Compendium of

Energy Efficiency and Renewable Energy in Leading Indian Corporates

CSO Forum
Chief Sustainability Officers'

teri | BCSD
Business Council for Sustainable Development

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Foreword

The Compendium that has been prepared brings out some of the best practices in the corporate sector on energy efficiency and renewable energy. The actions by these companies have a wide span covering agriculture, automobiles, engineering, financial services, IT, etc. It is the business case for implementing energy efficiency and renewable energy interventions that has been focused in this Compendium.

The importance of energy efficiency and renewables can never be overstated. Over 90% of our primary commercial energy is accounted for by fossil fuels (coal, oil and natural gas). Our import dependence is very high, and more importantly, rapidly increasing. There was a frenzy of energy conservation activities all over the world following the oil shock of 1973. Japan was in the forefront of the movement, but France, UK and other countries adopted extensive programmes as well. India also launched a number of steps and oil intensity for the GDP also came down significantly. A need has arisen now for re-intensifying our efforts. According to a TERI study, significant short term gains (nearly 30%) are possible by increasing energy efficiencies along the entire value chain. Energy efficiency has already been included as one of the eight missions in Prime Minister's National Action Plan on Climate Change and the scope of such efficiency in the industrial, residential, transport, agriculture and electricity transmission sectors has been well identified.

Renewables similar offer tremendous scope. Solar, biomass and wind energy have already started registering their presence and the potentials are very high. The National Solar Mission has put the target of 20,000 MW of solar power capacity by 2022, but with improvement in technology and lowering of costs, there is no reason as to why we cannot go beyond this capacity. Biomass based energy development as also solar thermal can immensely improve the access of rural population to safe and affordable energy.

The third area covered in this Compendium namely, energy efficiency in buildings has similarly got huge potential. The Government of India has already put in place building energy efficiency codes. According to a TERI estimate, efficiency measures can help 30% - 40% energy savings in new buildings and about 20% in existing buildings through application of suitable retrofit measures. This is significant as base load energy requirement for new buildings is estimated by TERI to be 5000-6000 MW over a 5 year period. Savings of this magnitude are obviously very attractive.

The inclusion of these subjects in this Compendium has been with an obvious intent. Progress in these areas will contribute to our energy security by reducing import dependence, improve access to electricity in rural areas and reduce the carbon imprint because of lower dependence on fossil fuel. Our success in these areas will no doubt boost our economic growth as well.

It is really heartening to note that so many companies have taken important initiatives for a sustainable approach to business practices. The cases that have been included clearly bring out that such a sustainable approach is financially attractive and, in the process, yields immense socio-economic benefits. We congratulate these prime movers and are sure that this perspective about sustainability will spread across the corporate sector.

Prabir Sengupta
Distinguished Fellow, TERI

Acknowledgements

The 'Compendium of Energy Efficiency and Renewable Energy Best Practices in leading Indian Corporate' was developed with the active engagement and support of the Energy working group of the CSO (Chief Sustainability Officers') Forum and other leading companies who contributed to the creation of this compendium by sending in the best practices followed in their esteemed organizations. In particular, we would like to thank our working group companies – TATA Quality Management Services (TQMS) Pvt. Ltd, BPCL, Indus Towers Pvt. Ltd, Philips Pvt. Ltd, Lavasa Pvt. Ltd and Shree Cements Pvt. Ltd. India to have come forward to develop this important compendium that encourages other businesses to learn to learn from the industrial best practices in mainstreaming sustainability across their business practices. This compendium strives to acknowledge and appreciate some organizations that have championed the cause of Industrial Energy efficiency.

Energy Working Group

The compendium has benefited greatly from a highly engaged set of thought leaders from the industry and beyond. We would like to acknowledge the contribution of the following individuals (arranged in alphabetic order of the first name):

- Mr. Ankit Narula, TERI
- Mr. Anuj Mishra, Akzo Nobel Pvt. Ltd
- Mr. Ashish Jindal, TERI
- Mr. Avinash Patkar, TQMS Pvt. Ltd
- Mr. Dipankar Sanyal, TERI
- Mr. J S Bhatia, Bharat Petroleum Corporation Limited
- Mr. Krunal Negandhi, Lavasa Pvt. Ltd
- Ms. Radhika Kapoor, TERI
- Mr. Rakesh Bhargava, Shree Cements Pvt. Ltd
- Ms. Smriti Bhatnagar, TERI
- Ms. Sudeshna Mukhopadhyay, Philips Pvt. Ltd
- Mr. Sushant Anand, TERI

Introduction

Nations across the globe recognize that energy security is critical to fuel their economic and developmental engines. However, with the fast pace of industrial development, the world is facing a significant threat to the readily depleting non-renewable energy resources. This model of development poses a question on our ability to sustain the pace of our growth and compels us to explore newer ways of development.

India ranks sixth in the world in terms of energy demand, accounting for 3.5 % of world commercial energy demand in 2001[1]. Being one of the fastest growing developing economies in the world, India faces formidable challenges in meeting its energy needs and in providing adequate energy of desired quality in various forms in a sustainable manner and at competitive prices. India needs to sustain an 8% to 10% economic growth rate over the next 25 years if it is to eradicate poverty and meet its human development goals.

Recognizing this challenge, India is facing the task of diversifying its energy basket with renewable sources of energy and ensuring measures to promote energy efficiency measures in the industry to sustain the growing energy needs of its economy. In the face of this enormous challenge, we find today that the cause of operating on clean energy and cutting down carbon emissions is being propagated by governments, civil service organizations and industries. Governments are being aided by civil service organizations to devise policy interventions which are not only inclusive, but also sustainable.

At the Copenhagen Summit, India has volunteered a reduction of 20% to 25% in carbon intensity by 2020 from 2005 levels through policy interventions, including mandatory fuel efficiency standards for all vehicles. This reduction in emission intensity has displayed the seriousness with which the country looks at climate change. The Indian government is following a three pronged approach of educating the business with guidelines and codes such as ECBC (Energy Conservation Building Code), institutionalising compliance measures such as PAT (Perform, Achieve and Trade) and introducing incentives to perform such as JNNSM (Jawaharlal Nehru National Solar Mission) to propel businesses into action with regards to sustainable development.

Global trends, energy prices, compliance requirements, and stakeholder pressure are all dictating a growing number of organizations in India to implement energy efficiency interventions and adopt renewable energy technologies as a means to hedge against the rising cost of energy. Organizations are implementing renewable energy projects, incorporating efficient lighting and air conditioning as a part of their sustainability drives.

Therefore, there lies a need to share these corporate experiences and best practices while benchmarking them with global best standards. This compendium strives to be a ready compilation of energy efficiency and renewable energy best practices of leading Indian corporate.

The compendium is divided into three sections, namely: Industrial Energy Efficiency, Energy Efficiency in Buildings and Renewable Energy Best Practices. All the three sections have the best practices from across industries We have received a total of 25 companies from 9 different industries, namely Agriculture, Automotive, Energy, Engineering, Financial Services, FMCG, Materials, IT and Telecom.

[1] India's 10th Five Year Plan – Chapter 7

The compendium provides access to case studies from across the industry on specific energy efficiency and renewable energy interventions which provides an opportunity for corporate to learn from and emulate the best practices from the leading organizations in the industry.

There has been a pronounced focus in the compendium on the business case for implementing energy efficiency and renewable energy interventions. Factors such as investment required, savings accrued, payback period, tons of CO2e emissions saved were considered while describing the intervention.

Most implementations were recent and the business case of these interventions was looked through in detail.

In the following section, we have a list of the sustainability leaders in the corporate sector who contributed towards the best practices included in this compendium. These corporate have demonstrated environmental stewardship and responsibility towards energy efficiency.

Participating Companies

Section I

Industrial Energy Efficiency

Introduction to Industrial Energy Efficiency

In a developing economy like India, a large proportion of the gross domestic product comes from agriculture and manufacturing based organizations. The energy needs for these industries are met through conventional sources like coal, petroleum and diesel. As a nation, there has not been much investment in the infrastructure for renewable sources of energy. Solely relying on these conventional sources for meeting the energy needs has its set of disadvantages. What India faces today is a twin challenge of meeting its energy needs while cutting down on its carbon emissions to ensure a sustainable and steady growth.

Industries today are facing an impending challenging of rising cost of energy and fuel. Manufacturing activities account for around one-third of the world's total energy demand; as populations continue expanding and living standards continue to rise, industrial demand for energy is set to grow further. Targeting better industrial energy efficiency—first and foremost the efficiency of the manufacturing processes at the core of industry—is the most effective lever available to curb industrial energy consumption .

Manufacturing industries such as Steel, Cement and Power are highly energy intensive. Organizations in these industries consume large amounts of energy all along their value chain. Almost all processes in the value chain, which range from production to packaging and then finally to transportation are energy consuming. The primary methods for reducing energy consumption in Industrial processes are installation or retrofitting new equipment or tweaking the existing processes to make them more energy efficient all along the value chain.

Industrial energy efficiency is of prime importance for the India Inc. One cannot ignore the immense contribution of the Energy Conservation Act of 2001 and the statutory body established called the Bureau of Energy Efficiency (BEE). The agency's function is to develop programs which will increase the conservation and efficient use of energy in India. The government has proposed to make ratings by the BEE mandatory for all appliances in India starting in January 2010. One of the BEE's flagship schemes is the Perform Achieve Trade (PAT) scheme. This finds special relevance in the area of industrial energy efficiency. Under the PAT scheme, almost 714 industrial units across the country in nine sectors — cement, thermal power plants, fertilizers, aluminium, iron and steel, chlor-alkali, pulp and paper, textiles and railways — will be given targets for reducing energy consumption. The companies that better their targets will be allowed to sell energy-saving credits ECERTs to those failing to achieve the required cuts.

The following section of the compendium strives to acknowledge and appreciate some organizations which have championed the cause of reducing industrial energy efficiency. Each of these organizations has innovated to incorporate energy efficiency in some or the other aspect in their business operations. We have tried to cover a gamut of industries which include cement, steel, chemicals, power and fast moving consumer goods. The best practices used by these organizations have resulted in increased energy efficiency or enhanced energy conservation. The idea is to show these best practices and set an example for other organizations to do the same.

Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by ACC Cements

Location(s) of Intervention
Bargarh (Odisha), Chaibasa (Jharkhand), Chanda (Maharashtra), Gagal (HP), Jamul (Chattisgarh), Kymore (MP), Lakheri (Rajasthan), Madhukarai (TN)

Type of Intervention
Energy Efficiency measures via retrofitting & innovation

Company Profile

ACC Limited is India's foremost manufacturer of cement and ready mix concrete with a countrywide network of factories and marketing offices. Established in 1936, ACC has been among the first companies in India to include commitment towards environment protection as a corporate objective.

