Capacity Building workshop

# Energy conservation

09th February 2018 at Coimbatore

**Under the project**
Capacity Building of Local Service Providers (LSPs)

**Supported by**
GEF-UNIDO-BEE Project
Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

teri gef UNIDO BEE COINDIA® COIMBATORE INDUSTRIAL INFRASTRUCTURE ASSOCIATION

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# Workshop summary

## Overview of workshop

Capacity Building workshop of Local Service Providers (LSPs) on Energy conservation was organized by TERI on 9th February 2018, Friday in association with COINDIA under GEF-UNIDO project. Total 50 participants were present during the workshop and for the industry visit, which was organized after the workshop. Agenda of the workshop and list of participants are attached in the annexure 1 and annexure 2 respectively.

## Summary of points discussed in the meeting

Mr. S Kuppusamy welcomed the participants and thanked TERI and UNIDO for arranging the capacity building workshop. He highlighted that, in a typical induction based foundry unit around 80 % of energy consumption is from induction melting furnace and only best operating practices can reduce the specific energy consumption in induction furnaces significantly. Also, it is very important to monitor the energy and production data in order to understand the energy losses and efficiency of the system. He encouraged participants to take advantage of energy audit equipment's, which are made available by UNIDO for industries for reducing their energy costs by arriving at energy saving potential.

Mr. R Sivakumar gave a brief background of the GEF-UNIDO-BEE project activities in Coimbatore and also explained the objective of the workshop. He informed about the current available equipment's at energy cell and how industries can benefit by availing energy audit services at low costs.

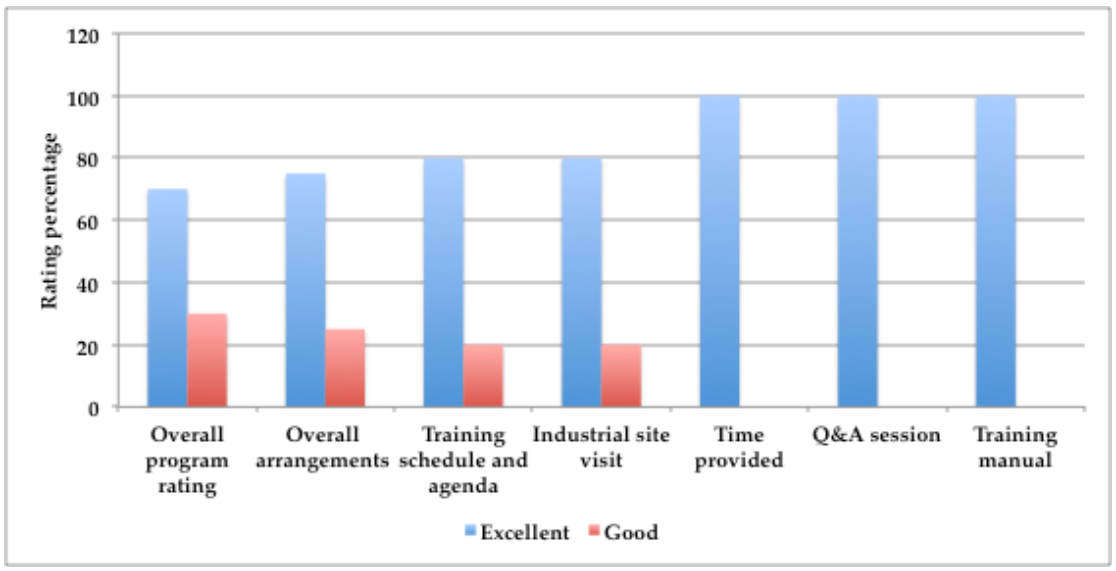
Mr. Prosanto Pal gave descriptive presentation on best operating practices in foundries. He explained in detail the areas where it is possible to improve operating practices, which eventually results in significant amount of energy savings. He also spoke about general practices followed in a foundry and how the existing system can be optimized to give energy savings and to improve the life by avoiding the losses. He explained about how energy efficient machines though high cost can result in lower running cost over a lifetime due to its efficient operation.

Mr. Nilesh Shedge gave presentation on actual case studies of implementation of different energy efficient technologies and best operating practices done by TERI in foundries. Case studies on retrofitting technologies as well as revamping of old technologies were given along with cost benefit analysis. He covered induction-melting furnace, which consumes 80% of energy along with all the auxiliaries like air compressors, pumping system, motors and lighting.

After the lunch, plant tour through the M/s Aqua Sub Engineering Foundry (Unit II )was arranged, so that participants can experience the actual implementations done for energy saving and best operating practices followed by the unit. Selected photos of the workshop and visit are attached in the annexure 3.

# Feedback forms

Based on the analysis of the feedback forms received from the participants, it is observed that workshop was well received by the participants and 100% participants were satisfied with foundry visit, Q&A session and training module provided to them. About 70% participants have rated overall program as "Excellent" while rest of them have rated it as "Good". More than 75% of participants were satisfied with arrangements made, training schedule and agenda of the program. Few sample feedback forms are attached in the annexure 4.




**Analysis of feedback forms**

# Suggestions by participants

Some participants have made suggestions as follows;

1) Requirement of detailed workshop on induction/cupola melting furnace
2) More technology specific workshops on topics like air compressors

# Learning's by participants

Some of the topics learned by the participants and mentioned by them are listed below;

1) Arresting air leakages in the plant
2) Ring loop air piping
3) Appropriate air receiver sizing
4) VFDs in air compressors
5) IE3 motors applications
6) Heat loss reduction in induction melting by using lid cover

# Annexures

# Annexure 1: Agenda of the program

**Capacity Building workshop**

**Energy conservation**

*Friday, 9 February 2018*

*COINDIA Board Room, II Floor – SIEMA Building ,*

*8/4 Race Course, Coimbatore 641 018*

Under the project:

**Capacity Building of Local Service Providers (LSPs)**

Supported by:

**GEF-UNIDO-BEE Project**

**Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India**

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**Agenda**

| | |
|---|---|
| 10:00 – 10:30 | Registration |
| 10:30 – 10:40 | **Welcome Address**<br>Mr S Kuppusamy, President & MD/CEO, COINDIA |
| 10:40 – 10:50 | **GEF-UNIDO-BEE project and initiatives in Coimbatore cluster**<br>Mr R Sivakumar, UNIDO Cluster Leader - Coimbatore |
| 10:50 – 11:50 | **Operating practice improvements to save energy in process (Induction Furnace Melting) and auxiliaries (Air Compressors, Pumps and Lighting)**<br>Mr Prosanto Pal, TERI |
| 11:50 – 12:50 | **Retrofits and new Technologies to save energy in process (Induction Furnace Melting) and auxiliaries (Air Compressors, Pumps and Lighting)**<br>Mr Nilesh Shedge, TERI |
| 12.45 – 13:00 | Q&A |
| 13:00 – 14:00 | Lunch |
| 14:00 – 16:00 | **Site Visit / On-site training**<br>Visit to a foundry unit |
| 16.00 – 16:30 | Feedback from participants |
| 16:30 – 16:45 | **Vote of thanks** |

