"Market Analysis of Energy Management in Pharmaceuticals and Steel Industry in Maharashtra"

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ABSTRACT:

Steel and Pharma sector are one of the largest industrial sectors in India and have been a power intensive industry. In addition to this they are one of the largest employment generation industries, having said so they are also one of the largest contributors to the CO2 emissions in the environment.

With increase in global demand the production capacities have been increased but many of the sectors continue to operate on the similar model as theyused to operate in the past decade, which is not the sustainable model in the long runespecially in lieu of the global warming and deteriorating climatic conditions.

The article highlightsthe present industry scenario for these two sectors and the power consumption of these sectors, also the article provides an insight of a Steel Industry through a case study that how it can deploy energy management in order to bring down their carbon foot prints and also increase their profitability and decrease their power consumption. A detailed capital requirement and the IRR have been calculated.

A further analysis can also be done by incorporating the MW scale battery storage system along with the Renewable energy source, also utilization of bio fuels can also play a significant role in trimming the CO2 emissions in these industries.

Keywords: Carbon footprint, Energy Management, Energy mix, Energy security,Renewable energy

1. Introduction

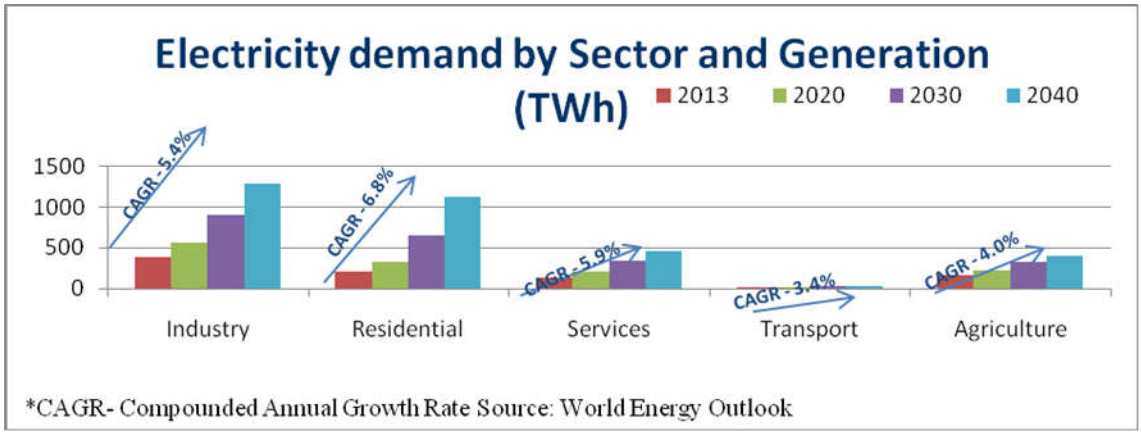
Energy is the essence of life; we all consume energy in some form or the other. The most usable form of energy that we all use in our daily life, is Electricity and Fuel. These two types of energy, form majority percentage of Energy Sector. Per capita Consumption of Energy has been the key parameter for any developed or developing country, which can be directly co-related to the GDP of a country. A lot of modern advancement can be attributed to revolution in Power and Fuel sectors. Energy is one of the most critical components of infrastructure, crucial for the economic growth and welfare of nations.

The existence and development of adequate infrastructure is essential for sustained growth of Indian economy. India's Energy sector is one of the most diversified in the world. Sources of Energy generation range from

conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar, and agricultural and domestic waste. Electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, massive addition to the installed generating capacity is required

With the governments push for make in India and due to faster industrialization, there is a sudden rush in the demand of power, which is only going to increase.

- By 2040 the generation capacity across all energy categories will increase due to India's GDP growth, increasing the need for new energy sources [7]



The scenario envisaged byUNIPCC requires CO2 emissions reduction across all the energy consuming sectors. For industries, action is particularly crucial in the five most energy intensive sectors: **iron and steel**; cement; **pharmaceuticals, chemical and petrochemicals;** pulp and paper and aluminium.