The Business Challenge as an Opportunity

ACC observed across its plants, that the specific energy consumption of its plant equipment was high and was adversely affecting the project's financials.

Devising the Intervention

To ensure the profitability and sustainability of its operations, ACC's plant officials surveyed the available options to devise cost effective energy conservation strategies, ranging from retrofitting equipment to even incorporating new equipment to lower the Specific Energy Consumption (SEC) of its plant.

The primary choice of intervention involved the inclusion of a Variable Frequency Drive (VFD), an equipment to regulate fan speeds (conventionally modulated by dampers) by removing damper control and by managing Unload Power & Pressure in case of compressors. The availability of an option to efficiently regulate fans speeds was considered effective to bring down costs as well.

The various sections of the plant's operation cycle for this intervention included the Kiln Section, Feeder section, Boiler Section, Pre & Post Clinkerization sections, Grinding & Welding sections, to name a few. VFDs such as fans were incorporated to regulate fan speeds and compressors to reduce unloading power throughout the operational value chain of the plant.

The Business Case

The costs incurred for acquiring new VFD equipment to be used as a retrofit to make the system energy efficient was to the tune of Rs 10 to 50 lakhs. Most savings in energy ranged from 100 kWh to 500 kWh per tonne of cement or per day of usage for compressors. The interventions were performed tactically to build the best trade-off between cost incurred and energy saved with an optimum payback period of close to one year.

Best Practice examples

LAKHERI CEMENT WORKS PLANT RAJASTHAN

The installations included a Rotary Air lock valve to avoid air-ingress and to ease the load on the mill fan. Medium Voltage (MV) VFD's were installed for Calciner Fan and E mill fan and the Grid Rotor Resistance (GRR) was removed from the circuit while the Damper was kept fully open to be removed at a later date. Apart from this, VFDs were retrofitted to 3 cooler fans and to mill compressors to save power and back pressure respectively. This intervention at the Lakheri plant was expected to save 197 Million Tons Oil Equivalent (MTOE) per annum. Intervention started in May 2013.

The total investment was Rs 117.5 lakhs and savings accrued were Rs 395.17 lakhs through the life of the project

MADHUKKARAI CEMENT WORKS, TN

Another intervention at the Madukkarai Cement Works plant (TN) required the installation of VFDs in the Clinkering Sections for 7 cooler fans in the Kiln and for vacuum pumps. The aim was to save on specific energy consumption by fans and to adjust vacuum pump speed as per varying moisture proportion in the slurry. Energy Savings through replacement of cooler fan dampers by VFDs were 96.7 kWh / fan and for the two Vacuum pumps it was 30 kWh.

Total investment in the project was of the order of Rs 26 lakhs and savings accrued ranged around Rs 91.2 lakhs/annum. Intervention started in Jan 2013.

BARGARH CEMENT WORKS, ODISHA

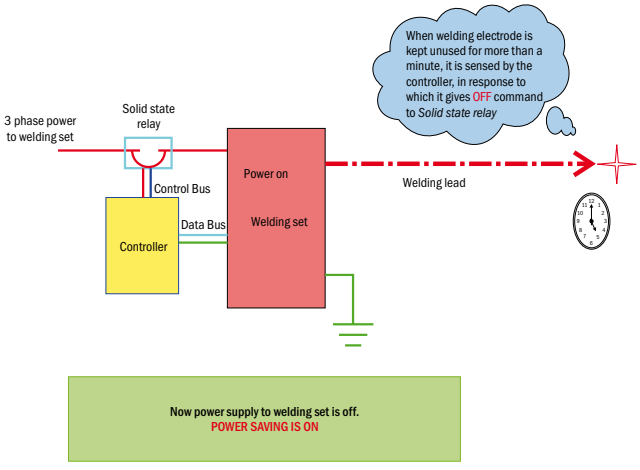
For an intervention in ACC's Bargarh Cement Works plant (Odisha), the load for three SA Fans was reduced from 105 kW to a mere 65 kW by installing VFDs.

The total investment was Rs 20 lakhs and a total of Rs 25.4 lakhs was saved in 6 months starting from March 2013.

Other Innovative technological interventions included:

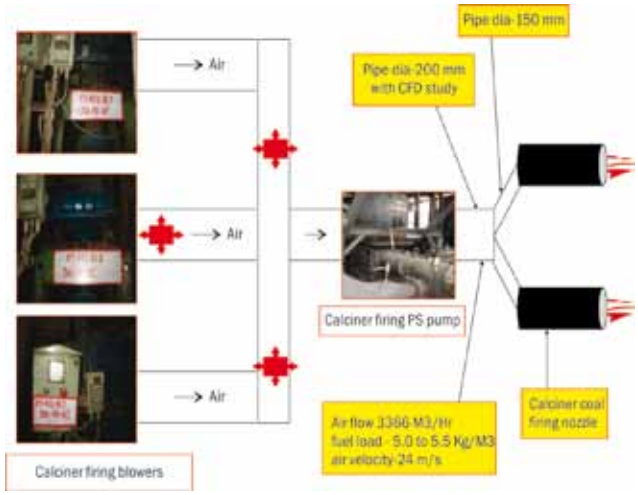
Automatic switch for welding to save the ON time

A simple electric circuit was incorporated within the welding set itself to reduce instances of long idle times for the welding set. The welding starts working as soon as the welder starts the job and gets automatically switched off when the welding work is suspended for more than the predetermined time. Auto On/Off switching of welding sets reduces the risk of electric shock to workers directly or indirectly associated with welding job. Annual savings of Rs 1.82 million is achieved with an investment of Rs 10 lakhs, resulting in annual emission reduction of 222 Tons of CO_2



Modification of feeder pipe size to deliver higher fuel load resulting in reduced coal consumption

An interesting intervention at the Kymore Plant (MP) reduced the power consumption in the coal conveying PD (positive displacement) blower by modifying the existing pipeline diameter and by replacing the blower with a new blower along with a motor. The PD blower was resized for lower air delivery, thus saving on electrical energy consumption. While this reduced power consumption by 60 kW, the coal consumption also reduced to the extent of 600 Tons as less air was available for combustion. Total investment was around Rs 15 lakhs and savings due to the intervention were to the tune of Rs 35 lakhs.



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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by GAIL

Location(s) of Intervention
Gas Processing Unit (GPU) in Vaghodia, Gujarat

Type of Intervention
Energy Efficiency measures via retrofitting & innovation

Company Profile

GAIL (India) Limited was incorporated in 1984 as Central Public Sector Undertaking under Ministry of Petroleum & Natural Gas, Govt. of India. From its humble beginning as a gas transmission company, GAIL has become integrated energy major having 10,800 Km Gas Pipelines, 2040 Km LPG Pipelines, seven gas processing plants of 1.4 MMTPA LPG / Liquid Hydrocarbons capacity, gas based petrochemical plant of 410,000 TPA polymer capacity which is being doubled. GAIL holds participating interest in 28 E&P blocks in India and 2 in Myanmar.

The Business Challenge as an Opportunity

Being an Oil & Gas major, GAIL is following to manage rising energy costs and growing concerns over greenhouse gas emissions, which results from the use of fossil fuels. Major challenges for GAIL remain to counter the increased use of energy to process leaner gas and to meet product quality standards. Availability of gas with suitable quality is also an issue. Therefore, climate change adaptation and mitigation measures have become an integral part of GAIL's Sustainability Aspirations 2020 and they are focusing extensively on increasing energy efficiency measures and rationalizing energy use.

For instance, in the gas processing industry, there is a lot of energy consumed in adjusting the pressure and temperature of the LPG. While it is necessary to reduce the pressure and temperature to convert the LPG in a liquid form at the source, it is equally important to raise the temperature of the LPG for the convenience of downstream consumers. This frequent adjustment of pressure and temperature at different points in the production phase of LPG is highly energy consuming. This was another challenge that GAIL was trying to overcome while ensuring energy conservation.

Devising the Intervention

As part of its internal mandate for sustainable development, GAIL introduced strong and robust energy management systems. GAIL found out ways to identify performance improvements which have led to significant energy and cost reductions. The pressure and temperature of gas needs to be increased or decreased several times in the value chain of gas production. This increase or decrease in pressure and temperature is an energy guzzling process, and therefore has financial implications for GAIL. Therefore, GAIL came up with an innovation to reduce the energy consumption.

The Business Case

The average investment towards incorporating the aforementioned initiatives at GAIL was approximately Rs. 2.35 Crores. However, the average savings accrued over the lifetime of this intervention was Rs. 194 lakhs per annum.

Best Practice examples

COOLING OF FEED GAS USING THE TEMPERATURE DROP IN THE REGASIFIED–LPG

GAIL has a gas processing unit and a compressor station installation at Vaghodia. While compressor station compresses all the gas coming to it from HVJ (Hazira–Vijaipur–Jagdispur) Pipeline, a part of this gas is fed into the Gas Processing Unit (GPU). The outlet gas of compressor station is at a higher temperature; therefore the gas is cooled by cooler fans.

South Gujarat Pipeline carries RLPG from Dahej to different customers of Gujarat. There is a substantial pressure reduction of RLPG to meet the customer delivery specification and for which considerable temperature reduction takes place.

This intervention was designed to utilize the temperature drop generated due to pressure reduction of RLPG supplied to South Gujarat pipeline, for cooling the feed gas supplied to the GPU at Vaghodia. This project, after commissioning was able to reduce feed gas temperature by approximately 7–8 °C which ultimately saved approximately 5,600 MWH/annum energy required through conventional mode of refrigeration.

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Industry Best Practices in Energy Efficiency by H & R Johnson

Location of Intervention:
H & R Johnson, Karaikal, Pondicherry

Types Of Intervention:
Energy Efficiency measures via Retrofitting

Company Profile

H & R Johnson (India), a division of Prism Cement Limited was established in the year 1958. The company is the market leader in the field of ceramic tiles in India. H & R Johnson has consistently maintained its leadership position in the field of tiles over the past five decades.

H & R Johnson enjoys the reputation of being the only company in India to offer end-to-end solutions of Tiles, Sanitary ware, Bath Fittings and Modular Kitchens. H & R Johnson's sales volume for the year 2010-11 was 43 million m2 of tiles and plans to achieve 90 million m2 by 2014-15.