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# Annexure 2: List of participants

| S. No | Name | Organization | Mobile No | Email ID |
|---|---|---|---|---|
| 1. | K. Boopathi | M/s Sri Sugunamachine Works | 9442221267 | boopathi4uall@gmail.com |
| 2. | A Pradeepan | M/s Indo Shellcast Pvt. Ltd | 9965488444 | mtc2@indoshellcast.com |
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| 5. | R Soundara Rajan | Sree Ragunandana Industries | 9865213757 | ragunandana71@gmail.com |
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| 8. | AVP Ramesh Kumar | Suguna Motors | 7010934719 | avprkumar@gmail.com |
| 9. | DHIL P Kumar | Si Tarc, Coimbatore | 9787142566 | dhilip_005kumar@yahoo.co.in |
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| 14. | R Nandakumar | Aquasub Engg. Unit II | 9952411235 | ase2mfg@aquagroup.in |
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| 16. | G Surya Prakash | Vasan Foundry | 9942557537 | vasanfoundry@.com |
| 17. | G Shanmugasundaram | S G Pneumatics Pvt Ltd | 9655503167 | sales.cp3@sgpneumatics.com |
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| 19. | S. Sathesh Kumar | Lakshmi Machine Works Ltd Unit-II | 8144921325 | satheshkumar.s@lmw.co.in |
| 20. | V S Mohankumar | LUMU -1 | 9486775486 | sivakumar.v@lmw.co.in |
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Capacity building workshop

# Energy conservation

9 February 2018, COINDIA Board Room, Coimbatore

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| 6. | P. Chellakkanji | Balajyam Engineering P/L | 9442116949 | Lab@Balajyam.com | |
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| 51 | | | | | |
| 52 | | | | | |
| | | | | | |

# Annexure 3: Selected photographs of the event


# Annexure 4: Sample feedback forms

Capacity building workshop

**Energy conservation**

*Friday, 9 February 2018*

*COINDIA Board Room, II Floor – SIEMA Building*

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**Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India**

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**Evaluation Sheet for Participants**

| *Feedback Form for Participants* | | | |
|---|---|---|---|
| *Parameter* | *Feedback* | | |
| | Excellent | Good | Average |
| How would you rate the overall programme? | | ✓ | |
| How would you rate overall arrangements? | | ✓ | |
| How was the training schedule and agenda? | ✓ | | |
| How was the industrial site visit? | | | |
| Do you think that adequate time was provided for each topic? | Yes [✓] | No [ ] | |
| Do you think that satisfactory answers were given to your questions during the training programme? | Yes [✓] | No [ ] | |
| Do you think that the background training manual is informative and useful enough? | Yes [✓] | No [ ] | |
| Do you think that the discussion on EE/RE will help you in your work? | Yes [✓] | No [ ] | |
| **Suggestions & Recommendations for improvement:** | | | |
| more workshops will be helpful. | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| * Upgrading suitable pipe line system – Compressor to our customers<br>* Fixing Retrofit VFD to those who have load fluctuation. * Supplying Inbuild screw Compressors (Chicago Pneumatic) | | | |
| **Signature:** | | | |
| **Name of participant:** | G. SHANMUGASUNDARAM | | |
| **Organization:** | SG Pneumatics (P) Ltd | | |
| **Mobile No:** | 96555 03167 | | |
| **Email ID:** | sales.epz@sgpneumatics.com | | |

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Capacity building workshop

## Energy conservation

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### Evaluation Sheet for Participants

| *Feedback Form for Participants* | | | |
|---|---|---|---|
| *Parameter* | *Feedback* | | |
| | Excellent | Good | Average |
| How would you rate the overall programme? | ✓ | | |
| How would you rate overall arrangements? | ✓ | | |
| How was the training schedule and agenda? | ✓ | | |
| How was the industrial site visit? | - | | |
| Do you think that adequate time was provided for each topic? | Yes [✓] | No [ ] | |
| Do you think that satisfactory answers were given to your questions during the training programme? | Yes [✓] | No [ ] | |
| Do you think that the background training manual is informative and useful enough? | Yes [✓] | No [ ] | |
| Do you think that the discussion on EE/RE will help you in your work? | Yes [✓] | No [ ] | |
| **Suggestions & Recommendations for Improvement:** Nice | | | |
| Further classes should be extend and presentation classes and more VFD systems notes. | | | |
| | | | |
| | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| ① Compressed air leakages | | | |
| ② cooling tower temperature Controlled System | | | |
| ③ Dust collector provide the VFD cont. | | | |
| | | | |
| **Signature:** | | | |
| **Name of participant:** | M. SAIRAJ | | |
| **Organization:** | M/s. Real Time Engineering India (P) Ltd. Chn. | | |
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### Evaluation Sheet for Participants

| *Feedback Form for Participants* | | | |
|---|---|---|---|
| *Parameter* | *Feedback* | | |
| | Excellent | Good | Average |
| How would you rate the overall programme? | ✓ | | |
| How would you rate overall arrangements? | ✓ | | |
| How was the training schedule and agenda? | | ✓ | |
| How was the industrial site visit? | | ✓ | |
| Do you think that adequate time was provided for each topic? | Yes [✓] | No [ ] | |
| Do you think that satisfactory answers were given to your questions during the training programme? | Yes [✓] | No [ ] | |
| Do you think that the background training manual is informative and useful enough? | Yes [✓] | No [ ] | |
| Do you think that the discussion on EE/RE will help you in your work? | Yes [✓] | No [ ] | |
| **Suggestions & Recommendations for improvement:** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| **Signature:** | | | |
| **Name of participant:** | D. Ravi Shankar | | |
| **Organization:** | LMW. | | |
| **Mobile No:** | 9244200234 | | |
| **Email ID:** | ravishankar.k.r@lmw.co.in | | |

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Capacity building workshop

## Energy conservation

*Friday, 9 February 2018*

*COINDIA Board Room, II Floor – SIEMA Building*

Supported by:

**GEF-UNIDO-BEE Project**

**Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India**

---

### Evaluation Sheet for Participants

| *Feedback Form for Participants* | | | |
|---|---|---|---|
| ***Parameter*** | ***Feedback*** | | |
| | Excellent | Good | Average |
| How would you rate the overall programme? | ✓ | | |
| How would you rate overall arrangements? | ✓ | | |
| How was the training schedule and agenda? | ✓ | | |
| How was the industrial site visit? | | ✓ | |
| Do you think that adequate time was provided for each topic? | Yes [ ✓ ] | No [ ] | |
| Do you think that satisfactory answers were given to your questions during the training programme? | Yes [ ✓ ] | No [ ] | |
| Do you think that the background training manual is informative and useful enough? | Yes [ ✓ ] | No [ ] | |
| Do you think that the discussion on EE/RE will help you in your work? | Yes [ ✓ ] | No [ ] | |
| **Suggestions & Recommendations for improvement:** | | | |
| All way good. | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| 1) Melting Methonod | | | |
| 2) Air compressor pipe line in our plant | | | |
| 3) | | | |
| **Signature:** | | | |
| **Name of participant:** | V.P. Ramesh | | |
| **Organization:** | Production Supervisor | | |
| **Mobile No:** | 9843519985 | | |
| **Email ID:** | vpramesh0555@gmail.com | | |