Globally, these sectors currently account for 77% of total direct CO2 emissions from industry; in India, they acc ount for 56% of industrial energy consumption and 82% of direct CO2 emissions. The total energy consumption of the Industrial sector was about 30% of the overall consumption in India. The total Energy consumed by the Steel industry in India was approximately 25% of the total Industrial energy consumptions in India in 2017 [6] Steel sector in India accounts for 28.4% of the entire industry emissions.

2. Maharashtra Industrial Overview

Maharashtra is one of the most advance states in India in terms of Industrialization. It has more than a lakh of industries. Maharashtra's gross state domestic product (GSDP) accounted for 12.98 % of India's gross domestic product (GDP) in 2015-16, the highest among all states. The GSDP grew at a CAGR of around 11.3 % between 2004-05 and 2015-16 to reach US$ 300.51 billion. Maharashtra has 956 commissioned projects in metallurgical sector and 515 operational pharmaceutical projects, till 2017, accounting for 12.84% and 2.34% of the total industrial investment in Maharashtra [10]

2.1 Present Energy Scenario in Maharashtra:

Maharashtra has the highest installed power generation capacity in India with 35,468 MW, out of this 21496MW is the Thermal plant capacity accounting for 60.60% of the total installed capacity. In addition to this there is a capacity addition of about 6570 MW in existing thermal plants, taking the installed capacity to 42,038

MW. The total energy production in Maharashtra was 1.15 Lakh Million units for FY 2016-17 accounting for 9.7% of the countries energy generation. The total consumption of Maharashtra was 1.16 Lakh units out of which 40,231 Million units was the industrial consumption accounting for nearly 34.5% of the total energy consumption. [10]

The consumption of other forms of energy sources in Maharashtra are the major petroleum products like HSD, Furnace Oil, Bitumen, Petrol, Aviation Turbine Fuel, (ATF) etc. accounted for 19,338 thousand Tonnes of consumption for FY 2016-17 an increase of 6% from the FY 2015-16.

3. Pharmaceuticals & Steel Sector and its Energy Problems

3.1 Pharmaceutical Sector

Present scenario

Pharmaceuticals Sectors is one of the core Sectors that contribute to the growth of our economy, it is very important that these sectors grow enabling the growth in the country. Indian pharmaceutical sector was valued at INR 2,40,900 Crores in the year 2017. India's pharmaceutical industry growth rate is estimated at a CAGR of 22.4 %. For the year FY 2017-18 the Export of pharmaceutical from India was INR 1,727 crores [3].From August 1991 to November 2016, a total of 859 projects with an investment of US$ 2,396.78 million have been approved for the pharmaceutical industry in the Maharashtra state

3.2 Steel Sector

Present scenario:

Steel sector has been given a big push by the Government of India by formulating "New National Steel Policy" in 2016. All government tenders shall give a preference to domestic manufactured steel. The New steel policy is envisagingto build a steel making capacity of 300MT in India. The main objective of New Steel Policy is to increase per capita steel consumption to 160 kgs by 2030. Indian steel industry touched a production of 97.4 MT in the FY 2017-18. Steel sector contributes for over 2% of the GDP of the nation [4].

India is the world's third-largest producer of crude steel (up from eighth in 2003) and is expected to become the second-largest producer. The steel sector in India contributes nearly two per cent of the country's gross domestic product (GDP) and employs over 6,00,000 people. Posco Korea, the multinational Korean steel company, has signed an agreement with Shree Uttam Steel and Power (part of Uttam Galva Group) to set up a steel plant at Satara in Maharashtra

If we compare the average energy consumption of the Steel plants in developed countries with the steel plants in India, the Indian plants consume almost 20% to 23% more energy for the same quantum of production. Few of the main reasons for this is outdated technologies, integrating the old plants with modern technologies and improper energy management.Energy Management can address this issue and can facilitate reduction in energy consumption in Steel industry.