The Business Challenge as an Opportunity

With the growing concern for cleaner production and conservation of fuel, the company enhanced its focus on energy efficient technologies. The key business driver towards this paradigm shift was to address the shortfall of natural gas availability for their production process. The business challenge for H & R Johnson was to increase the production while decreasing the high specific energy consumption of the frit making process and consumption of natural gas for this production process. . A Frit is a ceramic composition that has been fused in a special fusing oven, quenched to form a glass, and granulated

Devising the Intervention

In order to ascertain judicious use of natural gas as a resource in the production process, numerous alternatives were identified. While there were certain issues with the option of overloading the loading capacity of the smelters in terms of high maintenance costs, reduction of life-span and inadequacy of a robust heat recovery system, shifting to coal as an alternate fuel was certainly not an environmental friendly option. The plant officials thus went forward with installing continuous smelters with recuperative heat recovery system replacing batch type smelters for frit production.

Implementation

The intervention took place in the Karaikal, Pondicherry plant in the Frit Manufacturing Area.

The project used highly efficient regenerative type continuous smelter units to manufacture ‘Frit’ which was earlier manufactured by batch smelter.

The waste heat recovery system installed with the continuous smelter delivers inlet air at a temperature of about 1100 oC and saves the use of additional fuel. Energy consumption in the continuous smelter is approximately 2000 Kcal/kg of frit manufactured, which is around 70% less than the equivalent batch smelter. Water used for cooling is recycled in continuous process removing the wastage compared to batch process. In a continuous smelter there are two hot air regenerators that work in a cyclic fashion. When one hot air regenerator starts delivering hot air directly into the smelter chamber, gas flow regulating valve remains in the minimum position

to allow maximum heat utilization from hot air. As the temperature from hot air goes on decreasing, natural gas valve opens proportionally to allow maximum heat flow from natural gas.

Total Expenditure: Rs 350 lakhs (Cost of Smelters in 2006)

Total Savings: The saving realized out of NG saving is Rs 312 lakhs (FY 2007-2012)

The thermal energy saving in the project activity was estimated at 92.382 GWh per year along with Natural Gas savings of 3466946 SCM (Standard Cubic Meter) from FY 2007- 12.

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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by ITC

Location(s) of Intervention
ITC Manufacturing Plant, - Bangalore, ITC Process Department in ITC Bangalore, ITC Chirala Prakasam District, Andhra Pradesh, ITC Anaparthy East Godavari District Andhra Pradesh

Type of Intervention:
Energy Efficiency measures via retrofitting & innovation

ITC Limited

Company Profile

ITC is one of India's foremost private sector companies with a market capitalization of US $ 45 billion and a turnover of US $ 7 billion. ITC is an outstanding market leader in its traditional businesses of Cigarettes, Hotels, Paperboards, Packaging and Agri-Exports, while it is rapidly gaining market share even in its nascent businesses of Packaged Foods & Confectionery, Branded Apparel, Personal Care and Stationery.

The Business Challenge as an Opportunity

At the centralized cigarette manufacturing plants of ITC, the costs arising out of energy consumption were affecting their operating expenses immensely, while negatively affecting their bottom lines. The centralized air conditioning at ITC Bangalore Plant was notably consuming around 23% of the total energy requirement of the factory. While maintaining suitable temperature & humidity was critical for controlling quality of the production process, ITC identified that there exists considerable scope to reduce this energy consumption. Capturing and utilizing waste heat from processes was thought of as another avenue for reducing the energy needs of ITC's manufacturing plants to reduce costs. In the current scenario of power shortage, ever increasing cost of energy and its impacts on the operating costs as well as on the environment had driven the unit to look for technological solutions which addressed the pertinent issue of reduction of energy consumption.

Devising the Intervention

A number of interventions ranging from retrofitting of new energy efficient equipment to utilizing waste heat from industrial processes were conceived and implemented at their manufacturing facilities across the country. All of these aforementioned interventions helped drastically reduce energy consumption thereby reducing the cost burden on the organization.

An important area in which ITC incorporated the practice of sustainability was by making modifications in the pneumatic fans. Pneumatic fans have a very pivotal role to play in the tobacco manufacturing cycle. They are used for conveying un-threshed tobacco leaf from one stage to other stage. The electrical energy spent for this process constitutes around 20% of the overall cost of production. Therefore, it was essential to make minor modification to the kind of fans being used and change them into more efficient variety of fans.

The retrofitting of Air Cooled Chillers with Water Cooled Chillers at ITC was another such intervention which established an optimal balance between energy efficiency and resource consumption. This new technology resulted in an average annual saving of around Rs. 52 lakhs.

ITC Limited Bangalore, implemented an initiative in the area of waste heat recovery. At one of the points in their process chain, the equipment is used to cut the stems of the tobacco to increase their filling value. To this effect, ITC developed an innovative strategy by recycling the waste steam to boil water and develop more

steam. Essentially it was a steam recycling apparatus that resulted in huge cost savings.

Another innovative solution was replacement of existing fans of backward inclined vane type with energy efficient fans of backward curve vane type with optimized impeller blade angle and width. This solution had numerous advantages such as higher fan efficiency and reduction in energy consumption .

The Business Case

The total investment towards incorporating the aforementioned interventions at ITC was on an average of Rs. 55 lakhs. However, the average long term financial savings accrued over the lifetime of the interventions was to the tune of Rs. 195 lakhs per annum. Hence, ITC established that their savings in energy and water resources translated into actual financial gains, that depicted a strong business case,

Best Practice examples

REPLACEMENT OF AIR COOLED CHILLER TO RECYCLED WATER COOLED CHILLER

Figure 1: Replacement of Air Cooled Chiller to Recycled Water Cooled Chiller at the ITC Plant in Bangalore

Figure 2: Heat Recovery from Process Exhaust at the Process Department in ITC Bangalore

Since the area around ITC Limited Bangalore was a water scarce area, ITC installed air cooling chillers for their business operations. However, the air cooling chillers were not as efficient as water cooling chillers. At the same time, the water scarcity was inhibiting ITC to switch to the more efficient water based chillers. The most optimum solution that was also ultimately implemented by ITC was that to replace the existing inefficient air cooled centrifugal vapour compression machine with water cooled energy efficient screw chiller technology which utilized recycled water. This new technology was much more energy efficient and helped in maintaining the temperature and humidity levels as needed by the product.

The total investment for this initiative was Rs 145 lakhs and the total savings that were accrued over a period of 10 years was Rs. 548 lakhs.

Other Innovative technological interventions included

Introduction of Energy Efficient Fans (Backward Curved Technology) in place of Existing Radial Fans in Dust Recovery Filter

As part of Energy Conservation Programme, both Anaparthy and Chirala Units carried out efficiency evaluation for all pneumatic transport fans used in process Lines. After evaluation, Chirala Unit selected 3 fans which were found to be operating in low efficiency range of 60-65%. Hence, replacement of these fans was done with energy efficient fans, which operate in efficiency range of 80-85%. To this effect, Anaparthy unit replaced all existing pneumatic transport fans with the energy efficient fans which resulted in cutting down the energy costs to a great extent for ITC Limited.

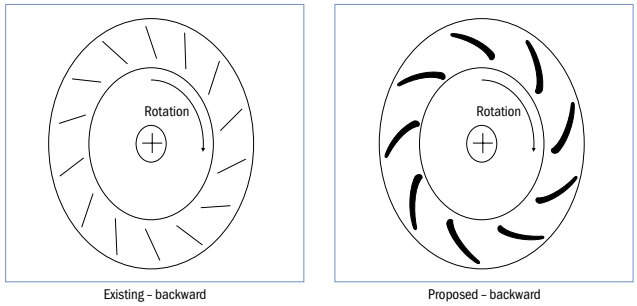

Figure 3: Introduction of Energy Efficient Fans (Backward Curved Technology) in place of Existing Radial Fans in Dust Recovery Filter at Chirala, Prakasam District, Andhra Pradesh and Anaparthy East Godavari District, Andhra Pradesh

The investment for this initiative was 22 lakhs for Chirala 39.43 lakhs for Anaparthy plant respectively. For Chirala unit, the total savings accrued over lifetime of 20 years at existing power cost of Rs. 5.6 per unit amounts to Rs. 188 lakhs and that for Anaparthy unit amounts to Rs 378 lakhs

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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by Jain Irrigation Systems

Location(s) of Intervention
Food Processing Industry,
Jalgaon and Chittoor

Type of Intervention
Energy Efficiency measures via retrofitting & innovation

Jain Irrigation Systems Ltd.

Company Profile

Jain Irrigation Systems Limited is the largest micro-irrigation company in India and the second largest in the world. It is also India's largest fruit and vegetable processor and the world's largest Mango fruit processor with manufacturing plants in Jalgaon, Vadodara and Chittoor. Jain's Farm fresh range of fruit products range from Mango, Guava, Banana, Tomato to a variety of other fruits.

The Business Challenge as an Opportunity

The food processing industry is highly energy intensive. Maintenance of proper temperature and humidity conditions in the vicinity of fruits and vegetables is important and requires constant monitoring. The financial losses, if these parameters not closely monitored can be immense. Hence Jain Irrigation had to invest heavily in technology which is related to cooling or heating of surroundings. This technology was energy intensive; hence there was a lot of scope for conservation which would have resulted in savings in the operational cost for the organization. The possibility of savings motivated Jain Irrigation to devise innovative solutions.

Devising the Intervention

Being in the industry of food processing, Jain Irrigation needed to ensure the right temperature and humidity levels for processing raw fruits and vegetables at their facility. Constantly monitoring and adjusting to changes in temperature and humidity is a highly energy intensive process. Jain Irrigation designed an innovative strategy to overcome this challenge. They cut down on the cost of refrigeration by installing poly-houses with semi-automated cooling fans. Energy was required to blow air through these fans, but it was a lot less than that required for operating a refrigerated set up for maintenance of the proper temperature and humidity levels. The rising costs of energy helped Jain Irrigation save on their energy costs. Other initiatives such as , like changing the type of de humidifier they used switching to a more efficient model and installing Vapor Absorption Machines were also undertaken. All of these changes helped Jain Irrigation save financially a lot more in the long run than the amount of money they invested initially.

The Business Case

The total investment towards incorporating aforementioned energy efficiency interventions at Jain Irrigation Systems was Rs. 8.41 Crores (Rs. 3.87 Crores in Jalgaon and Rs. 4.44 Crores in Chittoor). However, the average long term financial savings accrued from all the energy efficiency interventions was Rs. 1.58 Crores per annum. All of the aforementioned solutions were implemented. The payback period was 4.5 years. There has been an increase in the production process efficiency in terms of cost reduction and a decline in the specific energy levels.

