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A Review : Role of Energy Efficiency in Industrial Management

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Abstract: Manufacturing industry of India consume highest amount of energy. According to survey of energy analysis of overall world industrial sector energy use is one third of total consumption. So that effort has been made to analyze the energy efficiency of industrial sector to improve the performance. This can be done by evaluation of end energy uses and by implementation some measures to shrink the total amount of energy consumed for many of the end users. The requirement for efficient performance and economical process of manufacturing is combined now days for efficient production. This paper contains the energy efficiency analysis of manufacturing industry. It includes the energy management by efficiency analytics and providing solutions for predictive maintenance to avoid major damage to industrial equipment. With the help of efficient energy use in industry we can minimize losses and ultimately energy and cost saving.

Keywords - Energy Efficiency, Predictive Maintenance, Energy Intensity, Manufacturing Industry.

I. INTRODUCTION

Energy efficiency is a handler for manufacturing factory, as industry is historically one of the largest energy consumers and carbon emitters in the world [10]. The manufacturing sector is mainly under obligation for nearly 35% to 40% of the fundamental energy use and for 40% of the carbon dioxide emissions globally. Energy efficiency is effective utilization of energy to carry out manufacturing process facilities or provide a service, where by wastage of energy is minimized and the total consumption of primary energy resource can be reduced. In other words, energy efficient systems will seek to less use of energy while conducting activity which is dependent on energy at the same time; the corresponding (negative) environmental impacts of energy consumption are reduced.

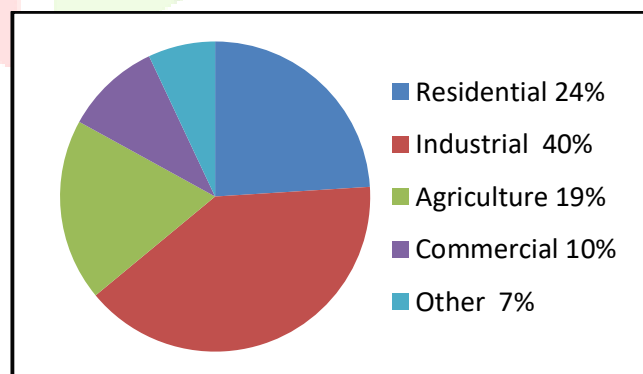


Fig: Electricity consumption in India

Energy is need of life, plays an important role for the progress of the developing country. Industry need to use energy effectively is the key advantage in the global competitiveness and ensure the continuous development. Country which is using the energy properly; they will economically succeed and have lead the sectors in the era of competition. The intention of this evaluation is to put step forward and importance of energy efficiency for the continuous economic development of the industries and country. In this exploration, the idea of energy efficiency has been emphasized by considering the studies in the literature and the role and importance of energy efficiency has been analyzed for the sustainable development and economical up gradation of the country.

The world is going towards different creation and digitalization Internet of Things (IoT), that optimization has tremendous benefit the industrial sector by giving information at correct time, place and to the correct people. Involving IoT increases smart handling of work and to the manufacturing processes which helps to industry to manage process flow and energy management at lower cost with savings. Concluding in scale down the carbon emission thus leading to economic savings for the manufacturing plant. There is

tremendous scope for energy savings in industrial sector at lower cost with less time with help of smart technology to improve process energy efficiency. Many plans and policies are there which encourage the industrial sector to improve energy efficiency by providing solutions with remarkable implementation policies, ultimately which helps to improve position in competitive world. Energy management plans also provide inducement to the company to invest in more effective system and control strategy. Savings at system level is also a huge chance than savings at device-level and therefore main motivations for event to encourage investment in intelligent efficiency and smart manufacturing.

II. ENERGY EFFICIENCY

A. Definition:

The concept energy efficiency is explored differently in various disciplines, the strength marks the degree of accomplishment of objectives of an activity, efficiency refers to the ratio of benefits to expenses. Energy effectiveness, therefore explain the ratio between the benefit gained and the energy used. Efficient use of energy can be understood in terms of using energy in such a way as to obtain the tremendous benefit, but can also imply shifting energy utilization to the times when energy is abundant and cheapest. For example at night, or during summer and windy period when renewable energy sources produce effective energy. At its most basic, energy efficiency refers to a method of scale down energy utilization by using less energy to attain the same amount of useful output [1].