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Capacity building workshop

## Energy conservation

*Friday, 9 February 2018*

*COINDIA Board Room, II Floor – SIEMA Building*

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**GEF-UNIDO-BEE Project**

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---

### Evaluation Sheet for Participants

| *Feedback Form for Participants* | | | |
|---|---|---|---|
| *Parameter* | *Feedback* | | |
| | Excellent | Good | Average |
| How would you rate the overall programme? | ✓ | | |
| How would you rate overall arrangements? | ✓ | | |
| How was the training schedule and agenda? | ✓ | | |
| How was the industrial site visit? | ✓ | | |
| Do you think that adequate time was provided for each topic? | Yes [ ✓ ] | No [ ] | |
| Do you think that satisfactory answers were given to your questions during the training programme? | Yes [ ✓ ] | No [ ] | |
| Do you think that the background training manual is informative and useful enough? | Yes [ ✓ ] | No [ ] | |
| Do you think that the discussion on EE/RE will help you in your work? | Yes [ ✓ ] | No [ ] | |
| **Suggestions & Recommendations for improvement:** | | | |
| ① melting Energy efficency Improve. | | | |
| | | | |
| | | | |
| **Name two learning, which from this programme you will be able to implement in your plant?** | | | |
| melting energy | | | |
| | | | |
| | | | |
| | | | |
| **Signature:** | | | |
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COINDIA

# Annexure 5: Copy of presentations


## Best Operating Practices (BOP) in Foundry

Training Workshop
**Energy Conservation**

Coimbatore
9 February 2018

Prosanto Pal
The Energy and Resources Institute


- About TERI
- Energy saving options in industry
- Energy audits
- Energy cost and Investment cost
- Compressed air systems
- DG sets
- Sample energy conservation recommendations

2

# About TERI

Creating Innovative Solutions for a Sustainable Future

***TERI's Vision***

*"To work towards global sustainable development, creating innovative solutions for a better tomorrow"*

- HQ at New Delhi; regional centers in Bangalore, Goa, Mumbai, Guwahati; field stations at Gual Pahari and Mukteshwar
- Overseas offices in US, UK, Netherlands, Japan, Gulf, and Africa
- Over 1000 professionals working in the areas of energy, natural resources, climate change, water resources policy and management, forestry and biodiversity, sustainable habitat, environmental and industrial biotechnology, social transformation

# Major research divisions at TERI

Creating Innovative Solutions for a Sustainable Future

Power and Renewable Energy

Energy Efficiency

Rural Energy and Social transformation

Climate Change and Forests

Energy Modeling & Policy

Sustainable Buildings

Industrial Biotechnology

Youth Education







- Pioneered energy audits in India
- Inhouse expertise - team of about 30 engineers at Delhi & Bangalore
- 3000+ detailed energy audits in industry
- Latest portable instruments/software

  Temperature, pressure, flowrate, electricity etc
- Detailed project reports (DPRs) prepared


# Energy audits

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# Energy intensive equipment in foundries

- Furnaces
- Electric motors
- Compressors/compressed air networks
- Blowers/Fans
- Pumps
- Cooling towers
- Lighting System

# Energy audit instruments

Thermal imager

Power analyser

Flue gas analyser

Ultrasonic flow meter

## Preliminary Energy Audit (PEA)

**Uses existing, easily obtainable data**

**Step 1** : Identify quantity & cost of energy

**Step 2** : Identify consumption at process level

**Step 3** : Relate energy input to production thereby highlighting areas of immediate improvements

**Typical output**

- Set of recommendations for immediate low cost actions
- Identification of major areas/projects which require a more in depth analysis.

**Duration:** 1 - 2 days (plant visit) 2-3 days (report writing)

## Detailed Energy Audit (DEA)

- Conduct diagnostic studies with accurate measurements
- Detailed analysis of systems/equipment
- Determination of system/equipment efficiencies; compare with design values and recommend measures for improvements

**Typical output**

- Set of recommendations - short/medium/long term
- Provide cost-benefit analysis of recommended measures

**Duration**: 7-10 days (field work) and 3-4 months (data analysis and report writing


# Energy saving options in industry

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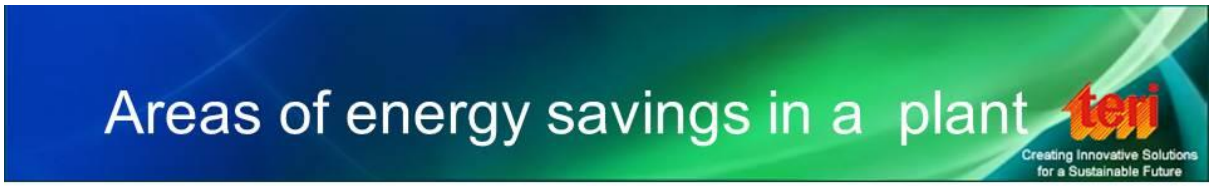


Area 1 Energy usage in utilities

Area 2 Energy usage in process

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# Energy saving options - 3 levels

1. Best operating practices (BOP)
2. Retrofit
3. New technology

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# Areas/levels of energy savings and investments

| | Area 1: Auxiliaries | Area 2: Process |
|---|---|---|
| **Level 1**<br><br>**Operating practice improvement** | E.g.<br>Compressed air leakage | E.g.<br>BOP |
| **Level 2**<br><br>**Retrofit** | E.g.<br>VFD for screw compressor | E.g.<br>Retrofit DBC |
| **Level 3**<br><br>**New plant** | E.g.<br>Invertor compressor | E.g.<br>New DBC |

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Selection of equipment

**Operating cost ?**

**or**

**Investment cost ?**

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## Energy Cost vs Investment Cost

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- A 1000 cfm compressor using approximately 160 kW at Rs.6 kWh costs as high as Rs. 96 lakh/year if run @8,000 hrs
- Which is 5 times the cost of compressor itself

## Energy Cost vs Investment Cost

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- A 500 kg induction furnace consuming 650 kWh/tonne at Rs.7.50/ kWh costs as Rs. 175 lakh/year if run for 24 hr for 25 days a month
- Which is about 6-7 times the cost of the furnace itself