Best Practice examples

EVAPORATIVE COOLING RIPENING CHAMBER

Figure 1: Evaporative Cooling Ripening Chamber at Food Park, Jain Valley, Shirsoli Road, Jalgaon

In the food processing industry the ripening of fruits and vegetable takes place by keeping them in artificially monitored temperature. Maintaining and constant monitoring and attainment of the right temperatures in case of variation are energy intensive processes. To tackle this challenge, Jain Irrigation installed poly houses with semi-automated cooling fan-pads, instead of ripening the fruits and vegetable using traditional methods of refrigeration. In the poly houses, relatively less amount of energy is required for blowing the air through fans and pumping water on cooling pads, for maintaining the desired temperature required for ripening. This initiative has substantially reduced the cost for construction of the refrigeration units and energy required for their operation. The investment in incorporating this initiative at Jalgaon was Rs.3.87 Crores. The savings accrued from this initiative were Rs. 72 lakhs per annum.

Other interventions

Reducing Thermal Energy Consumption

Another set of interventions which aimed at reducing thermal energy consumption in the operations at Jain Irrigation were

- Installation of a Vapor Absorption Machine to utilize the waste heat out of thermal jacket of biogas engines. In the long run, this initiative contributed to heavy energy saving.
- Waste Heat Recovery was another initiative which helped Jain Irrigation to meet their energy saving goals.
- Air cooled dehumidifier was changed to water cooled dehumidifier. Lesser energy is required to cool or heat water than air; hence the air cooled de-humidifier consumed a lot less energy than the water cooled dehumidifier.

Figure 1: Vapor Absorption Machine based chillers at Food Park, Jain Valley, Shirsoli Road, Jalgaon

An investment of Rs. 1.83 Crores was made to incorporate these interventions in the value chain of Jain Irrigation Systems. However the long term accrued benefits were Rs. 84 lakhs per annum.

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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by KPIT Cummins

Location(s) of Intervention
KPIT, 35 & 36 Rajiv Gandhi Infotech Park, Phase-1, MIDC, Hinjawadi, Pune – 411 057

Type of Intervention
Energy Efficiency measures via retrofitting & innovation

KPIT Cummins

Company Profile

KPIT Cummins is a recognized technology leader delivering Product Engineering services, ERP solutions and Enterprise IT consulting with focus on Automotive & Transportation, Manufacturing and Energy & Utilities verticals. .

The Business Challenge as an Opportunity

Operating in the IT industry, KPIT realized that their major costs were operations and maintenance of computer related hardware. They leveraged this challenge as an opportunity to develop a virtual desktop environment to reduce their energy consumption. In the automobile sector, consumers were increasingly looking for affordable solutions to meet their fuel needs sustainably. To this effect, KPIT saw an opportunity for market expansion in the electric vehicle space by developing a plug-in parallel hybrid solution for automobiles.

Devising the Intervention

The excessive consumption of electricity for computer usage in offices was seen as an opportunity to reduce energy consumption. In the wake of the above problem, the conventional desktop technology was replaced by the Virtual Desktop Infrastructure (VDI). The VDI is a Desktop centric service that hosts user desktop environments on remote server which are accessed over a network using PCoIP (Pixel compression over internet Protocol). It eventually reduces the hardware needed to maintain the IT systems at KPIT thereby reducing the power consumption.

Due to significant growth in population there is substantial increase in the number of automobiles on road, this results in an increase in emission of greenhouse gases. KPIT saw this as an opportunity and developed a solution that can be retrofit to vehicles making them more fuel efficient and less polluting. REVOLO is an intelligent, plug-in parallel hybrid solution for automobiles. It can be fitted onto automobiles to convert them into Hybrid electric vehicles.

The Business Case

The average investment towards incorporating the interventions at KPIT Cummins was Rs.525 lakhs for installing the VDI Technology and Rs. 100 Crores to develop the retro fit technology of REVOLO. The VDI Technology resulted in an accrued saving of Rs. 17 lakhs per annum over the life of the equipment.

Best Practice examples

TYPICAL VDI INFRASTRUCTURE

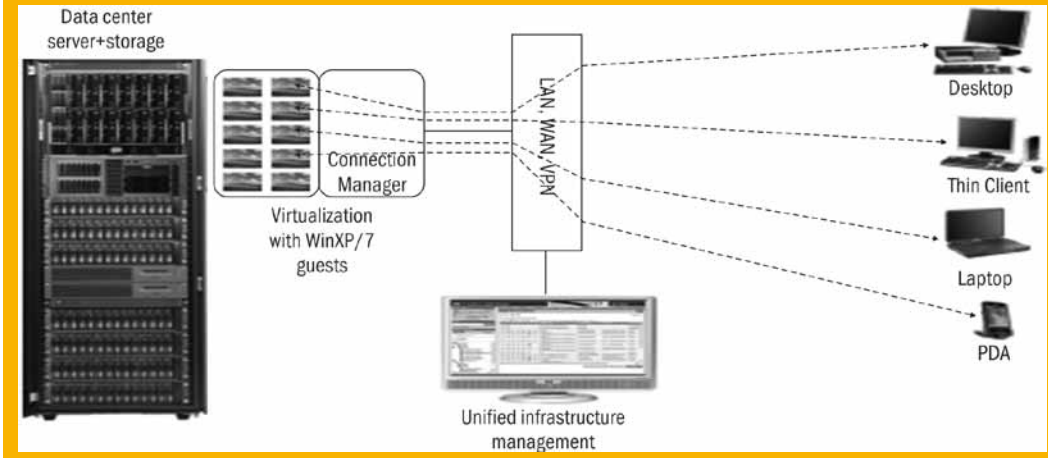

Figure 1: A typical VDI Infrastructure

Implementation of Virtual Desktop is a step towards reducing the energy consumption at KPIT. This is a new technology which delivered high-memory capacity to support a large number of virtual machines on each server. At the user's end, desktops which consumed around approximately 150 Watts of electricity were replaced with very small devices called thin clients that consume just 30 watts of energy. This reduced the amount of physical equipment needed thus reducing the power consumption. There were many benefits accrued by switching over to this technology. There was more than 60% reduction in energy consumption as compared to the conventional computers. Total energy savings were approximately 3,00,000 units per year amounting to 360 MT of CO_2 emission. There was 90 % reduction in e-waste generation due to the absence of IT Hardware, laptops & workstations.

PLUG-IN PARALLEL HYBRID SOLUTION

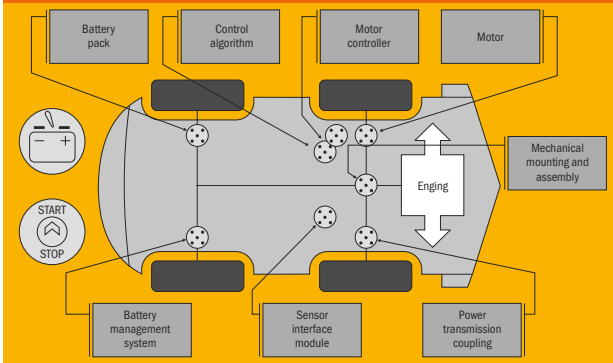

Figure 2: Plug-in parallel hybrid solution by the registered name of "REVOLO"

KPIT developed the REVOLO, which is an intelligent, plug-in parallel hybrid solution for automobiles. It can be fit onto the automobile to convert it into a hybrid electric vehicle. The product is made of sub-systems that include the battery pack, a motor, motor controller. All of these are controlled by intelligent algorithms that manage engine variations and help reduce fuel cost and cut down on harmful greenhouse gas emissions from engine powered vehicles.

TERI BCSD does not support or endorse or is responsible for the content presented in this case study titled "Plug-in parallel hybrid solution" featuring REVOLO. This case study is featured to substantiate how organizations are leveraging the sustainability paradigm.

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Reduction in industrial energy consumption by means of process optimization and energy efficient equipment by Mahindra & Mahindra

Location(s) of Intervention
Nashik (Maharashtra)
Kandivili, Mumbai (Maharashtra)
Chakan (Maharashtra)
Rajkot (Gujarat)

Type of Intervention
Energy Efficiency measures via Process orientation & Retrofitting

Company Profile

Mahindra & Mahindra is a leading SUV maker in India. Apart from SUVs, it also manufactures electric vehicles, pickups and commercial vehicles that are rugged, reliable, fuel efficient and eco-friendly.

It introduced utility vehicles to its product portfolio including vehicles like Scorpio and Bolero along with other farming essentials including tractors, cooling units, lighting systems, etc.

The Business Challenge as an Opportunity

The Automotive & Agricultural Equipment industry in India is a highly competitive one and the cost of manufacturing affects the company's financial performance. As for the entire industry, energy consumption is one of the major costs associated with manufacturing and assembly of automobiles & farm equipment at Mahindra. In order to save energy costs, and improve operational efficiency, multiple energy efficiency measures were identified which even capacitated the business potential.

Devising the Intervention

To ensure the profitability and sustainability of its operations along with energy use optimization, the plant officials devised numerous interventions ranging from eliminating redundant processes that consumed extra energy to retrofitting energy efficient equipment to even capturing waste heat for reuse in operations. The financial considerations for these interventions were duly considered before commissioning such interventions.

Major interventions in the automotive plant were at the paint shop division further in the air supply unit, heating chamber and the Cathode Electrode Deposition (CED) area to optimize processes which saved energy. In the Farm equipment plants division of Mahindra, energy efficient equipment was retrofitted to counter rising energy costs.

Major interventions in the automotive division (Paint Shop) were:

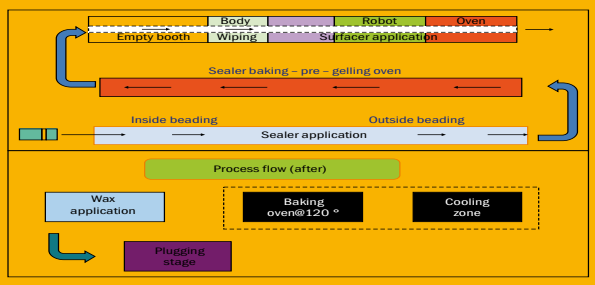
- Oven Process Elimination & Air Drying (Cooling Zone)
- Switching from two cooler fans to one
- Waste heat recovery from Surfacer Oven, Cooling zone & Electrode Deposition Oven
- Replacement of Constant Voltage Rectifier to Variable Voltage Rectifier

The Business Case

The costs incurred through the course of every intervention ranged from Rs. 5 lacs in some cases to almost Rs. 200 lacs in others. These investments helped save costs to the tune of Rs. 40-50 lacs on an average. The interventions were performed tactically to build the best trade-off between cost incurred and energy saved with an optimum payback period of one year in most cases.

