CHAPTER 6

FINDINGS, RECOMMENDATIONS, SUGGESTIONS
AND CONCLUSION

6.1 FINDINGS

The findings of this thesis present a general overview of the energy efficiency and management practices in the selected industries in Pune. In addition, the report explores factors that inhibit energy efficiency improvement in the industrial area. The study has revealed that, the government of India over the years has made significant efforts to improve energy efficiency and management in industries; by formulating policy instruments and initiating energy efficiency schemes and programs. However, there still remains a huge ‘efficiency gap ‘in the industrial sector. Information dissemination geared towards increasing industrial energy efficiency is generally very low in these industries. Deducing from the results, it could be said that energy is poorly managed in the surveyed industries; with a low implementation of cost effective energy efficient technologies in the respective industries studied. A majority of the industries surveyed had neither a standardized energy performance assessment procedures for major utility equipment nor utilities costing procedures. Training programs on energy management were found to be inadequate and employees needed to train on electrical and thermal utilities. The following are the specific findings of the present study.

Findings from Objective No 1

a. It is evident from the study that Practice of installing energy efficient lamps is followed the most by the industries. 91.03% respondents reported that they have installed energy efficient lamps in their industries.

Practice of turning off electrical power when not needed and installing variable frequency drives wherever required is also followed seriously by most of the industries. 87.18% respondents reported that they turn off electrical power when
not needed and 83.33% respondents reported that they have installed variable frequency drives wherever required.

b. Optimization compressed air velocity in the piping network is the least followed energy efficiency techniques in the industries. Only 32.05% respondent reported that they are following it.

Conducting the power quality audit from the external professional agencies and trimming the impeller of centrifugal pumps are also the least followed energy efficiency techniques in the industries. Only 35.9% respondents reported that they are conducting power quality audit from the external professional agencies and 30.77% respondents reported that to reduce excessive pressure of the centrifugal pumps, they are following the practice of trimming the impeller.

**Findings from Objective No 2**

c. It is evident from the study that Practice of calculating per unit cost of electrical and thermal utilities with a standard procedure is rarely followed in the industries.

**Findings from Objective No 3**

d. Study found that the there is a scope for optimization of utilities to bridge the gap between generation and demand. 92.31% respondents reported so.

e. 51% respondents reported that they do not receive the demand for utilities in advance from the user departments.

**Findings from Objective No 4**

f. Training on Air conditioning system is required to be given on top priority. 43.59% respondents have given the highest priority for the same.
Findings from Objective No 5

g. Study found that inadequate training programs on energy management and lack of awareness about energy conservation among the employees are the major barriers to energy efficiency in industries.

h. Study also found that production is given more importance and adequate importance is not being given to energy conservation. 61.54% respondents think so.

Findings from Hypothesis No 1

i. It is evident from the study that the industries are lagging in effective application of energy efficient technologies in utilities.

96.15% respondents reported that still there is a wide scope to replace higher wattage lamps with lower wattage lamps to save electricity. As per 65.38% respondents, they are not conducting energy audits with external professional agencies.

j. There is a bigger scope to replace existing water taps with sensor taps to conserve water.

k. Waterless urinals are rarely installed in the industries. 89.74% respondents reported that they have no waterless urinals in their plant.

l. 93.59% respondents are not using treated sewage water for cooling tower make up. This is having a great potential for water conservation.

m. Auto tube brushing system helps to keep chiller condenser surface clean and avoid deposition of scaling. However, practice of installing auto tube brushing on chiller condenser is not followed seriously in industries.
n. Two speed motors on ventilation system enable us to reduce motor speed in order to reduce energy consumption in winter season. But it is also is not followed seriously in industries.

o. Leakages in compressed air are a major reason for the poor overall efficiency of compressed air system. But practice of identifying air leakages with ultrasonic leak detector is rarely followed in industries. As per 82% respondents, they do not practice identification of air leakages with ultrasonic leak detector.

p. Reduction in inlet air temperature to the air compressor reduces specific power consumption of the air compressor. But no industries have made provision to reduce inlet air temperature of the air compressor.

q. Maximum potential of energy saving is by reducing compressed air use. As per 69.23% of respondents, there is a scope to replace pneumatically operated tools with electrically operated tools.

r. Reducing the compressed air pressure through optimization wherever feasible leads to energy savings. 52% of respondents reported that they have installed compressed air pressure control system for pressure optimisation.

s. 88.46% of respondents reported that they are not having online flue gas analyser on Hot Water Generator to monitor the performance of combustion.