In both of these industrial sectors Power cost, power availability and power affordability are the key concerns. Power plays a significant role in both of these industries, while for steel sector power accounts for 25% to 30% of the production cost, in Pharma sector it accounts for 15% of the production cost. Thereby contributing for significant CO2 emissions to the environment. Especially for steel sector where it takes at least 200 KWh of energy to melt 1 Tonne of steel, thus each Tonne of steel melted shall release a 164 Kg of CO2 in the atmosphere

The key for these sectors to continuously operate profitably lies in the uninterrupted power supply. Hence availability is a big aspect in today's competitive business environment. Further to this affordability is another major aspect which should go hand in hand with the availability for industries to optimize their potential. Thus Energy Management should be one of the key focus areas for the industries to ensure their longevity. Energy management deals with Availability of power, Affordability of power and efficient utilization of power.

According to India's Integrated Energy Policy 2006, we need to focus not only on the supply side demand but also focus on the demand side management. It also specifies that the energy security can be obtainedby reducing demand and energy needs by implementing comprehensive measures on Demand Side Management [5].

4. Solution

What is the way Ahead??

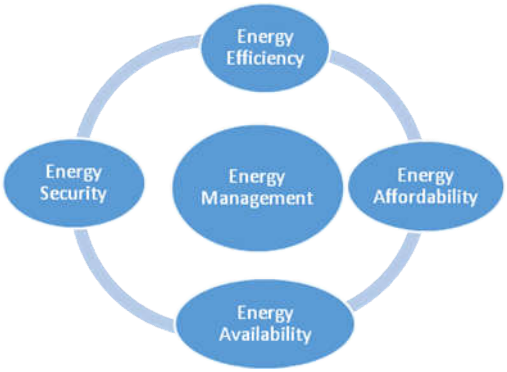
Traditionally Energy Management has been used as a tool which is used more specifically for improvement of Energy Efficiency in industries and with a sole view of reduction in cost of the energy by improving the operational efficiencies in the Industries[1]. Predominantly a lot of emphasis is given on effective utilization of energy by focusing on efficient utilization and improvement in Load profile, while other key factors have not been effectively utilized or explored which play a key role in the overall energy management.

Energy Management is a complex process which involves strategic planning and requires both corporate planning, commercials and technical team's inputs in designing and drafting the energy management protocol to be adopted for the Industry. However not much research has been done in adaptation of energy management practises, nor the studies on energy services in the industry have been extensively explored. [1]

While energy affordability plays a key role in Steel sector, energy availability plays a crucial role in Pharmaceuticals sectors. The Overall cost of Energy and mitigation against the volatile energy market are the key focus areas that any energy management program should address for improvement in energy efficiency [1]

5. Analysis

At the outset a lot of research has happen on the energy efficiency and improvement of energy efficiency in various industries. But a thorough holistic study is yet to be conducted on the proper energy management especially for the Pharmaceuticals and Steel Industries. An effective Energy management should ideally have the following traits



TRAITS of Energy Management

5.1 Energy Efficiency

Industries face today a tough task of lack of availability of power and the cost of power is also high. Power contributes a significant part in the cost of production, hence for this to be low, one needs to ensure that the production is done with minimal power requirement. Hence today the primary focus of the Industries should be to optimize the power usage. Also a lot of industries have started doing their Energy Audit. One of the earlier works on textile industry clearly highlights the insights of the sector with regards to their energy management. Mr. Prakash Khude [2] has a very clear view about energy being one of the main factors in the cost of production in a textile industry. Mr. Khude [2] highlights the importance of energy efficiency especially when the cost of energy is high and emphasizes that despite availability of number of energy efficiency techniques not many are practised in the textile industries' due to lack of knowhow and limited guidance available. Energy efficiency refers to the most optimum utilisation of the energy in any form that can be derived in the process of manufacturing. Few of the methods in Pharmaceutical and Industrial sectors in energy efficiency are:

a. Methods for operating near unity power factor
b. Recovery of waste heat energy
c. Shifting to low power consumption and higher efficiency equipment's
d. Designing the buildings in line with the Green building code
e. Deployment of advanced technology for better optimization