Energy efficiency means doing more with less; that is, squeeze as much useful power out of as small energy as possible, and not wasting it. Energy efficiency is a ratio between an output of performance, service, goods or energy, and an input of energy. Energy efficiency improvement is a rise in energy end-use efficiency as a result of technological, behavioral or economical change. Understanding of energy efficiency can be done by effective consumption of energy to provide a better facility at manufacturing industry cost effectively, where wastage of energy is reduced and also reduction in primary energy resource utilization. In other ways, energy efficient services with minimum use of energy at time of various events in process industry without harming the environment.

B. Improvement in Energy Efficiency:

Industry uses a huge deal of energy, often not effectively, and is main contributors to CO₂ emissions. Industries are also a major contributor to economical up gradation. There is no basic difference between industrial energy efficiency and economic growth. Industry is giving facility that is well organized for energy efficiency is typically well managed, generally more sustainable, and therefore more competitive in global markets [9]. With the industrial optimization system will result in high production and reliable operation. Energy efficiency improvement helps the bottom of the factory for improvement in reliability in operation and control system. The benefit of this is that it will increase the production through better utilization of the assets equipment. Proper matching of the equipment to the demand result in less cycle time of operation of equipment thus it will reduce the wear and maintenance cost may decline.

Energy efficiency improvement can be achieved by adopting high efficient process and technology for reduction in system losses. The energy efficient technology importance is increasing now days. Reduction in demand of energy contributes to the development of the factory to improve environmental condition and to preserve the natural resources. For economic development and social progress energy efficiency plays vital role. For the observation of change in energy intensity the contribution of the energy efficiency improvement in equipment and process is more. Efficiency of the system has contribution to strengthen energy security.

C. Energy Intensity:

Energy intensity of manufacturing process is amount of energy required to produce one unit of product. Energy intensity will provide the significance of energy in the process of production and this will change with different industries. It is related to the economy of energy efficiency. This can be formulated as units of energy per unit of GDP. Energy intensity can be calculated by amount of energy required per unit output of process; hence for the production of the products using less amount of energy will reduces the intensity. High energy intensity indicates a higher cost of converting energy into GDP. Low energy intensity indicates a lower cost of converting energy into Gross Domestic Product. The meaning of high energy intensity high production output of industry as a part of GDP. Country having lower energy intensity signifies that labor intensive economy. There are some points which may impact energy intensity that are method of transportation, utility and capacities, energy conservation efforts, energy sources without grid (off grid), energy efficiency of appliances and economic shocks such as disruption of availability of energy due to natural catastrophe, disasters, wars, power outage, efficient energy uses. If we follow these opportunity of energy efficiency, we can increase the rate of improvement of efficiency and reduction in energy use. To promote energy efficiency of the industry we need to take some efforts with the smarter technology and doing it at its best level [6].

D. Energy Requirement in Manufacturing Industry:

For the manufacturing product we need tremendous amount of energy. Economy of the industrial sector depends on energy efficiency and conservation measures. In the era of competition globally, all industrialist knows that the cost of the products is one of the important concept. Hence for the successful manufacture the process of the plant or factory should be with energy efficient technology. There are many works are going on for efficient technology. Reducing unnecessary loads in industry is one of the way by which consumption of energy can be reduce. If heat losses are there in industry then we can use that heat for other use like cogeneration. Industry should have proper management of purchase of product; with help of limited required product we can reduce energy utilization. Reduce, reuse and recycle, repair are some main key points that will help for conservation of energy [5].

E. Energy Sustainability at Industry:

For energy sustainability at industrial sector is important aspect for efficiency measure and to keep energy resources conserve, without doing compromise of demand of energy and needs for generation. For future perspective of sustainable energy there should be plan or strategy that will give idea about the energy utilization and energy requirement as per need. This also includes encouragement of policies that beneficial for environment, promote alternate energy resource. To achieve the goal as per strategy there should be development of new technology for sustainable and efficient working of process.