## MSME Foundry

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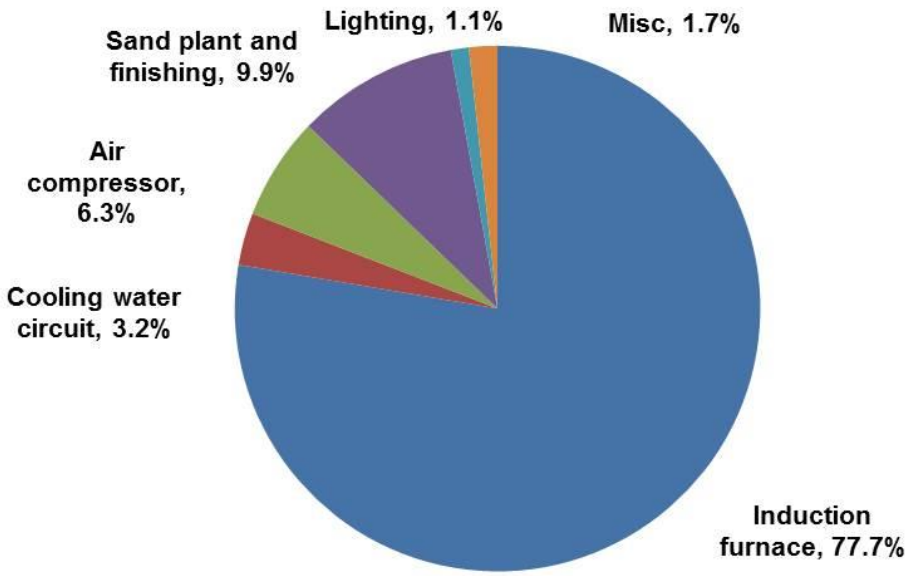

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# Induction Furnace

## Select more efficient furnace

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*IGBT (Insulated Gate Bipolar Transistor) is the more efficient induction furnace technology compared to traditional SCR (silicon controlled rectifier) furnace technology*

- Better efficiency
- Higher P.F.
- Better control

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From 584 to 541 kWh/MT

**IGBT Induction furnace**

Replacement of SCR based induction furnace with IGBT induction furnace

# Raw material charging

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- Charge must be free from sand, rust, oil/grease, moisture
  - Clean foundry returns by tumble/shot blast
- Reduce charging time by use of mechanical vibrating feeder arrangement

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**Raw material charger**

Charging basket on track to charge raw material faster


- Install lid mechanism for induction furnace
  - Reduces radiation losses
  - Improves work place environment

*Radiation loss is about 25 kWh/ton for 500 kg crucible furnace melting at 1450 °C*

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Avoided 23 kWh/MT

## Lid mechanism

Reduction in radiation losses from induction furnace crucible

Energy saving 9 kWh per batch

## Lid mechanism

Reduction in radiation loss from induction furnace crucible


Avoided
11 kWh
per batch

## Lid mechanism

Reduction in radiation loss from induction furnace crucible


Avoided
3-4 kWh
per batch

## Lid mechanism

Reduction in radiation loss from induction furnace crucible


Avoided
12 kWh
per batch

## Lid mechanism

Reduction in radiation loss from induction furnace crucible


Avoided
28 kWh
per batch

## Lid mechanism

Reduction in radiation loss from induction furnace crucible

# Pouring

- Optimize pouring & transfer time
- Use glass wool/ceramic wool to cover the ladle
- Use ladle pre heaters and not molten metal to heat the ladles

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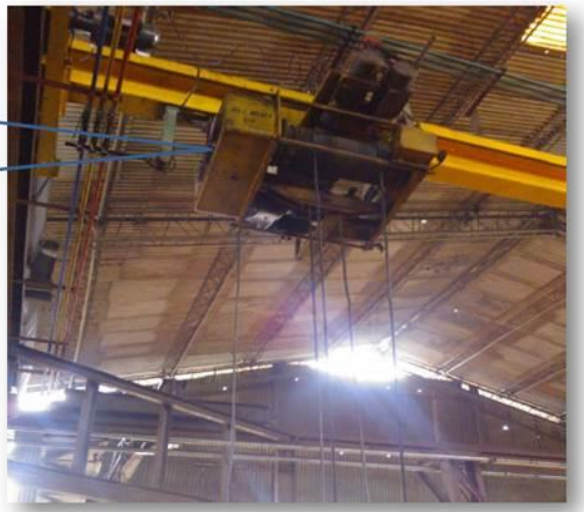
**Pouring automation**

Reduction in time taken for pouring, saving of energy wasted during metal holding


Crane Pouring time saving 6-8 min per batch



## Pouring automation

Reduction in time taken for pouring, saving of energy wasted during metal holding


## Ladle pre-heater

Avoiding use of molten metal for heating pouring ladle


**Ladle cover**

Ceramic wool+MS cover for pouring ladles


**Ladle cover**

Ceramic wool+MS cover for pouring ladle


**Ladle cover**

Ceramic wool+MS cover for pouring ladle


# Compressed air system

# ENERGY SAVING TIPS

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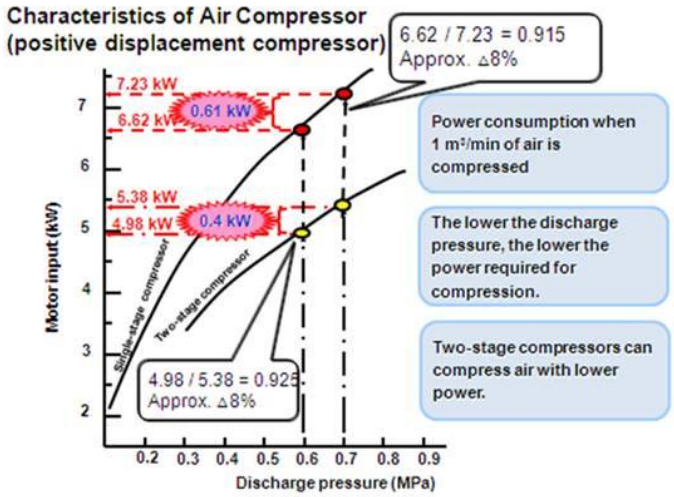
- Choose Energy Efficient Compressors