5.2 Energy Availability

We as a country have always been a power deficient nation and with a GDP growth of 6% to 7% our woes on power availability are only going to worsen. Our per capita electricity consumption is far lower when compared to other developed or developing countries. Thus with increased demand and limited generation capacity availability is going to be a big concern for Industries. Energy management needs to address this key issuein order to ensure the profitability of these industrial sectors.

5.3 Energy Affordability

The availability of Energy has to be affordable, for industries to operate profitably. They need to have a control on the cost of power which is one of the major cost contributor of production in many industrial sectors. Historically, Industries have been bearing the crunch of high cost of power and have witnessed a CAGR growth of 6% YoY for past 10 years. Also different states have different cost of power thereby resulting in an uneven platform for Industries to compete. India is a country where the domestic and agriculture sector is always heavily subsidised, resulting in a high tariff on Industrial and commercial sectors in order to compensate for the gap in revenue collections by DISCOM's. So on one hand we are facing a tough competition from global manufacturers, on one hand we are promoting make in India and on other hand we have increasing the power tariffs for industries and commercial sectors. Will this sector be competitive and profitable?

5.4 Energy Security:

With the ever increasing demand and global competition industries need to always keep their cost of energy on check, with higher demand and reduced availability how are industries going to secure their Energy requirement, energy cost is directly proportionate to the Energy demand and Energy availability is linked to the installed generation capacity which cannot be scaled rapidly in line with the increasing demand. The rising

demand has to be satisfied with capacity addition, but there are other challenges for capacity addition in Thermal, Nuclear and Hydel power plants. India has committed in Paris Convention on shifting to 40% of total energy consumption from Renewable energy. Hence the majority of the capacity additional shall have to come from Renewable energy sources. Industries need to secure their source of energy to ensure their energy security.

Energy security is "the uninterrupted availability of energy sources at an affordable price". Energy security has many dimensions: long-term energy security mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs. Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance. Lack of energy security is thus linked to the negative economic and social impacts of either physical unavailability of energy, or prices that are not competitive or are overly volatile.

6. Case Study of a Steel Industry

One of the leading Steel Industry in Andhra Pradesh, India engaged in manufacturing of MS Billet using Sponge Iron & Scrap as major raw material having a decade old presence having a production capacity of 60,000 Ton. The Company is engaged in manufacturing of MS Billet using Sponge Iron & Scrap as major raw material. Company has employed imported production technology well accepted globally.

Steel billet production process encompasses three steps: First, scrap is prepared. Second, the scrap is then melted in the electric induction furnace (EIF) with required elements added to enhance the characteristics and quality of the steel according to customers' demand. Last, the steel is cast into billet. The EIF technology will transform electricity energy into heat to melt iron and steel. The advantage of the induction furnace is a clean, energy-efficient and well-controllable melting process compared to most other means of metal melting.

EIF technology for making steel is an energy intensive technology andthe Steel Company has been consuming around 5.73 Million units of Thermal energy per month amounting to a monthly emission of 4698.6 Tonne of CO2 in the atmosphere, with a conversion factor of 0.82 Tonne of C02 / MWhr [11] resulting in a yearly emission of 56,383.2Tonne of CO2 in the environment. This being a case when they are operating only for about only 60% of their capacity.