Best Practice examples: Mahindra & Mahindra plant, Nashik, Maharashtra

OVEN & COOLING ZONES PROCESS

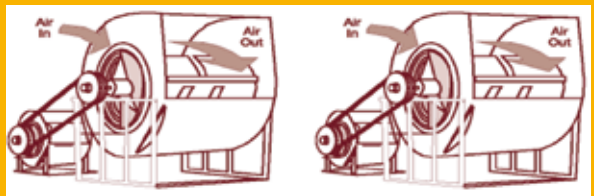


The following two interventions were carried out at the new paint shop of the automotive plant of Mahindra and Mahindra at Nashik :

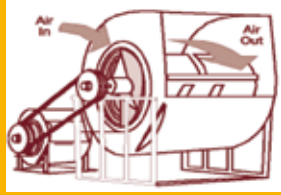
1. In the painting process for the automobile body parts, certain design changes were implemented to make the system more energy efficient. The modified design eliminated the baking oven zone and replaced the cooling zones with air drying unit at ambient temperatures in. Since LPG was used in the entire process, Mahindra and Mahindra saved 864 kgs of LPG, which translates to savings of 34.57 lac units of power. Investment towards the intervention: Rs 52.88 lakhs; Savings accrued: Rs 24.84 lakhs
2. To further streamline the process to consume less energy, the sealer applied automotive body shells were allowed to pass through the oven only once while ensuring that the pre-gelling ovens were not fired. This process change saved 1.2 tons of LPG per body shell, while saving a total of 175 tons of LPG annually. Intervention investment: Rs 63 lakhs; Savings accrued: Rs 96 lakhs

TO SWITCH FROM TWIN FAN TO SINGLE FAN

Before



After

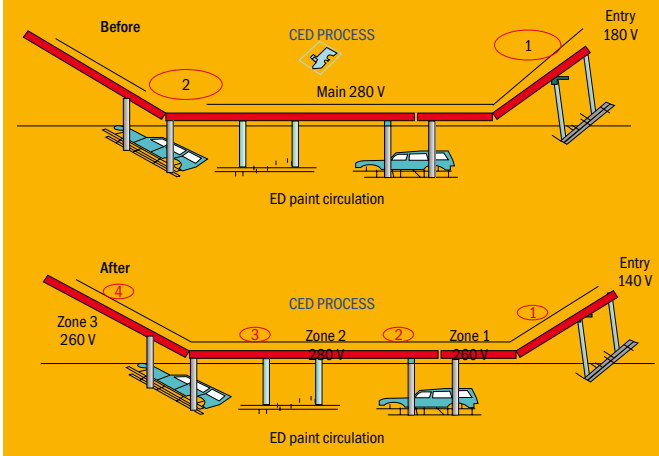


An intervention was carried out in the Air Supply Unit (ASU) at new paint shop of the Mahindra and Mahindra Plant in Nashik, where initially there were two fans being used with a capacity of 132 kW each and a total discharge of 326000 m3/hr consuming 5123 units a day.

This arrangement was replaced by a single fan of higher power (220kW) with a total discharge of 310000 m3/hr, consuming 3182 units a day.

Total investment for this intervention was Rs 26 lakhs and savings were of the tune of Rs 32.3 lakhs. The intervention was carried out in 2012.

REPLACEMENT OF CONSTANT VOLTAGE RECTIFIER WITH VARIABLE VOLTAGE RECTIFIER

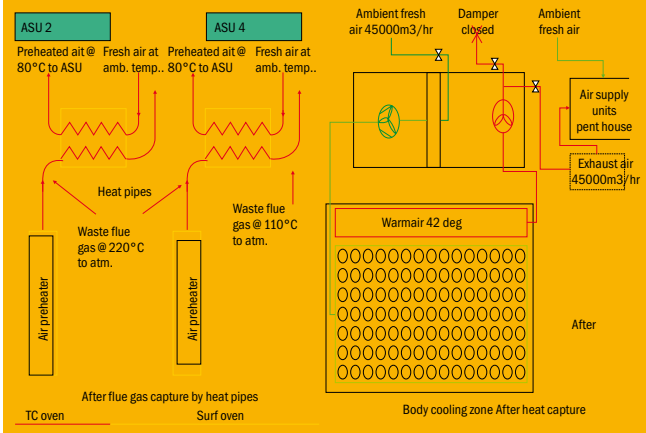


Another paint shop based intervention was using the Cathode Electrode Deposition (CED) process (Electroplating) for painting process.

A variable voltage rectifier was retrofitted in place of the constant voltage rectifier in the Electrode Deposition area of the CED process. This intervention allowed differential cooling & heating process for the right precision saving on idle time and thus electricity.

The intervention cost was around Rs 230 lacs and it saved Rs 75 lakhs annually. This intervention was implemented by Mahindra and Mahindra in the year 2012.

HEAT RECOVERY AT NEW PAINT SHOP



Among the other energy efficiency interventions to utilize heat from industrial processes, two prominent ones were:

1. To tap the latent heat from hot body shells at the cooling zone in the paint shop processes, which was earlier exhausted into the atmosphere, a heat recovery system was installed which utilized the heat from waste flue gases. Due to this intervention, the latent heat of the waste flue gases was captured and reused in Air Supply unit (ASU). Investment: Rs 4.45 lacs, Savings: Rs 14 lacs/annum
2. Heat was also recovered from the top coat and surfacer oven by heat pipes which was earlier lost as waste flue gases at 220 degrees.

Investment made: Rs 74 lakhs, Savings accrued: 53 lakhs/annum from saved LPG cost.

Mahindra & Mahindra Farm – Kandivili Plant, Mumbai

Company Profile

Mahindra & Mahindra is the number one tractor company in the world by volume with annual sales of over 200,000 and over 2.1mn tractors have been sold till date. The products made by the company are making farms prosperous in more than forty countries on six continents.

Business Case: Farm Equipment

ENERGY SAVINGS BY USE OF NATURAL RESOURCES FOR COOLING

Forced Draft Cooling Tower

Natural Cooling Tower

To effectively control operational temperatures in the manufacturing process, an intervention involving replacement of the forced draft cooling tower with a natural cooling tower was undertaken. The natural cooling tower is without a fan and thus does not consume electricity, while the forced draft consumes electricity for running the fan.

The total investment was Rs 2.1 lakhs. The total Savings from this intervention were around 60000 units of electricity per annum which translated into savings of Rs 4.2 lakhs.

Mahindra & Mahindra Gears, Rajkot, Gujarat

Company Profile

Mahindra Gears is a leading manufacturer of gears and other transmission components in India since 1987. It produces more than 400,000 quality assured gears a month, conforming to German specification DIN 7 to DIN 9 class of accuracy.

Business Challenge as an Opportunity

Energy is an important resource at Mahindra Gears and savings in energy directly impacts the cost of production given that Mahindra Gears is into manufacturing business. There were opportunities identified to reduce costs by reducing energy consumption in PLC Equipment by reprogramming the PLCs (Programmable Logic Controller)

Business Case: Mahindra Gears

TO TURN OFF EQUIPMENT WHEN IDLE

Mahindra Gears identified that if they turn off the machine hydraulic and other power consuming functions automatically when machine is in idle condition for more than 10 minutes, there could be substantial energy savings and cost reductions. This intervention was also thought to minimize unnecessary noise & human dependence while maximizing on the equipment's life.

To undertake the intervention, PLC (Programmable Logic Controller) programming was calibrated to automatically switch off the hydraulic function when idle for more than 10 minutes.

Savings of approximately 1285 KWH/year were achieved, which translated to savings of Rs. 100,196 a year, at a minimal investment of Rs. 900.

DESIGN OF NEW HYDRO POWER PACK

Before

After

Mahindra Gears designed a new Hydro Power Pack with the latest technology as per the given load to reduce extra load and save power.

Total investment of Rs 8.75 lakhs in this intervention yielded total savings of Rs 5.53 lakhs/annum. Power savings of up to 40% were recorded and payback period close to 1.5 years was observed.

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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by Shree Cements

Location(s) of Intervention
Grinding Unit Khuskhera, Loading/Unloading Unit at Suratgarh

Type of Intervention
Energy Efficiency measures via retrofitting & innovation

Company Profile

Shree cement is an energy conscious and environment friendly sustainable business organization. The present capacity of 13.5 MTPA makes it the largest plant in Northern India. The Company commenced its operations with first unit of 0.6 Million Ton established in 1985 at Bangur Nagar, near Ajmer, Rajasthan. Company has expanded its capacity from time to time. The present capacity is 13.5 Million Tons

The Business Challenge as an Opportunity

Cement production is an elaborate and a highly energy intensive process. Hence there is scope for incorporating measures to increase energy efficiency. These measures would finally translate to financial saving for the organization. This was the primary motivation for Shree Cements to incorporate the following energy conservation measures in their production plants.

Devising the Intervention

Shree Cements has implemented a range of interventions to incorporate the practice of energy conservation and energy efficiency in their production plants. Shree Cements strongly believes in making modifications to processes and incorporating sustainability right from the design phase. Therefore, they conducted energy audits and invested heavily in research and development to come up with strategies that would be helpful in increasing the energy efficiency of the production process.

As an example, in the cement production chain, the grinding process is the step where the clinker cement (an amalgamation of the basic raw materials of cement) is ground to powder form. Certain modifications were made to the grinder to make it more energy efficient. Also, modifications were made to compressors and their run times were regulated in a way that resulted in extensive power saving and energy conservation.

The Business Case

Energy conservation was the primary tool for Shree Cements to enhance their productivity and reduce their production costs. Shree Cements is an excellent example of how measures for attaining energy conservation goals were met efficiently at not just one but various stages of the cement production cycle.

Best Practice examples

REDUCING ENERGY CONSUMPTION WITH PROCESS OPTIMIZATION A THE GRINDING UNIT AT KHUSKHERA

At the Khuskhera Cement manufacturing Plant, the grinding unit was consuming a lot of energy. This unit which is the part of the cement production chain where the clinker cement is crushed into the powdered form is highly energy intensive. It is important to maintain the pressure inside the grinder system. Pressure and flow measurement are carried in a separator vent circuit to capture the energy saving potential in grinding unit. At Shree cements it was found that separator vent fan volume was higher than it was required to be. The separator vent volume was immediately reduced to a minimum level. Reduction in volume was achieved by decreasing the RPM of separator vent fan, which has resulted in energy savings of 17 kW. Similar energy audits were conducted. It was found that several pumps were designed to handle more than what their requirement was. All of these pumps were optimised. The energy consumption reduced drastically.