# ENERGY SAVING TIPS

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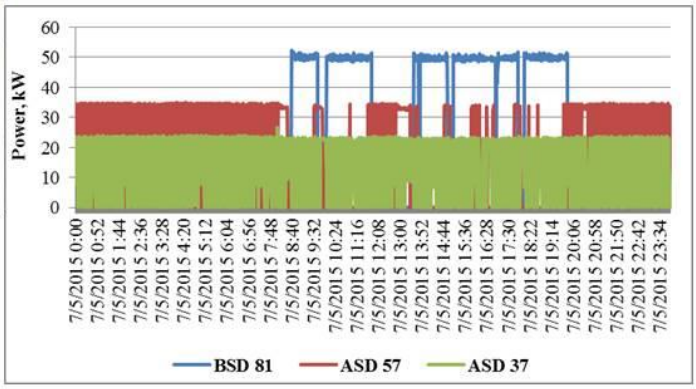
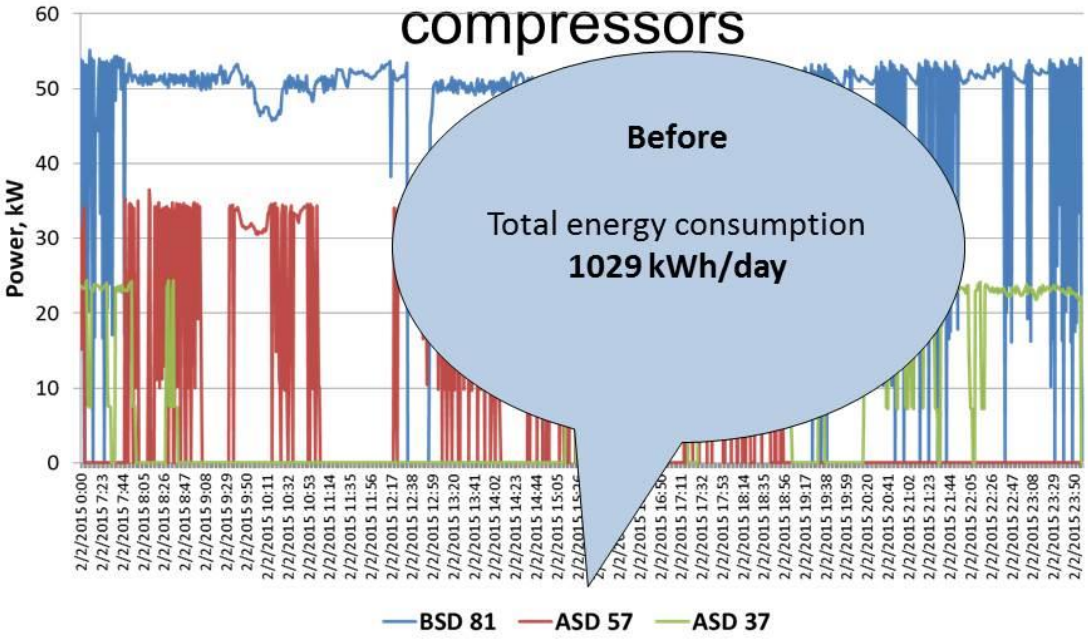
- Install PLCs controllers




Selects compressor for maximum loading

# Case Study – Retrofit
## Sequence controller for air compressors




# Case Study – Retrofit
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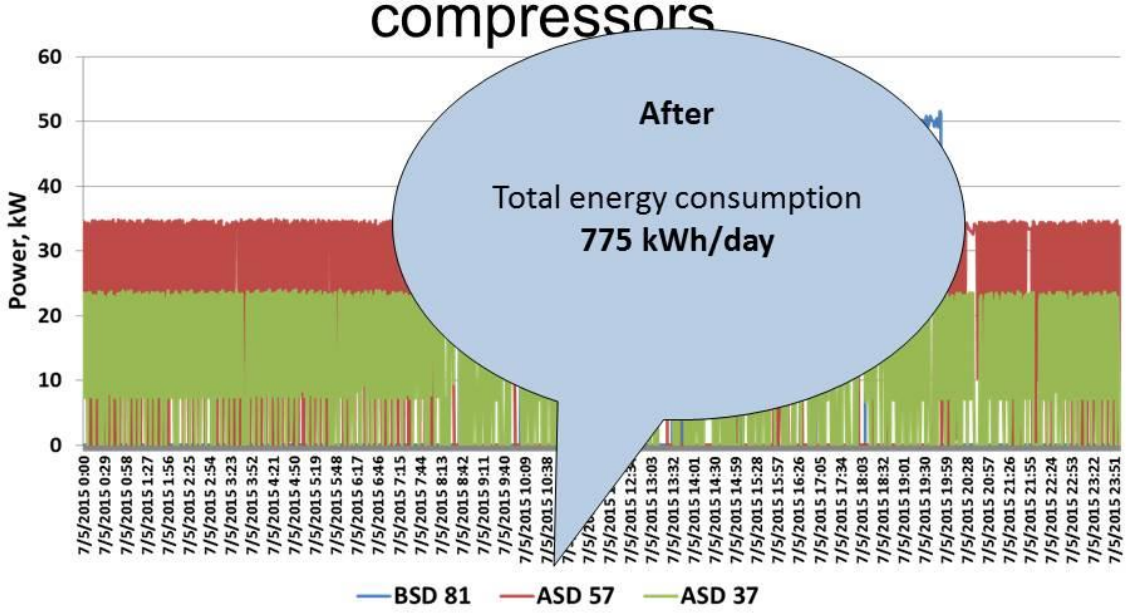


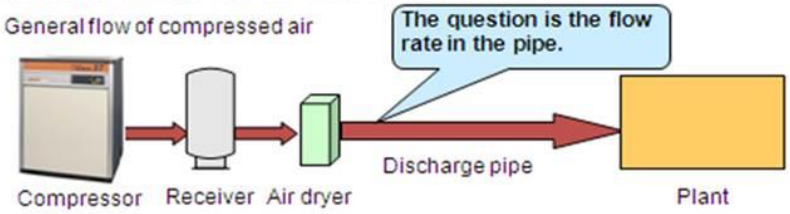

- Install air flow meters with totalizers
- Install dedicated energy meter for compressor house
- Install larger capacity air receivers
- Use only energy efficient accessories like dryers / filters / valves
  - In globe valves there are 60% more losses than gate valves


Select optimum supply pressure

- Pressure increase by 1 bar will increase energy consumption 4-5% power
- Increase air leakages by 10%

# ENERGY SAVING TIPS

- Select piping with lower velocity to minimize pressure ( <10 m/s)




$$\text{Flow rate in the pipe. } V\ (m/s) = \frac{Qs \text{ Compressor's discharge air volume} \times Ps/Pd}{A \text{ Sectional area of discharge pipe} \times 60}$$

**The flow rate in the pipe is desirably 4 to 5 m/s. - Economic speed**

The smaller the pipe size, the higher the flow rate, causing a larger loss in the pipe.Accordingly an energy loss is generated, reducing energy-saving effect.

* Example of 75-kW HISCREW NEXT (Discharge pressure: 0.69 MPa, discharge air volume: 13.2 M3/min), size of discharge air pipe: 50mm
V = 13.2 x 0.101 / (0.101 + 0.69) ÷ 0.05 ÷ 0.05 ÷ 3.14 / 4 ÷ 60
= 14.31 m/sec (This is a very high speed.) The energy-saving effect is low.