Energy Situation prior to implementing Energy Management			
Sl.No	**Description**	**Values**	**Units**
1	Monthly Thermal Units consumed	57,30,000	Kwh
2	Monthly CO2 emissions caused	4,699	Tonnes of CO2
3	Yearly Thermal units consumed	6,87,60,000	Kwh
4	Yearly CO2 Emissions caused	56,383	Tonnes of CO2
5	Cost per unit of Thermal Power	5.93	INR
6	Total Annual cost of Thermal power	**40,77,46,800**	INR
7	Source of Power	Discom / Power exchange	

This Steel Industryhas adopted the below energy Management traits in order to bring down the CO2 emission levels and as well their energy cost

6.1 Energy Efficiency:

The Steel Industry was already using the Electrical Induction Furnace (EIF) which is the most efficient way of melting the steel, and the industry then started implementing the other efficiency measure like

a. Maintaining unity power factor
b. Replacing the old motors and machinery with the new and more efficient ones'
c. Shifted to LED lights and other appliances with 5-star BEE rating equipment's
d. Deployment of Energy efficiency measure as highlighted in the Study of Energy Efficiency in Indian Iron & Steel Industry [12]

6.2 Energy Security:

Since Energy is one of the key input cost for steel sector, having a captive plant especially the renewable energy plants of Hydel-Solar-Wind Hybrid actually served the purpose of energy security. Thus the Steel industry got into a captive mode with an existing solar plants of 30 MW capacity and 10 MW from Wind plant.This shall definitely bring down the cost of their power and would also bring down their CO2 emissions levels.

6.3 Energy Affordability:

The Steel Industry can explore and identify the correct technology which shall bring down their energy cost and reduction in CO2 emissions. IT went into a captive model with Solar and wind plants for a 40 MW capacity that would deliver almost about 85% of their energy requirement. The steel industry is also trying to explore the usage of Bio fueland usage of biomass Billets for enhancing the affordability. Proper energy mix is being planned for optimization of cost of power and reduction of CO2 emissions.

6.4 Energy Availability:

With a captive Solar and Wind plant which are renewables source of energy and have a life span of 25 years the availabilityof power is fairly secured. The added advantage is that these plants require zero raw material for operating and are sustainable for long time. The Steel industry is also exploring the integration with a MW scale Li Ion battery bankwhich shall ensure a sufficient power availability as the life of these plants are usually more than 20 to 25 years.

6.5 Postdeployment of above methodology the revised consumption of the steel industry is

Energy Situation POST implementing Energy Management			
Sl.No	**Description**	**Values**	**Units**
1	Monthly Thermal Units consumed	3,13,333	Kwh
2	Monthly Consumption from Solar Plant	37,50,000	Kwh
3	Monthly Consumption from Wind power	16,66,667	Kwh
4	Monthly CO2 emissions caused	257	Tonnes of CO2
5	Yearly Thermal units consumed	37,60,000	Kwh
6	Yearly CO2 Emissions caused	3,083	Tonnes of CO2

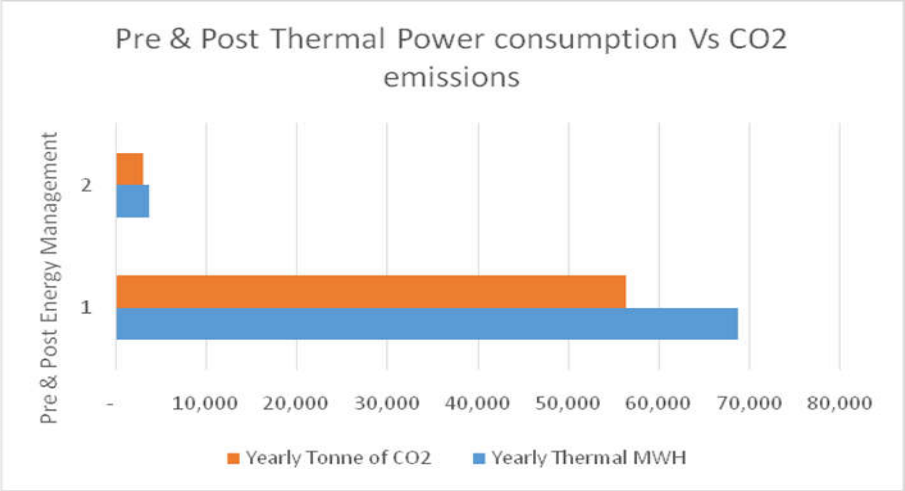
7	Cost per unit of Thermal Power	5.93	INR
8	Average cost of Solar + Wind power	4.50	INR
9	Total Annual cost of Thermal power	**2,22,96,800**	INR
10	Total Cost of Power per annum=	**31,47,96,800**	
11	Source of Power	DISCOM +SOLAR+WIND	

