)
  ❖ Proper selection of all equipment (compressor, receiver, filter, piping, pneumatic actuators, energy saving nozzle, etc.) is crucial
  ❖ Significant energy saving could be achieved with zero cost (pressure setting, stop leakage)
  ❖ Installing inverter type air compressors, is quite costly, but pay back period is between 2 and 4 years
Results #4: Best practices in electric induction furnace

- **Application**
  - Foundry, metal casting units

- **Observations**
  - Process parameters like product yield and rejection ratio have important influence on energy efficiency
  - Often data recorded is not linked to improvements in operation
  - Awareness on best practices among operators is not high

- **Major recommendations**
  - Establish systems to analyze data and take corrective action
  - Use computer simulations for improving yield and reducing reductions
  - Implement 3S/5S activities
  - Train SME or train trainers (experts) regarding best practices
Results #5: Capacity building and awareness raising (level1)

- Targeting SME at unit level:
  Onsite capacity building for managers and workers during site visits (in total, more than 50 sites visited)
Capacity building and awareness raising (level 2)

- Targeting SME at cluster/segment level
  Several cluster workshops to introduce technology to business entrepreneurs and business associations
  (in total 10 conducted)

IGES –TERI Joint Workshop
January 2014, Chandigarh (India)

IGES –TERI Joint Workshop
January 2014, Rajkot (India)
Capacity building and awareness raising (Level 3)

- Targeting Indian experts:
  Training workshops to Indian experts (In India and in Japan)
  (in Total 4 (2 in India and 2 in Japan))
Capacity building and awareness raising (Level 4)

- Targeting Policy makers:
  Interaction with policy makers through meetings, symposiums, etc.

Delhi Sustainable Development Summit (DSDS) (February 2014 New Delhi- India)

India-Japan Energy Forum (September 2013 New Delhi- India)
CASE STUDIES
Case study- Use of EHPs

Site A
Application - Food processing
Size – Heating- 59.6 kW, Cooling – 37.6 kW
Features - Cooling water from 15°C to 12°C (for production process) and simultaneously to heat water from 35°C to 80°C (that will be used to preheat water for boiler).
Refrigerant used – CO2
Energy saving achieved: Around 30-40%

Site B
Application - Dairy industries
Size – Heating- 59.6 kW, Cooling – 37.6 kW
Features - Simultaneously provide pre-heated water (from 35°C to 90°C) to the boiler and pre-cooled return chilled water (from 15°C to 10°C) for chiller.
Refrigerant used – CO2
Energy saving achieved: Around 30-40%
Case study: Use of GHPs

- GHP technology demonstrated at two SME units in Rajkot in February 2013.
- Application - shell drying in wax investment casting
- Size:
  - Unit 1 – 32 TR (2 units)
  - Unit 2 – 93 TR (5 units)
- Replacement of small electric ACs with GHPs in two SMEs
- Overall primary energy savings: around 50 %
- Energy cost savings: Highly elastic - depending upon NG cost
## Case Study: Energy savings in Compressed air usage in Forging Unit-1

| Introduction of Unit | - 2700 t/yr production capacity  
| - Electricity consumption: 2,053,000 kWh/yr  
| - Manufactures flanges for automobile sector |

| About air compressor infrastructure | - 15-20% energy consumption in air compressors alone  
| - 5 air compressors (range 37.5 - 150 kW, 200- 900 cfm) |
## Forging Unit-1: Impact

<table>
<thead>
<tr>
<th>Energy savings measures</th>
<th>Impact</th>
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<tr>
<td>-Optimization of set air pressure</td>
<td>-92,385 kWh/yr, primary energy savings</td>
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<tr>
<td>-Replacement of old (diesel) air compressor by new energy efficient compressor</td>
<td>-86 tCO2/yr, emission reduction</td>
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<td>-Removal of air leakages from 30 machines</td>
<td>-Rs. 600,502/- per yr, energy cost savings</td>
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<td>~less than 1 yr payback period</td>
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### Before
![Before Image](image1)