# ENERGY SAVING TIPS

- Segregate process air and service air
- Maintain compressor in good health with preventive maintenance
- Replace all filter elements in regular, stipulated and recommended intervals (250 mm wc pressure drop → 2% more power)
- The filter size should be adequate so, that there is no pressure drop. Higher resistance causes pressure drops and also there is overloading of the air compressors resulting in frequent breakdowns

# Cleaning of air filter


Increase in specific power consumption of the air compressor by 2 kW per 100 cfm. The energy saving by proper cleaning of filter was in tune of 1 – 1.5%

# Replace the screw type connector with a aluminium crimping arrangement

Before

After

**Conduct leakage test / audit and arrest leakages**

## Install exhaust duct to throw the hot air outside the compressor room


## Improve air piping system: Piping from top

Bad example of piping connection

There is a possibility of drain flowing to the facility since this pipe is connected with the underside of the main piping.

Good example of piping connection

There is no risk of drain flowing to the facility as the pipe is connected with the upper-side of the main piping.

# Avoid underground piping

# Pump and pumping system

**Power consumption (kW)**

- Usually lower than rated power
- Near to or higher than rated if re-winded

**Flow rate (cu.m/hour)**

- Most cases it was lower than design, few cases < 60% of design flow rate

**Head (m)**

- Most cases pressure gauges found not functioning

**Optimizing piping design**

- Water velocity ~ 1.8 – 2.0 m/s

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## Lighting mercury to induction

Replacement of mercury vapor and metal halide with magnetic induction lamp

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# Thank You

Prosanto@teri.res.in

# Retrofits and new Technologies to save energy in Foundry process and auxiliaries

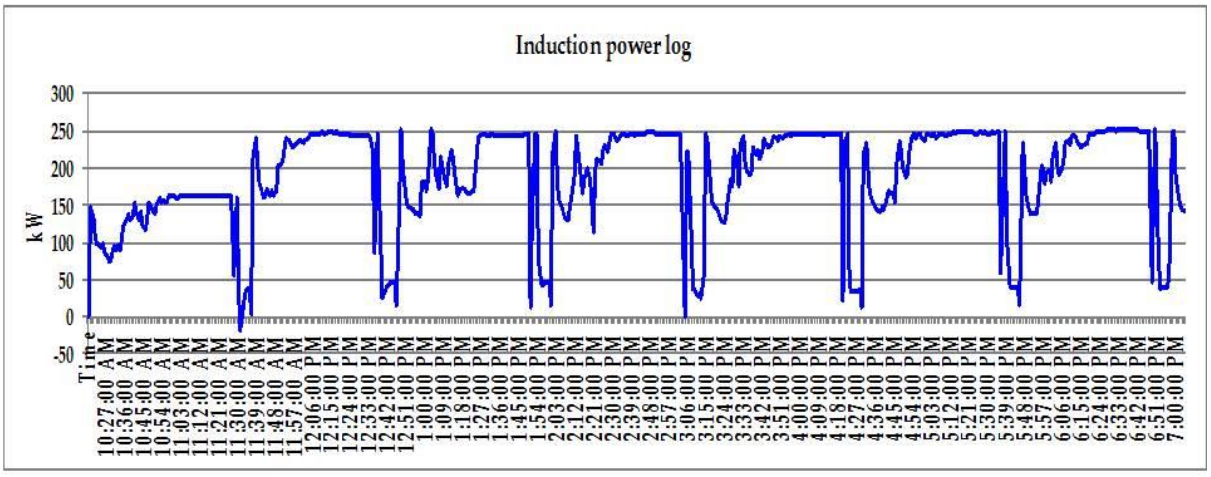
Capacity building workshop
Energy conservation
**Friday, 09 February 2018**
Coimbatore
Nilesh Shedge, TERI

## Contents

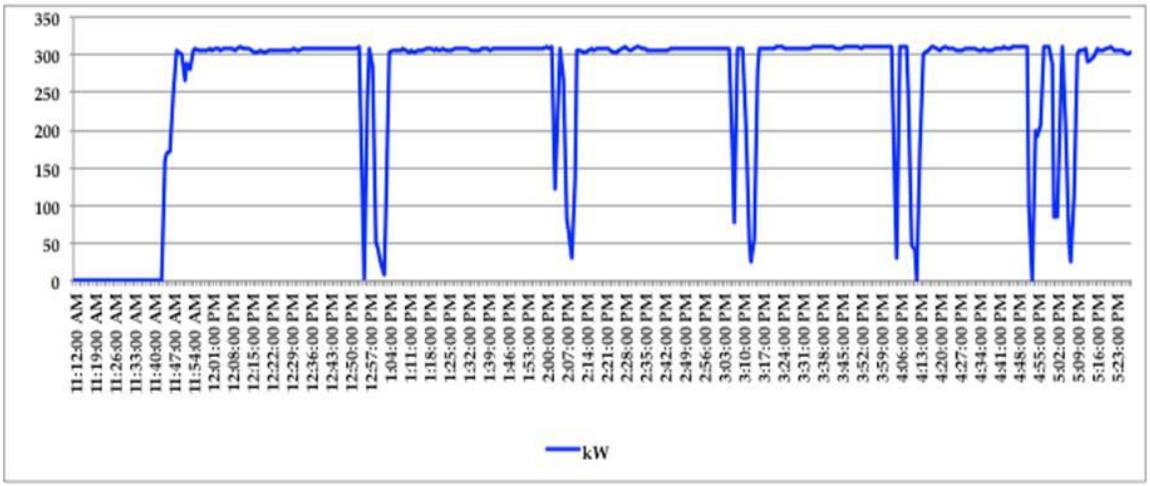
- Induction Melting
- Auxiliaries
  - **Motors**
  - **Air Compressors**
  - **Pumps**
  - **Lighting**

# Induction Melting Furnace

Power lag/delay in Induction furnace
250kW/250 kg
SEC: 736kWh/tonne @1600oC
Power delay: 25min



## Induction furnace ideal curve
## 300kW/5000kg
## SEC: 610kWh/tonne @1650oC




## Lid covers for Crucible/ladle

Lid cover for Crucible

Insulation Ladle cover

**Ladle cover**

Ceramic wool+MS cover for pouring ladles

Pouring automation

# Implementation- Case Studies#1

133,953 kWh/year

Rs.10 lakh/year

131.2 $tCO_2$/ year

Performance optimization of melting furnace of rating 450kW (changing the former size to actual designed specifications)

# Implementation- Case Studies#3

27,503 kWh/year

Rs.2.1 lakh/year

27 $tCO_2$/ year

Performance optimization of induction furnace (use of small pieces of MS scrap for charging)