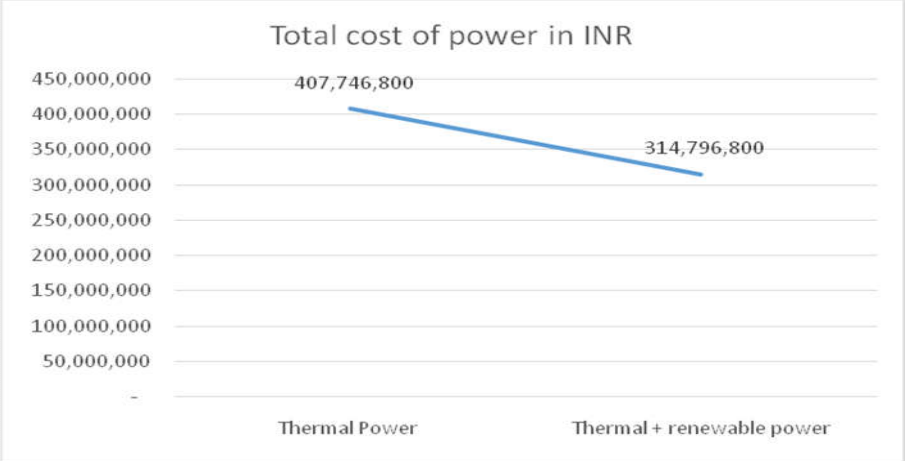
6.6 KEY EFFECT OF THE ENERGY MANAGEMENT

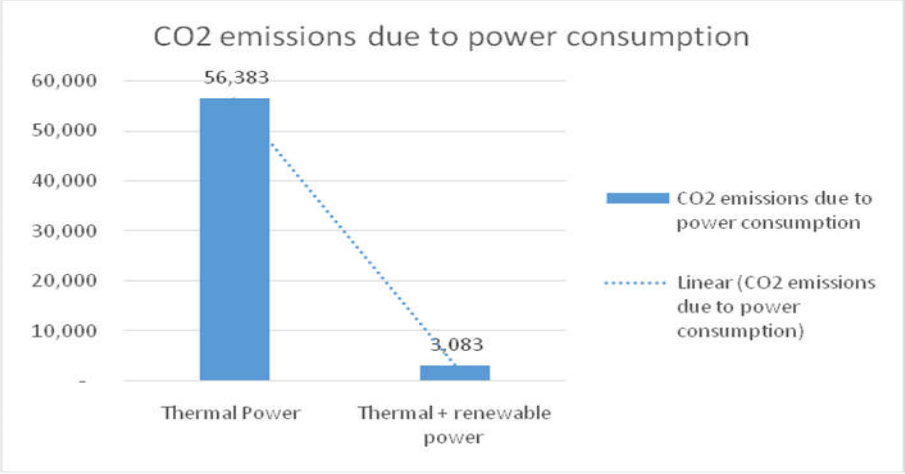
COMMERCIAL BENEFITS		
Cost of Thermal Power prior to Energy Management	40,77,46,800	INR
Cost of Power post considering the Energy mix implemented in energy management	31,47,96,800	INR
Annual savings on power bill=	**9,29,50,000**	INR

ENVIRONMENTAL BENEFITS		
Yearly CO2 Emissions caused prior to energy management	56,383	Tonnes of CO2
Yearly CO2 Emissions post energy management implementation	3,083	Tonnes of CO2
Yearly Reduction in CO2 (carbon foot print)	53,300	Tonnes of CO2
Yearly Sequester of CO2 by an average size tree	20	Kg of CO2
No of trees Equivalent of CO2 emission reduced	26,65,000	Trees in 1 year
% Reduction on CO2 emissions	94.53 % reduction	