The investment in bringing about all of these modifications was zero as they were all done in-house. The savings were approximately 1.8 lakhs per annum over the life of the fan and the pumps.

INSTALLATION OF WASTE HEAT RECOVERY SYSTEM TO TRAP THE WASTE HEAT FROM PREHEATERS

Figure 1: Installation of Waste Heat Recovery system to trap the waste heat from preheaters and Air Quenched Coolers (AQC) of Clinker manufacturing pyro process to trap the waste heat

Conversion of 'waste into energy' is part of the green power project at Shree Cement which is aimed at saving water and generating electricity. Flue gases generated during the cement manufacturing process contain a very high amount of thermal energy. This energy has the potential to be re-used, conserving large amounts of electricity which would otherwise be used for heating water. By saving on water and electricity costs they are not only reducing capital expenditure, but also decreasing their dependency on natural resources in the long run. The capital cost of setting up the waste heat recovery plant was Rs. 100 Millions/ Megawatt. Although the return on investment starts after seven to eight years, the long term benefits are significantly greater than the business-as-usual scenario. Today Shree Cements is the largest generator of power using waste heat recovery in the global cement industry.

OPTIMIZATION OF COMPRESSED AIR SYSTEM FOR BULKER UNLOADING IN THE SURATGARH CEMENT MANUFACTURING PLANT

At the Suratgarh Cement manufacturing plant, there was inefficient capacity utilization. Three compressors were running for unloading three bulkers. Power consumption of all compressors was around 75 kW. After studying the energy requirements in detail, it was found out actual power demand was much less than what was being supplied to run the existing number of compressors. It was affordable to switch off one of the compressors. The plant is now running with two compressors only. This has resulted in drastic energy saving for the organization.

The investment for incorporating this strategy was nil and it has resulting in savings of Rs. 8 lakhs per annum.

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Industry Best Practices in Energy Efficiency by TATA Chemicals

Location of Intervention
TATA Chemicals, Babrala Plant, UP

Type of Intervention
Energy Efficiency measures via Innovation

TATA CHEMICALS LIMITED

Company Profile

Tata Chemicals Limited, a part of the prestigious Tata group, is located at Babrala, Sambhal District, Uttar Pradesh. The company is one of the largest chemical companies in India with significant operations in India and Africa. It has the second largest soda ash production capacity plant in India.

The Business Challenge as an Opportunity

In the TATA Chemicals ammonia plant at Babrala, the temperature of the stack rose to 195 Celsius than the specified temperature of 170 Celsius. This unexpected rise of temperature was happening due to fouling of the heat exchanger tubes. The motivation for TATA Chemicals was to devise an energy efficient strategy to clean these tubes, so as to achieve enhanced operational efficiency, thereby accruing energy savings.

Devising the Intervention

The issue of higher flue gas temperature in the primary reformer stacks was affecting their plant efficiency. This was happening due to poor heat recovery in the heat exchanger coils as a result of fouling (accumulation of waste on surface). After a rigorous study, the plant officials ideated the process of dry ice cleaning of coils to remove the fouling from the heat exchanger's coil surface. The advantage of dry ice cleaning is that, it leaves no chemical residue as dry ice sublimates at room temperature.

Thus the above method was identified as an effective way to increase operational energy consumption. The area of intervention was the Primary Reformer waste heat section coils in Ammonia plant of TCL Babrala.

The Implementation

Dry ice cleaning is a form of abrasive blasting, where dry ice (solid carbon dioxide) is accelerated in a pressurized air stream and directed at a surface in order to clean it. The advantage of dry ice cleaning is that it leaves no chemical residue as dry ice sublimates at room temperature. At atmospheric pressure it sublimes

at –78.7°C providing a cooling effect to the surface. The blasting process involves propelling pellets of dry-ice at on the surface to be cleaned at an extremely high speed and pressure. The pellet sublimates almost immediately absorbing a large volume of heat from the surface. This is believed to improve the cleaning process as the top layer of dirt or contaminant is expected to transfer more heat than the underlying substrate and flake off more easily. The rapid change in state from solid to gas also causes microscopic shock waves which are transferred to the surface of the solid. These shock waves are also thought to assist in removing the contaminant.

The increase in heat transfer rate resulted in energy saving of 12442 Gcal/year by reducing flue gas loss. Equivalent natural gas conservation is 1463765 sm3. Other benefits accrued through the course of this intervention displayed an increase in primary reformer efficiency, decrease in stack temperature by 20 °C and natural gas conservation and reduction in carbon footprint.

Cost Considerations of the project involved an investment of Rs. 55 lakhs accruing total savings of Rs 213.8 lakhs/annum (Saving is calculated by taking energy price of Rs.1718/GCal for the year 2012-13). Implementation was carried out in April, 2012.

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Industry Best Practices in Energy Efficiency by TATA Motors

Location(s) of Intervention
TATA Motors , Lucknow Plant

Type of Intervention
Energy Efficiency measures via Retrofitting & Innovation

Company Profile

Tata Motors Limited is amongst India's largest automobile companies.

Though it started as a leading commercial vehicle manufacturer in the automobile segment, TATA Motors is now amongst the leading organizations in passenger vehicles in the compact, midsize car and utility vehicle segments. It is also the world's fifth largest truck manufacturer and the fourth largest bus manufacturer.

The Business Challenge as an Opportunity

Tata Motors' is committed towards maximizing the use of energy efficient technologies. Tata Motors, being an ISO 50001 – Energy Management System certified company, is directed towards maximizing energy conservation in all its industrial practices. The primary business challenges related to higher cost of manufacturing, GHG emissions and carbon footprint stimulated the officials to critically think about plausible solutions to resolve the issues. There was also an opportunity to ease financial viability of the plant operations.

Devising the Intervention

To ensure the profitability and sustainability of its operations along with energy use optimization, the plant officials devised numerous interventions ranging from low cost innovative methods of energy conservation to retrofitting of efficient technology for operational efficiency while lowering GHG emissions. The financial considerations were duly registered for all the interventions before commissioning.

While the major retrofitting interventions involved substantial cost considerations, the benefits in the form of energy savings were immense which further eased the operational cost. The innovation driven initiatives on the other hand were based on cost effective design solutions yielding exponential savings. Some of the innovative interventions included modification of circuit design, automatic pit designing, and modification of process parameters in case of compressors to reduce operating pressure consuming lesser power.

These interventions were carried out in the Transmission Shop (Area), Gear/ Heat Treatment Shop, Welding Area, Main Receiving Station, Paint shop, DG House (Generator), Tire Yard, TCF (Trim Chassis Fitting) Assembly line and Vehicle factory of the TATA Motors' Plant in Lucknow, Uttar Pradesh.

Major interventions included:

- Installation of High Tension (HT) capacitors at Main Receiving Station to centralize regulation & control, as a measure of central compensation of reactive power
- Demand Side Compressed Air Management System as a means of pressure control valve to ensure constant and stable air pressure at the end use point was carried out in various parts of the plant
- Installation of Fiber Reinforced Plastic (FRP) blades for Man Coolers which provide controllable air movement, ventilation and noise reduction at high temperature plant sites.

- Other smart interventions included the arrangement of 2mm orifice air gun for cleaning auto parts at different floors/areas of the plant, Timer installation and easy modification of wiring of lighting circuit.

The Business Case

The average cost incurred to implement all the aforementioned interventions was Rs 7-8 lakhs. These interventions yielded benefits of the order of approximately Rs 10 lakhs (as on August, 2013). Most savings in energy were from efficient electricity consumption and efficient air pressure optimization. Several frugal solutions were also introduced towards de-bottlenecking the plant. The interventions were performed tactically to build the best trade-off between cost incurred and energy saved with an optimum payback period of about one year.

Best Practice examples: TATA Motors Plant, Lucknow

ELECTRICAL CONNECTION MODIFICATION FROM DELTA TO STAR (MOTORS)

An exercise was carried out at the transmission shop of the Lucknow plant to identify electrical motors running under 45% load. For the 12 under-loaded motors, it was suggested that the connection topology be changed from Delta to Star to reduce voltage across windings. This change would translate into energy savings by the reduction in iron loss.
The intervention had no investment and required in house circuit modification. Initiated in May 2012, it saved Rs. 4.1 lakhs as on August 2013 and is expected to save around Rs. 20.5 lakhs through a 10 year life cycle. Energy savings were of the order of 5.18 tonnes of Oil Equivalent.

FRP BLADES FOR MAN COOLERS

To address the issue of better ventilation at the manufacturing facilities, while ensuring that substantial energy savings were accrued, Tata Motors installed Fiber Reinforced Plastic (FRP) blades in Man Coolers in their Welding Shop & Vehicle Factory of their Lucknow facility as against conventional metal blades to maximize airflow. The use of FRP blades reduced the Power (22.3 Tonnes of Oil Equivalent) and Noise (9 DB) by 50%.
Total investment: Rs 4.5 lakhs, Total Savings: Rs 13.05 lakhs in 14 months.

FURNACE INSULATION

It is known that heat treatment enhances the strength and durability of metals; though it is an energy intensive process. To optimize the energy efficiency of the furnace by reducing the conduction based heat losses, Tata Motors' Lucknow facility, considered coating its furnace with heat insulating material and thermal insulation.

A special ceramic coating along with a sheet of heat resistant sheet and a final covering of Heat Resistant Nitril rubber was applied on the external surface of furnace oven, which reduced the energy losses substantially.

Total investment: Rs 5 lakhs, Total savings in 18 months: Rs 3 lakhs while expected savings in 5 years is Rs 80 lakhs.

TIMER IN UNDER PIT LIGHTING

At the Trim Chassis Fitting (TCF) Area of the TATA Motors' plant in Lucknow , where the painted chassis delivered from the paint shop is accessorized from scratch to a finished car, a number of 36 W lights used to keep glowing even after the B working shift (after 23:00 hours). To use this opportunity for energy conservation, ten timers were eventually installed in the Lighting Distribution Boards (LDB) of the pit lights for automatically switching OFF the lights after 23:00 hrs.

Total investment: Rs 0.39 lakhs

Savings Achieved: Rs 7.39 lakhs/annum.