### After
![After Image](image2)
## Case Study: Energy savings in Compressed air usage in Forging Unit- 2

| Introduction of Unit | - Energy consumption: 2,776,560 kWh/yr
|                     | - Manufactures flanges, valve bodies and shafts for automobile sector |

| About air compressor infrastructure | - 20-25% energy consumption in air compressors alone
|                                    | - Three air compressors (range 132-160 KW, approx 1000 cfm each) |
## Forging Unit-2: Impact

**Energy savings measures**
- Reset (reduce) pressure setting from 6.5 - 7.0 bar to 5.2 - 5.8 bar
- Removed leakage from air pipes, flow control valves, through installing proper air guns, etc. resulting in 60% reduction in air leakage

**Impact**
- 139,690 kWh/yr, primary energy savings
- 130 tCO2/yr, emission reduction
- Rs. 907,985/- per yr, energy cost savings
- ~less than 1 yr payback period

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OPPORTUNITIES
Opportunities for scaling up ALCT project in Indian SMEs

• Demonstrated technologies /practices
  – EHP in dairy industry and other industries like Pharmaceutical, food processing, textile, other sectors
  – GHP in locations depending upon NG availability
  – Compressed air generation/distribution in forging and other SME sectors
  – Induction furnace BOPs in foundry sector

• New Japanese technologies
  – Demonstration and dissemination
Example : Indian Forging Sector

- ~1200 forging units
- Spread over Pune, Chennai, Delhi, Hyderabad, Ludhiana
- 1.5 million ton per year production capacity
- Energy consumption: Appx. 0.6 mtoe/year
- 30% energy savings as per TERI-IGES study on compressed air systems
- ~300,000 tCO₂ emission reduction potential p.a. - only through compressed air optimization
Example – Indian Foundry sector

- More than 4,500 foundries in India
  - 80% of the foundries are MSME
- Indian foundry industry FY’12
  - More than 9.3 million tonnes production
  - Accounts for 8-9% of total world’s casting production
- Located in different clusters
  - Induction furnace study conducted in Kolhapur cluster
  - Significant energy savings possibilities exist through Kaizen and 3S/5S programs
Example: Indian Dairy Industry

- Annual milk production in India - 128 million tonne/year
- India accounts for 15% of world’s total dairy production
- Operates under
  - Milk Producers’ Cooperative Unions
  - Private entrepreneur
- Primary products
  - Different liquid milks (skimmed, toned, standard and high fat etc.)
  - Assorted milk and food products (curd, butter, chocolate, sweets and baby foods etc.)
- Estimated saving potential in just two milk producing states (Punjab and Gujarat) through adoption of EHPs:
  - Potential number of industries for replication of EHP - 50
  - Saving in equivalent primary energy – 1000 toe/year
  - Saving in equivalent CO2 generation at primary level – 3000 t-CO2/year
Example: Adoption of GHP in investment casting industries in India

- Number SMEs - 120
- Production capacity – 50 tonne casting/month
- Connected electrical AC load – 12 TR/tonne of casting/hour
- Equivalent primary energy consumption – 2.6 million toe/year
- Equivalent CO2 generation at primary level - 10 million tonne/year
- Potential saving at primary level on application of GHP – 30% assumed
- Saving in equivalent primary energy – 0.78 million toe/year
- Saving in equivalent CO2 generation at primary level – 3 million t-CO2/year
Conclusions

- Project has demonstrated that significant energy and GHG saving is possible through adoption of EE technologies and practices among SMEs.
- Seeded interest among stakeholders on the demonstrated Japanese technologies.
- Generated awareness on best operating practices.
- Built local capacities through diagnostic studies by Japanese experts and pilot demonstrations.
- Serve as a model to promote cleaner technologies under bilateral/multilateral cooperation.
- Huge opportunities to conduct projects that built upon the findings and lessons learnt from current project.
  - TERI already getting enquiries from dairy plants and other industry stakeholders on demonstrated options.
Thank you for your attention