Capital Investment & Returns from the Power plants	
30 MW Solar plant project cost =	1,20,00,00,000
10 MW Wind plant project cost =	38,00,00,000
Total project cost for 40 MW=	1,58,00,00,000
Minimum 30% equity of project cost=	47,40,00,000
70% debt for project cost=	1,10,60,00,000
Fixed Power procurement price from 40 MW power plants for 25 years	4.50 per unit
Minimum requirement of 26% of Equity contribution to qualify for captive power consumption from these plant=	**12,32,40,000**
Annual Savings from Power bill=	9,29,50,000
IRR=	75.14%
Equity Payback duration=	1.32 years







7. Conclusion

Energy efficiency alone will not be sufficient to reduce emissions in the industrial sector as the production growt h in India by far exceeds the savings potential from energy efficiency. Government policies are needed to facilitate a transition to more efficient and lower carbon technologies

Energy security concerns are compounded by the increasingly urgent need to mitigate greenhouse gas (GHG) emissions, including those relating to energy production and consumption. Current energy consumption and carbon dioxide (CO2) emission trends run directly counter to the repeated warning sent by the United Nations Intergovernmental Panel on Climate Change (UNIPCC) which concludes that only scenario resulting in a 50% to 85% reduction of global CO2 emissions by 2050.

A significant reduction in CO2 emissions in Indian industry will only be possible if all sub-sectors contribute. The same is demonstrated via case study presented in this article, a mere change in strategy for the energy mix and utilization of renewable energy has not only had a significant impact on the profitability of the organisation but also has significantly brought down their CO2 emission levels.

There is a need to creating an environment for Industries to bring down their carbon footprints and as well survive in this globalised market. In order to achieve this objective, the Industries needs to have Energy Management and a zeal to utilize new and clean Technologies for their energy requirements

The factors that would form the key elements of this Environment are

1. **Resource Conservation**
2. **Economic Viability**
3. **Access to Energy**
4. **Energy Security**
5. **Environment Protection**
6. **Sustainable Energy Resources**

As rightly concluded in citation [1] Energy Management has to be clearly defined with the key objectives covering all facets of the Energy management which results in a more sustainable approach rather than to just focus on mere improvement of operational efficiencies. Also the citation [2] restricts itself to the enhancing and improving the operational efficiencies of the existing system. Todays need is to have a comprehensive energy management system that address the above four segments of energy management.

Having an appropriate Energy Mix can help address the issues of affordability for the industries, the case study above throws a significant light on this. Also deployment of new and evolving techniques for alternate mode of fuel, battery storages [8] etc., can seize the issue of availability and affordability aspect of the energy requirement. With a significant improvement in technologies and rapid commercialization, industries now can setup their own captive power plants to cater to their energy requirement and to address their energy security challenges, which was demonstrated in the case study.

There is a large gap in the implementation of a comprehensive energy management program which results in a more sustainable mode of operations. Energy is one of the major components in the cost of production especially in pharmaceuticals and Steel industries. A proper energy management can result in huge commercial benefit to the industries and will result in a larger environmental benefit to society.

A detailed Market Analysis is the need of the hour for enabling the industries to accept and focus more on the energy management aspect and to understand the true potential of energy management.

A marketing analysis is a study of the dynamism of the market. It is the attractiveness of a special market in a specific industry. Marketing analysis is basically a business plan that presents information regarding the market, its economic environment, its entry barriers and regulations.

Market Analysis of the Energy Management and utilization of clean energy can be successfully implemented in the prevailing market dynamics, the volume in the market and the present economic environment, also this will help us understand the other means of bringing down CO2 emissions and curbing release of greenhouse gases, especially for the bulk power consuming Industries like Steel and Pharma"

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