**Finding from Hypothesis No 2**

t. Performance assessment of major utility equipments like Air Compressor, Chiller, Cooling Tower, and Pump is rarely done in industries and standard procedure for performance assessment is also rarely available and practiced.
Findings from Hypothesis No 3

u. All the respondents reported that training programs on energy management conducted in the plant are not enough and additional training programs should be conducted on energy management to create awareness and gaining knowledge about effective and efficient energy management.
6.2 RECOMMENDATIONS

a. Industries are recommended to adopt most energy efficient technologies in utilities to reduce energy consumption.

b. Industries are strongly recommended to give adequate importance to energy management.

c. Industries are recommended to conduct energy audit with external professional agencies at least once in a two year.

d. Certified energy Auditor/Manager should be appointed to initiate and co-ordinate energy savings activities within the organization. He shall be responsible for conducting energy audit at periodic intervals and preparing energy management policies.

e. Output of Utilities per unit of electricity input must be measured at regular intervals. Efficiency of utility equipments tends to deteriorate with time. Therefore, Industries are strongly recommended to practice performance assessment of major utility equipments like Chiller, Air Compressor, Cooling Tower, Pump etc. with a standard procedure every year and take corrective action against deficiency.

f. Industries are recommended to practice cost of utilities generation with a standard procedure. This will help to create awareness among the employees and to control generation cost.

g. Leakages in compressed air are a major reason for the poor overall efficiency of compressed air system. Practice of identifying air leakages with ultrasonic leak detector is recommended at periodic intervals in order to find out minor leakages.
h. It is recommended to reduce inlet air temperature of the air compressor to get advantage reduced power consumption as the cooled air improves performance of the air compressor. 4°C reduction in inlet air temperature will reduce compressor power consumption by 1%.

i. It is recommended to replace pneumatically operated tools with electrically operated tools wherever possible as compressed air very expensive utility.

j. Compressed air is very energy intensive. Only 5% of electrical energy is converted to useful energy. Use of compressed air for cleaning is rarely justified.

k. Pressure Control System is recommended on compressed air system to optimise the compressed air pressure exactly matching with the user requirement. A 1 bar reduction in operating pressure will save 7% of air compressor power consumption.

l. A 0.8 mm scale build-up on condenser tubes can increase energy consumption by as much as 35%. Therefore, it is strongly recommended to maintain chiller condensers for proper heat exchange by installing Auto Tube Brushing (ATB).

m. Industries are recommended to conduct training programs on energy management especially on electrical and thermal utilities to create awareness among the employees and enhance their technical capabilities.
6.3 SUGGESTIONS

a. Management can focus all the three dimensions of energy management i.e. Organisational, Technical and Behavioural (OTB) for effective and efficient implementation of energy management systems.

b. Industries can sincerely practice 3R principle i.e. Reduce, Reuse and Recycle for water conservation.

c. As per the results, inadequate training programs on Energy Management is a major barrier in adopting energy efficient technologies. Therefore, it is suggested to conduct Training programs at periodic intervals for the employees. It will help create awareness among the employees and to build their technical capabilities.

d. Top management shall plan for a separate budget to assist funding for energy savings proposals within the organization. Also considering depleting nature of energy resources, management should not focus always on commercial matters only while investing in energy conservation projects and considerable cushion is to be given on pay back period.

e. Industries can generate plant level utilities exactly matching with the user requirements for optimization of utilities.

f. Occupancy sensors are recommended for intermittently occupied rooms like discussion rooms, conference hall to save electrical power consumption.

g. Sensor faucets are recommended to install at all the wash basins for water conservation.

h. Waterless urinals can be a great option to reduce overall water consumption of the plant.
i. Industries can use treated sewage water for cooling tower make up by maintaining required parameters.