# Implementation- Case Studies#5

120,294 kWh/year

Rs.9.1 lakh/year

118 $tCO_2$/ year

Replacement of old induction melting furnace with new EE induction furnace


# Motors

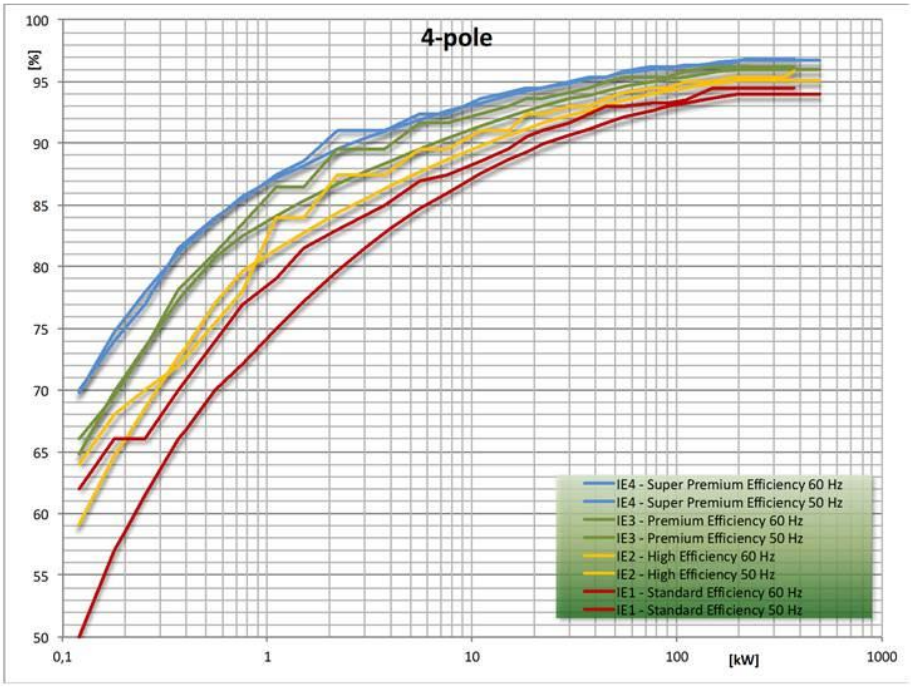
# Motor-Energy efficient motors



# Motor-Energy efficient motors

- Energy saving due to high efficiency class motors
- Improved life, less maintenance and increased reliability
- Better insulation class and high quality Copper
- Energy saving of 3% on replacement of old IE2 motor with IE3 motor
- Energy saving of 7% on replacement of old IE1 motor with IE3 motor
- Motor efficiency decreases by 2.5-3 % when rewinded once
- Motor should be replaced with IE3 motor if it is rewinded more than two times

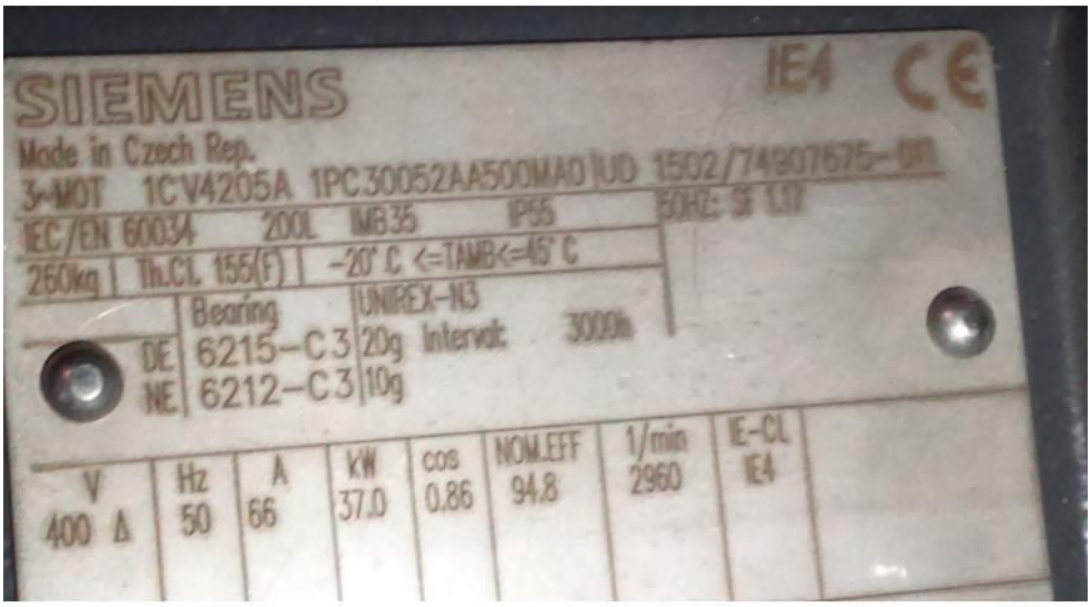
# Motor Efficiency class




# IE3 Standards

| | 2P | | | 4P | | | 6P | | |
|---|---|---|---|---|---|---|---|---|---|
| kW | IE1 | IE2 | IE3 | IE1 | IE2 | IE3 | IE1 | IE2 | IE3 |
| 0.75 | 72.1 | 77.4 | 80.7 | 72.1 | 79.6 | 82.5 | 70.0 | 75.9 | 78.9 |
| 1.1 | 75.0 | 79.6 | 82.7 | 75.0 | 81.4 | 84.1 | 72.9 | 78.1 | 81.0 |
| 1.5 | 77.2 | 81.3 | 84.2 | 77.2 | 82.8 | 85.3 | 75.2 | 79.8 | 82.5 |
| 2.2 | 79.7 | 83.2 | 85.9 | 79.7 | 84.3 | 86.7 | 77.7 | 81.8 | 84.3 |
| 3.0 | 81.5 | 84.6 | 87.1 | 81.5 | 85.5 | 87.7 | 79.7 | 83.3 | 85.6 |
| 4.0 | 83.1 | 85.8 | 88.1 | 83.1 | 86.6 | 88.6 | 81.4 | 84.6 | 86.8 |
| 5.5 | 84.7 | 87.0 | 89.2 | 84.7 | 87.7 | 89.6 | 83.1 | 86.0 | 88.0 |
| 7.5 | 86.0 | 88.1 | 90.1 | 86.0 | 88.7 | 90.4 | 84.7 | 87.2 | 89.1 |
| 11 | 87.6 | 89.4 | 91.2 | 87.6 | 89.8 | 91.4 | 86.4 | 88.7 | 90.3 |
| 15 | 88.7 | 90.3 | 91.9 | 88.7 | 90.6 | 92.1 | 87.7 | 89.7 | 91.2 |
| 18.5 | 89.3 | 90.9 | 92.4 | 89.3 | 91.2 | 92.6 | 88.6 | 90.4 | 91.7 |