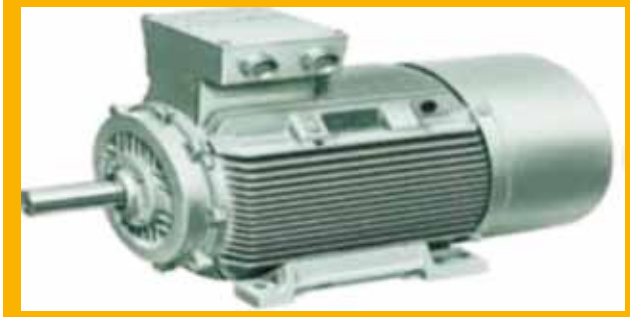
Energy savings were of the order of 9.9 Tonnes Oil Equivalent) 83 tCO2/annum)

USE OF 2MM ORIFICE AIR GUN

The cleaning of Auto parts at various areas of the plant was initially done by means of large orifice air guns (10mm hose pipes) which resulted in pressure losses and lacked quality posing a threat to longevity of the equipment.

It was then proposed to employ 2mm orifice Guns for cleaning as it saves on compressed air energy with minimum pressure losses. Eight guns thus used at low pressure (3bar) for every floor saved Rs 4.35 lakhs in 16 months at an investment of mere Rs. 1.2 lakhs. Energy conservation was of the tune of 5.5 tonnes of Oil Equivalent (40 tCO2).

USE OF ENERGY-EFFICIENT MOTORS IN FDV BLOWERS



The FDV (Forced Draft Ventilation) blowers are used to cool the shop floor at the manufacturing facility. The FDVs at TATA Motors were earlier propelled by conventional motors (rated 110 KW each) which consumed more energy due to their low efficiency. These motors were then replaced by five energy efficient motors (EFF-1). The new motors had an efficiency of 95.5% which resulted in energy conservation by 12% in the FDV system. The use of Energy-Efficient motors in FDV Blowers was considered due to higher energy saving potential and longevity. This retrofitting was carried out in the Assembly Line-1, Gear shop and Heat Treatment shop areas.

Total Investment: Rs 10.92 lakhs

Total Savings: Rs 9.19 lakhs in 17 months

Expected savings: Rs. 129 lakhs in 10 Years

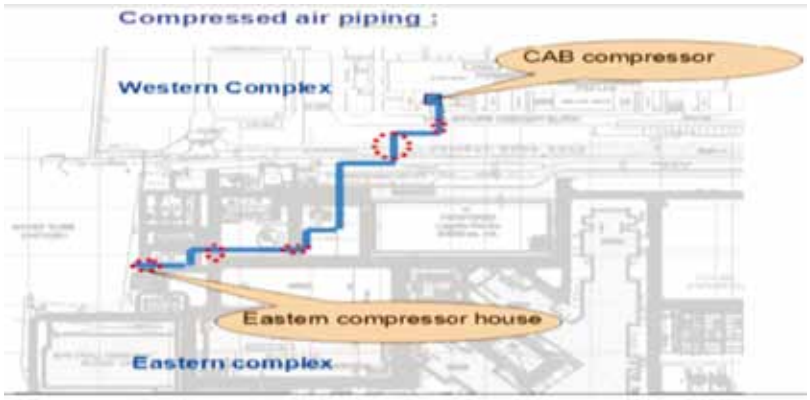
Energy Savings: 11.63 Tonnes of Oil Equivalent (97.34 tCO2)

Other Interventions

1. Compressed air interconnection between eastern to Western Complex, Lucknow Plant:

In order to centralize the compressed air generation system for simplified maintenance & control, the compressor house for the entire plant (both for Eastern and Western complexes of the TATA Motors' facility in Lucknow) was unified.

The system inter-connected the complete compressed air generation and distribution network between eastern and western complexes by putting down 1.2 Kms. of MS pipe line (4 Nos) crossing main Lucknow Dewa road and plant road. Pipe line size was 150 MM NB pipe. The figure shows the interconnection of the complexes.



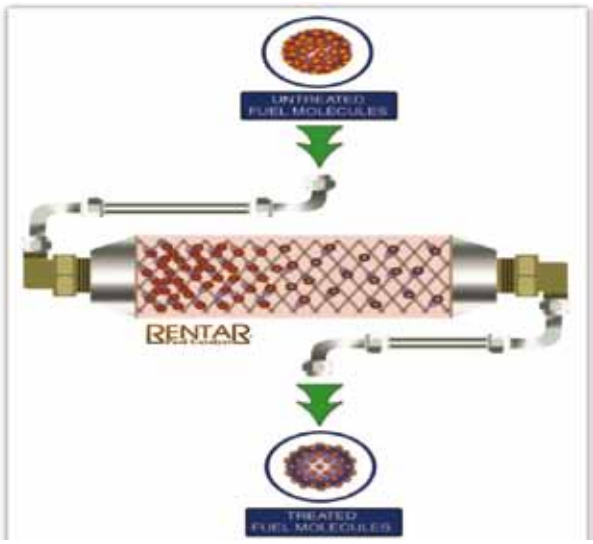
Total Investment: Rs 44 lakhs

Savings Accrued: Rs 3.19 lakhs (15 Months). Expected Savings: Rs 300.9 lacs (20 years)

Energy Savings: 6.46 Tonnes Oil Equivalent

2. Rentar Fuel Catalyst Device

With an objective of improving fuel efficiency and pollution control the installation of a device called, Rentar Fuel Catalyst was installed in the DGs (Generator). The initiative further reduced engine maintenance cost and extended life of equipment. In case of a Rentar Fuel Catalyst device, fuel is passed through the catalyst's combination of metallic and rare earth elements. A reaction occurs separating the clustered molecules. The more fuel molecules that are exposed to oxygen the more it is burned, leaving less to be blown out as exhaust, wasted horse power and pollution.



Total Investment: Rs. 7.9 lakhs

Total Savings: Rs 2.5 lakhs (10 Months). Expected Savings: Rs 30 lakhs (10 years)

Energy Savings: 4.3 tonnes of Oil Equivalent

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Industry Best Practices in Energy Efficiency by TATA Power

Location(s) of Intervention:
Trombay thermal power station

Type of Intervention:
Energy Efficiency measures via Retrofitting & Innovation

TATA POWER

Company Profile

Tata Power is the oldest and largest integrated power sector company with over 9,500 MW in installed power capacity of which 1,100 MW is from renewable sources. The Trombay Thermal Power Plant provides power to the metro area of Mumbai and has two 500 MW boilers, one 250 MW one and one 225 MW combined cycle gas power plant. .

The Business Challenge as an Opportunity

The operations at the Trombay Thermal Power Station posed some challenges pertaining to higher energy utilization in case of some primary equipment at their facility such as Pumps, Boiler Fans, etc. This provided an opportunity for Tata Power to retrofit some of these equipment with energy efficient devices.

Devising the Intervention

The Cooling Water Pumps, Boiler Feed Water Pumps, Condenser Recycle Pumps and Ventilator Fans were identified as problem areas for the intervention. Energy efficient retrofitting was carried out to avoid auxiliary energy losses due to impeller corrosion by sea water in case of Cooling Water Pumps & losses due to partial load of pumps in case of conventional RPM (Rotations per Minute) drives.

To ensure the profitability and sustainability of its operations along with energy use optimization, the plant officials devised numerous interventions ranging from low cost innovative methods of energy conservation to retrofitting of efficient technology for operational efficiency (Variable Frequency Drives to manage speed & load variation) while lowering GHG emissions. The financial considerations were duly registered for all the interventions before commissioning.

The Business Case

The costs incurred through the course of every intervention were averaged out at Rs 8-10 lakhs yielding benefits of the order of Rs 10 lakhs on an average. Most savings in energy were from efficient electricity consumption. The interventions were performed tactically to build the best trade-off between cost incurred and energy saved with an optimum payback period of about one year.

Best Practice examples: Trombay Thermal Power Station, TATA Power

COATING OF IMPELLERS AT AUXILIARY COOLING WATER PUMPS

Auxiliary Cooling Water (ACW) Pumps were primarily used to pump water from the Arabian Sea to the steam condenser area in the plant. Each ACW pump consumes approximately 110 kW (150 HP) of power but due to corrosion on the impeller devices within the pumps due to saline sea water, the efficiency of the pumps got impeded.

The impellers were thus coated with a 'Corro-Coat' solution offered by the pump manufacturers to reduce friction and resist corrosion by sea water eventually optimizing power consumption.

Total Investment: Rs 9.6 lakhs
Total Savings: Rs 23.14 lacs/annum
Energy Saved: 462878 kWh/annum
GHG Emissions: 347tCO2/annum

REPLACING STANDARD RPM DRIVE WITH VFD

Boiler Feed Water Pumps were initially operated by a standard RPM (Rotations per Minute) Drive to pump feed-water into the steam boiler to produce steam for the thermal plant.

As this arrangement was consuming a total power of 4.6 Lac units of power, there was a need to reduce this auxiliary consumption.

Instead of installing efficient motors which was an expensive option, the plant officials decided to install a Variable Frequency Drive (VFD) into the system which enabled the pump to operate even at partial load saving approximately 35% power consumption.

Total investment: Rs 7.5 lakhs/annum
Total Savings: Rs 7.5 lakhs/annum
Energy Saved: 155001 kWh/annum
GHG Emission reduction: 116 tCO2/annum

REPLACING EXISTING V NOTCH DRIVE BY A FLAT BELT DRIVE

Ventilation Fans at the plant facility are used to maintain working temperatures. The fans at the plant site run by V Notch belts have a high risk of slipping from the groove of the sheave and cause heat due to friction reducing motor speed & efficiency. Initial power consumption was around 37 Lac units and there was a need to change the drive to a 'flat belt drive' to avoid the risk of slipping for an approximate 10% estimated reduction in power.

Total Investment: Rs 12.4 lakhs; Total Savings: Rs 13.53 lakhs/annum
Energy Savings: 270684 units/annum; GHG Emission Reduction: 203 tCO2 reduction

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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost innovative strategies by TATA Steel

Location(s) of Intervention
Tata Steel Europe, Tata Steel Limited, Jamshedpur Steel Works, Jamshedpur, India

Type of Intervention
Energy Efficiency measures via retrofitting & innovation

Company Profile

TATA Steel is one of the top ten steel producing companies. It has an annual crude steel producing capacity of over 28 million tonnes per annum (mtpa). It is now one of the world's most geographically-diversified steel producers, with operations in 26 countries and a commercial presence in over 50 countries.

The Business Challenge as an Opportunity

Steel production is a highly energy intensive process. It is here that TATA Steel saw an opportunity for interventions that would not only help in energy conservation, water conservation, particulate matter mitigation and waste heat recovery but also result in financial gains for the organization by substantially decreasing their operational costs.