j. Industries can install Dual speed motors on Air Handling Units to take benefit of power savings in winter season when air conditioning load is less.
6.4 CONCLUSION

a. Energy is playing a very vital role in the development of any sector. But rapidly depleting energy sources have forced entire world to search for various methods and techniques which conserve energy in any form. Industrial sector being the major energy customer and consumer, industries need to exploit every energy savings opportunity. In industry, majority of energy is consumed in generation, distribution and utilization of utilities such as compressed air, steam, electricity, air conditioning, water system etc.

b. The research work presents a framework for energy management at plant level utilities in automobile industries manufacturing passenger cars. It addresses all the critical aspects of energy management such as top management commitment, energy efficient technologies and barriers in their adoption, utility costing and performance assessment of major utility equipments, employee training and their involvement in the process of effective energy management. All these aspects are very vital in conducting a successful energy management program and may be used as a reference tool in managing plant level utilities and energy efficiency at the energy intensive plants.

c. The findings of this thesis present a general overview of the energy efficiency and management practices in Automobile industries in Pune. The report explores the factors that inhibit implementation of energy efficient technologies in the industrial area. The results reveal that energy is poorly managed in the industries and industries are lagging in effective application of the energy efficient technologies in utilities. In addition the study reveals that the important barriers impeding the implementation of cost effective energy efficiency technologies or measures in the surveyed firms are in adequate training programs on energy management and lack of awareness about energy conservation among the employees. The study also finds that Practice of calculating per unit cost of electrical and thermal utilities and energy performance assessment of major utility equipment with a standard procedure is rarely followed in the industries.
The study further finds that there is gap between generation and demand of the utilities and scope for optimization is there. It is observed that the training programs on energy management conducted in industries are inadequate and additional training programs should be conducted especially on air conditioning system and electrical system.

d. Study identifies that for Industries to successfully manage their energy use, the technological solutions alone do not achieve maximum energy savings. But Energy management has the greatest impact when organisations address the three dimensions of energy management i.e. technical, organisational and behavioural. Further, energy management at plant level utilities not only makes business sense but is also the answer to environmental concerns and the ever-increasing energy price.

e. The study has revealed that, the government of India over the years has made significant efforts to improve energy efficiency and management in energy intensive industries; by formulating policy instruments and initiating energy efficiency schemes and programs. However, there still remains a huge efficiency gap in the industrial sector.

f. In the surveyed firms, inadequate training programs on energy management for employees is found a major barrier followed by lack of awareness among the employees about the energy conservation. Both these major barriers are inter-related to each other in the sense that lack of awareness among the employees about the energy conservation is mainly because of inadequate training programs on energy management. Training programs helps employees to enhance their technical capabilities and identify and implement most energy efficient technologies to reduce energy consumption. Another major barrier is found that management is focusing only on manufacturing and adequate importance is not being given to energy conservation. Without top management commitment and involvement, it is an uphill battle to improve energy efficiency. Further, it is suggested to have a dedicated energy manager in the plant who will
be responsible for Energy Auditing, Energy Policies, and co-ordination between the departments. This study represents a preliminary contribution for the promotion of Industrial Energy Policies that would lead to a widespread increase of the overall energy efficiency of the investigated territory, along with strong benefits for the whole local industrial system.

g. Researcher has developed procedure for “Energy performance Assessment of Utility Equipment” which will help industries to assess the energy performance of major utility equipment and to take corrective action against deficiency. Procedure developed to calculate the generation cost of utilities will definitely help industries to create awareness among the employees and to control the generation cost. Researcher has also identified the potential barriers in adoption of energy efficient technologies and suggested various actions to overcome these barriers. This would help industries to implement energy efficient technologies in their plant. Training needs of the employees identified by the researcher with respect to energy management in utilities would help industries to plan and develop training programs to create awareness and enhance technical and managerial capabilities so as to implement energy management systems effectively and efficiently. Present Energy management study can be applied to Automobile, Pharmaceutical, Steel, Utility Industries in major.

h. Energy management is the practice of using energy more efficiently and effectively in an organization’s operations. Energy is a valuable resource and a cost which can be controlled when managed efficiently and effectively. Energy management provides an opportunity to optimize energy costs by understanding energy flow as well as procurement and economics of energy, and reduce its harmful impact on our environment. It is an ongoing process and must be reviewed at regular intervals and fine-tuned as required, from time to time.