Sustainable energy is the type that will fulfill our current requirement of energy without keeping it in dangerous zone and that can be use again for other purpose. This energy does not harmful to the environment and can be easily available. The industrial sector plays important role for growth of the country. To be the part of global competition utilization of energy, less carbon emission and use of resources are key element of manufacturing industry. The main aim of sustainability of industry is improvement in energy management,

less carbon emission and preventive maintenance, information of use of energy and avoiding losses by predictive maintenance, also arrangement of climate condition which may cause problems in availability of energy.

III. INDUSTRIAL ENERGY EFFICIENCY ASPECTS

Manufacturing sector is one of the highly developing sectors in world. This is intensive power sector involve more consumption of energy [10]. In most of the manufacturing industry the expenditure of the energy is at topmost priority. Therefore by energy efficiency analysis can be help the industry not only in conservation of energy but also for reduction in operation cost and sustain in competition [7]. That is why efforts have to be made for effective management of energy to improve profit. Improvement in industrial efficiency can be done by monitoring, study of analytics of operation parameters by doing some modifications, minimizing losses at various locations.

A. Process Plant Analysis:

Detailed study and analysis of the plant is first step in energy management program of the industry. By understanding of the process flow we can analyze the energy transformation during manufacturing process. Manufacturing process analysis is one of the methods that help to increase efficiency and process operation will be effective. By this we can get the idea about process plant and we can easily reach up to the point where efficiency improvement is required. Various models that will provide qualitative analysis and quantitative measures to different kind of range of appliances. Appropriate process selection for the manufacturing is also important part for conservation of energy at machine level. This can be done only by process plant analysis at overall factory level. One of the examples is of cooling unit consumption that is totally depending on process speed. Cycle time is also one of the parameter of function of process. For the appropriate production planning at factory level this parameters of machine plays important part in manufacturing process.

B. Monitoring and Survey:

The examination and survey of process flows of industry to reduce the energy losses and for conservation of energy, also to reduce demand of energy at input side and not affecting production. Energy audit of process plant i.e. industry is basic step to identify opportunity to reduce expense of energy and footprint of carbon. It mainly include the machine learning and understanding behavior and analyzing atmospheric condition and schedule, selection and evaluating measures of energy conservation. Major problem areas are finding out from this survey after that some changes have to be made for improvement of energy efficiency. Primary management technique of energy is targeting energy monitoring study that collection of information will be useful for reduce unnecessary loads and waste and to improve available process operations.

At the time of monitoring is necessary to establish currently available pattern of process, energy consumption at machine level. Energy monitoring and process targeting is method where energy component is also dealt as controllable resource such as in the case of personnel and capital. It involves a systematic, disciplined division of the facility into Energy Cost Centers, where the energy used is compared with the final product output. By this survey we can get the information regularly. With the help of this collected information about variance in data, it is possible to set the target, planning of the required action can be done.

This is very effective tool to check the optimization required in machine and possible ways to reduce cost of energy during production.

Elements of the Monitoring & Targeting System are:

- Record data – Measure and record consumption of Energy.
- Analyze – Correlate consumption of energy to an output like overall quantity of product.
- Compare – Compare consumption of energy with set value and targeting benchmark.
- Set the Target –with the help of set target we can control energy consumption.
- Monitor – Regularly compare energy utilization to the target which have been set.
- Report – calculation of result and by comparing the variation in data from set target.
- Control – implement the control technique and strategy that will avoid the variation in result data which have been set.

The main reasons of failure of the energy efficiency projects are due to unavailability of appropriate monitoring system and measurement techniques. Analysis of data is not defined way so that it is unable to reach the set target and goals. If defined analysis is done then cost reduction of energy and saving can be achieved.

C. Data Collection:

Collection of the primary information of energy flows of the facility and technical details such as process diagrams, drawings and complete list of equipments [8]. To start the efficiency analysis and conservation examination, utilization and data of process operation should be available. Some important data required is;

- (i) Profile of daily consumption of energy.
- (ii) Inventory of the process equipment.
- (iii) Rate of production of equipment individually and overall plant production.
- (iv) Specifications of every equipment involving in process.
- (v) Energy consumption of the each and every equipment or machines involving in production process.
- (vi) Overall operating time of equipment and working hours.
- (vii) Energy source, its type, characteristics etc.