# IE3 Standard motors




# Old rewinded motors

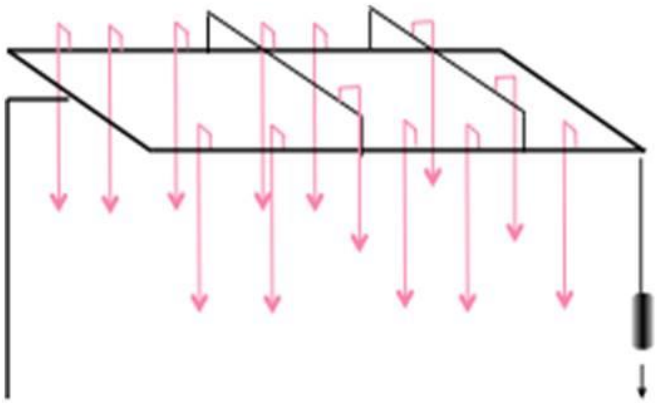
# Case study

## ECM: Replacement of old IE1 standard motor of rating 7.5 kW with IE3 motor

| Particular | Unit | Existing | Proposed |
|---|---|---|---|
| The present annual power consumption of motor | kWh/year | 39228 | |
| The proposed power consumption with new EE IE3 motor | kWh/year | | 37752 |
| Energy savings | kWh/year | | 1475 |
| Monetary benefits | Rs in lakh/year | | 0.11 |
| Investment required | Rs. In lakh | | 0.3 |
| Simple payback period | Years | | 2.8 |

# Air Compressor

# Compressed Air & distribution systems



drainage

Ring Loop air Piping


Auto drain valve

# Air Receivers

**Thumb rule:**
**100CFM=1000litres**

# Air Guns & Air Leakage Arresting

**Use of small diameter air guns/nozzles**

**Arresting air leakages in air distribution system**

- Use of crimped joints instead of clip joints
- Use of quick release coupling (QRC)

# Use of Variable frequency drives

- Optimum usage of air in the plant as per the demand
- Reduction in motor loading
- Soft starting of motor
- Minimum 10% saving compared to existing non-VSD based compressors


**VFD – Air Compressor**
Variable frequency drive for air compressor

## Reduction in compressed air generation pressure


ECM: Optimization of compressed air generation pressure for air with ring loop air piping

| Particular | Unit | Existing | Proposed |
|---|---|---|---|
| The present annual power consumption of air compressor set @ pressure 7.8 bar | kWh/year | 91656 | |
| The proposed power consumption of compressor @ pressure 6.5 bar | kWh/year | | 83315 |
| Energy saving | kWh/year | | 8341 |
| Monetary saving | Rs lakh/year | | 0.57 |
| Investment required | Rs.lakh | | 0.20 |
| Simple payback period | Years | | 0.35 |

# Implementation- Case Studies

9,851 kWh/year

Rs. 0.74 lakh/year

9.6 $tCO_2$/ year

Arresting the air leakages in the compressed air distribution network in the plant (use of crimped hose joints)

# Implementation- Case Studies

21,378 kWh/year

Rs. 1.6 lakh/year

21 $tCO_2$/ year

**Installation of sequence controller for air compressors or installation of VFD for air compressors**

# Implementation- Case Studies

105,000 kWh/year

Rs. 7.9 lakh/year

103 $tCO_2$/ year

**Replacement of existing screw air compressor with new EE screw air compressor with VFD and Permanent Magnet Synchronous (PMSN) motor**


# Implementation- Case Studies

3,298 kWh /year

Immediate Simple Payback Period

3.2 $tCO_2$/ year

**Changing the location of air compressor for reduction in SEC**

# Implementation- Case Studies

38,965 kWh/year

Rs. 2.9 lakh/year

38.2 $tCO_2$/ year

**Replacement of existing reciprocating air compressor with new energy efficient VFD based screw air compressor**

# Pumping System

## Pumps

### Energy efficient pumps

- Energy savings due to high quality casting material , fabricated S.S Impellers and energy efficient motors
- Use of high pressure multistage centrifugal pump instead of submersible pumps
- Low performance deterioration rate
- Low power consumption hence high energy savings


**High efficiency Pump**

Flow characteristic is improved and power consumption reduced

# Pumping System

Old inefficient monoblock pump

Energy efficient multistage monoblock pump

## EE Pumps

# EE pump – Furnace coil cooling

## Base case

- Induction furnace coil cooling soft water pump submersible pump
- Flowrate :18 $m^3$/hr; Head: 37 metre
- Overall pump efficiency: 28%

## Implementation

- Replacement with EE pump of flowrate 18 $m^3$/hr and head 40 metre
- Overall pump efficiency : 55%
- Estimated energy saving: 10,966 kWh/yr

# Implementation- Case Studies#11

17,280 kWh/year

Rs. 1.3 lakh/year

17.0 $tCO_2$/ year

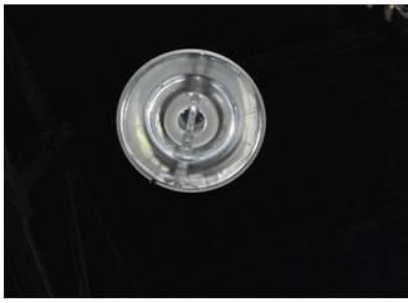
Replacement of old single stage pump with new EE horizontal multistage pump

# Lighting

## LIGHT





## Energy Efficient Lighting-Indoor

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### LED lighting for office areas, machine shop etc

- Suited for office places, machine shops and labs
- High energy savings when replaced with old FTLs and CFLs
- Less cost
- Better color rendering compared to CFL
- LED high bay lamps more suited in machine shops, storage areas, open areas

Energy Efficient Lighting-Indoor

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# Energy Efficient Lighting

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## Induction lamps for melting shop and foundry areas

- High lumen per watt output
- More burning hours life than LEDs (100000 Hours life cycle)
- Soothing light effect with no glare
- Energy saving when replaced with old MVL, MH, Sodium vapor lamps
- No effect of dust on heat dissipation, hence no failure

# Industrial Lighting

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## ECM:Replacement of existing lighting scheme with energy efficient lighting scheme

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| Parameters | Unit | Existing | Proposed |
|---|---|---|---|
| **Type of lamp** | | T8 FTL/LED TL/Halogen/ HPMV/CFL | LEDtubelight /Inductionlamp /LED floodlight |
| **Wattage of lamp** | Watts | 40W/400W/250W /80W/18W | 30W/100W/ 200W/20W/ 9W/60W |
| **Working days per year** | Days/year | 300 | 300 |
| **Exisiting power consumption** | kWh/yr | 40,714 | 19,385 |
| **Savings in electricity consumption** | kWh/yr | | 21,329 |
| **Monetary benfits** | Rs lakh/yr | | 1.47 |
| **Total investment cost** | Rs lakh | | 2.2 |
| **Payback period** | Years | | 1.5 |

## Implementation- Case Studies#12

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12,262 kWh/year

Rs. 0.91 lakh/year

12 $tCO_2$/ year

**Replacement of existing lighting scheme with energy efficient lighting scheme**


# The Energy and Resources Institute

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**www.SAMEEEKSHA.org**

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