By using collected data we can easily analyze the process flow and energy balance can be done. In this analysis qualitative and quantitative examination is performed to calculate the actual input energy, output and all types of losses within the operation.

D. Load Management :

As per analytical point of view management of load offers lot of energy savings. In collection of data we are calculating total working hours and peak load analysis. With the help of this peak load analysis we can shift some load of peak hours at off hours without harming production process, called load shifting. Load shedding can be plan as per analysis of off-hours to save the energy. For energy efficient production planning is achieved with control and production mapping along with time, cost [3].

E. Benchmarking:

To describe the all possible outcomes or situation that can be happened during the search or study, it is important to mention some performance of the working of the machines in production. Benchmarking is done to conclude the rate and type of performance whether it is good or bad. It mainly consist the comparative study of the actual measured value to the reference value or calculations of consumption of similar production process. With the help of this we can simulate the excessive consumption or energy cost. Benchmarking is also a tool for setting up the energy saving potential of particular factory or production process of the manufacturing industry. Study of the benchmarking involves the total loads mainly basic load and environmental sensitive load. This might be achieved from detailed analysis of the energy consumption of process and energy demand also data in accordance with climate change.

IV. SYSTEM OPTIMIZATION

Study of technology related to efficiency of energy in manufacturing industry is done with system optimization. In this system optimization includes the design appropriate industrial operation to provide better support for the production with less amount of energy and cost effective. Process of optimization of system includes:

- Evaluation of performance of machines system involving in production process and finding out the requirement.
- Comparing the supply energy and demand side load requirement.
- Eliminate unnecessary load and uses of energy and shifting of load according to peak load analysis.
- To increase operation and equipment efficiency changes in equipment like motor, fans etc might be done in optimization.
- Application of variable speed drives and control system automation that will increase cycle time of system and ultimately increment in efficiency.
- With the help of process flow and data analysis we can plan predictive and preventive maintenance to avoid damage before they happen actually.
- Up gradation of current process flow and maintenance concept by involving some strategy.

Industrial system consist of every equipment from utility i.e. supply side up to the end production process equipment (i.e. distribution side load). Analysis of these points from supply to end loads is done and probable solution can be found for improvement in efficiency.

V. ENERGY ANALYSIS FOR PREDICTIVE MAINTENANCE

Predictive maintenance is type of maintenance for interruption in process before they happen. The data collected in previous step in analysis can predict the possibility of issue by analyzing the variations in parameter. In most of the industry scheduled the maintenance to prevent shutdown. This predictive maintenance helps the industry to avoid the unnecessary maintenance because this prediction will clear the idea about the actual point fault where maintenance is required [11]. Therefore, in era of industry 4.0 predictive maintenance is emerging quickly. Implementation of industrial IoT technology to examine health of system, to get alert quickly on monitor and real time data, by which we can schedule the maintenance activity[8]. For implementation of predictive maintenance, manufacturing industry need mapping of parameter and details about interruption or failure for production system and different areas of production plant.

Advantages of predictive maintenance are:

1. Predictive maintenance system will provide automatic report of system operation. This will reduce the maintenance time.
2. It helps to increase overall equipment effectiveness (OEE). In industrial process management to calculate and analyze rate of production, OEE concept is immerging now days by which we can find root cause of problem.
3. Predictive maintenance will avoid major damage and also it will give clear idea about the savings of energy.

VI. BENEFITS OF ENERGY EFFICIENCY ANALYSIS

The biggest strength of energy efficiency is that this study or analysis allows process plant to implement new plans and strategy to achieve proper utilization with help of new technology and energy savings and cost benefits in different areas [4].

Benefits of an energy technical studies and implementation of recommendations include:

1. Reduced energy consumption and energy costs.
2. Establishment of the carbon footprint of the industry and reduction of greenhouse gas emissions.
3. Reduced operating and maintenance costs [2].
4. Improved asset value and performance of Industry.
5. Establishments of benchmarks to track performance.

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