Devising the Intervention

TATA Steel has implemented a range of energy conservation interventions throughout the production process of steel manufacturing.

Molten coke which is the primary component for steel production needs to be cooled before it is fed into the blast furnace. It was observed at TATA Steel that the cooling of this molten coke by using water was leading to a large amount of energy loss and water wastage. The process was also generating particulate matter which is harmful for the environment. To counter all of these concerns, the method of Coke Dry Quenching was introduced to cool down the molten coke. This innovative method primarily used an inert gas to cool the molten coke. Emission of harmful gases is another area which was tackled by TATA Steel to the best of its advantage. It was identified that the heat content of the harmful gases emitted during the process was being wasted. This heat content was utilized by converting the coal fired boilers into 100% byproduct gas boilers. Challenges in rolling out this initiative like retrofitting, relocating and the internal modification of existing coal fired boilers were successfully met by TATA Steel.

Other initiatives involved installation of Variable Speed Drives in furnaces which helped to regulate fan speed thereby leading to savings in energy. Installation of more efficient pumps to flume flush and filter feeds, which are devices used for washing off traces of scrap metals from blooms, helped in water conservation. Modifications to Programmable Logic Controllers (PLC) regulated energy consumption, which led to huge amounts of savings.

The Business Case

The average investment towards incorporating the interventions at TATA steel was to the tune of Rs. 200 Crores. However, the average long term financial savings accrued over the lifetime of the interventions was Rs. 3.2 Crores per annum over the lifetime of the project. In almost all of the interventions, energy and water conservation translated into short term or long term financial gains.

Best Practice examples

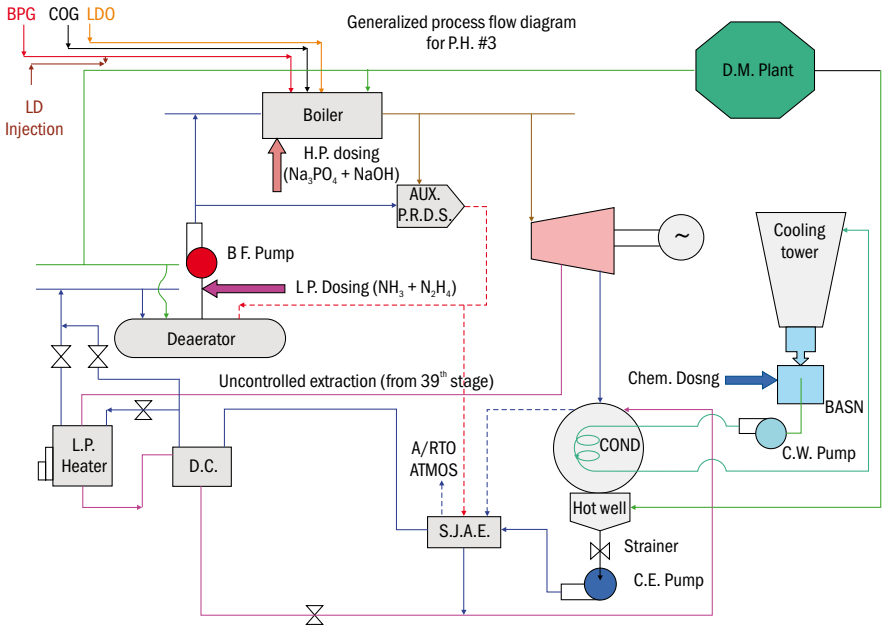

Figure 1: The Process flow chart of Steel production

CAPTIVE STEAM & POWER GENERATION AT TATA STEEL PLANT (JAMSHEDPUR)

The production process of steel leads to the emission of many by-product gases from various furnaces. These gases, which do not find any other substantial use, are only flared up in the atmosphere. TATA Steel found an application for these waste gases in generating electricity and steam for the operation of the steel producing plant. The figure above shows the exact place of installation of this intervention in the steel production chain. The challenges of relocating the existing coal fire based boilers, making internal adjustments to them, were all met successfully by TATA Steel. The initiative resulted in huge amount of energy conservation and reduction of the carbon foot print on the environment.

For an investment of Rs. 160 Crores, the savings that will be accrued over a period of 10 years are estimated to be Rs. 850 Crores.

COKE MAKING: COKE OVEN BATTERY AT THE TATA STEEL PLANT (EUROPE)

Molten Coke which is the basic raw material for steel making has to be cooled before being fed into the blast furnace. It was observed that there was a lot of potential to make this process more energy efficient. Quenching the molten hot coke with water was leading to loss of sensible heat. The dried up coke contained a residual 5% of moisture because of the quenching which took up additional energy inside the blast furnace to dry up. Wet quenching also generated dust which was adding to the carbon footprint.

To counter these issues that were resulting from the wet quenching of coke, the strategy of coke dry quenching was introduced. This method uses an inert gas to recover the sensible heat from hot coke. This heat can then be used for producing electricity or steam for the operation of the steel plant. The total investment in this intervention was Rs.200 Crores and the accrued savings over a time span of 20 years were estimated to be Rs. 1300 Crores.

Other Innovative technological interventions included

Flume Flush & Filter Feed, Lead Plant at TATA Steel Plat, Europe

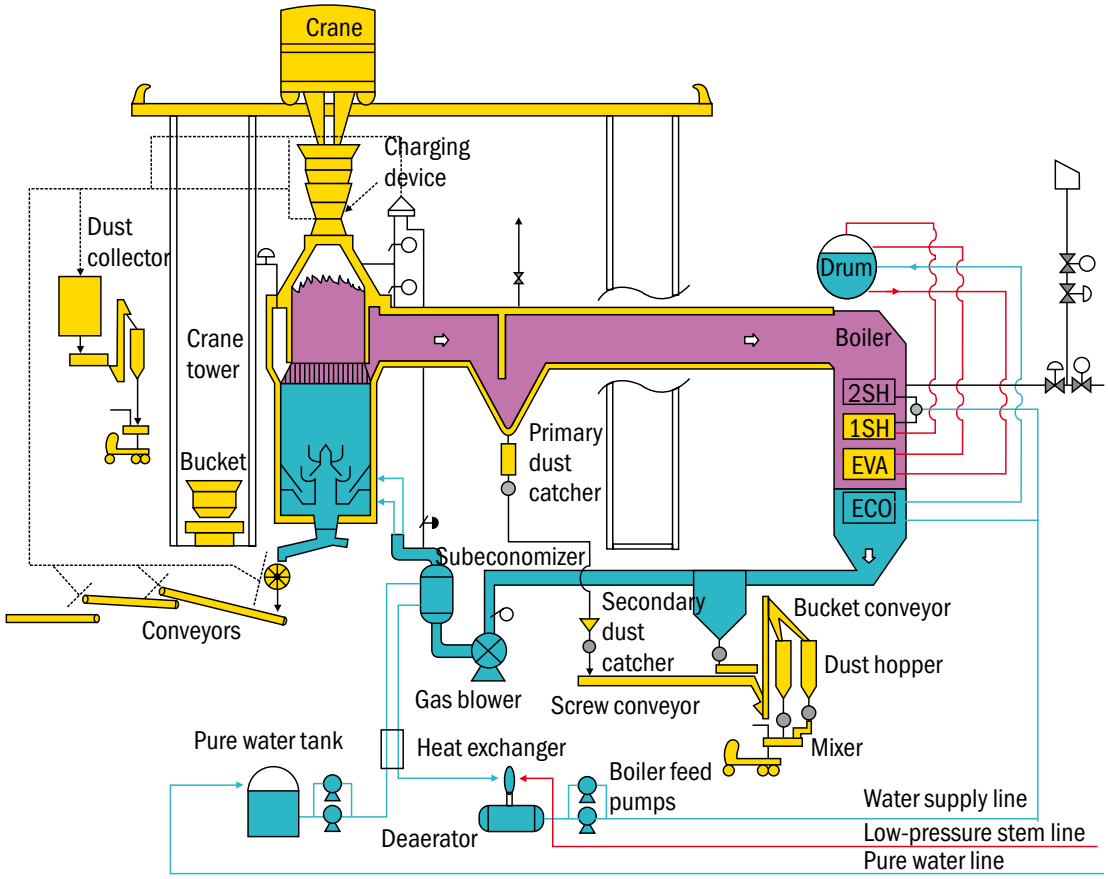

Figure 2: The Process flow chart of Steel production

Other significant interventions included installing Variable Speed Drives (VSD) amongst other modifications to motors, pumps and fans. Variable Speed Drives have contributed to a great extent in energy conservation by regulating speeds of the components they are attached to. Water conversation was another area which required attention at TATA Steel. It was practiced by regulating the flow of water through the flume flushes. Flume flushes are devices which are used to wash of scraps of metals from billets or blooms. Better efficiency in these devices resulted in extensive water conservation.

On an average these modifications translated to a financial investment of Rs. 9.1 Crores. This investment accrued to savings of Rs. 3.2 Crores annually. The payback periods of these initiatives ranged from 1.6 – 3.6 years.

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Industry Best Practices in Energy Efficiency by TATA Tele-Services

Location of Intervention:
TATA Teleservices, PAN India

Types Of Intervention:
Energy Efficiency measures via Innovation

TATA TELESERVICES LIMITED

Company Profile

TATA Teleservices Limited is the fifth largest wireless operator in India with 64 million subscribers with integrated mobile, fixed line and Internet Protocol solutions and has been providing telephony & mobile services under Tata DOCOMO as a brand name.

Tata Teleservices has one of the largest national backbone networks of more than 70000 kms of fiber network with hybrid, wire line and wireless access network. Tata DOCOMO, mobile brand of TATA Teleservices Limited has been recognized as "Best Mobile Broadband Service Provider" for 2012 by Frost & Sullivan.

The Business Challenge as an Opportunity

The network energy cost of the telecom towers is one of the major components amounting to about 30% of the total network cost. Network energy cost consists of two components-electricity charges and diesel consumption for running Diesel Generator (DG) set when there is no power. The cost of running a Diesel Generator (DG) is much higher than the cost of electricity provided by electricity board.

The present average costs vary from an average of Rs.9400 in 4+ tenancy sites with less than 4 hours diesel generator (DG) run per day to about Rs. 55600 in 1 tenancy sites with 20 hours DG run per day. The high variations in costs for similar network setups offer a huge opportunity for reduction of the energy costs. This could be done though implementation of innovative solutions whose effectiveness is monitored & controlled through a remote monitoring solution.

Devising the Intervention

The energy expenses in a shared telecom tower system are divided amongst the tenants and offer them with limited control over the expenses. This does not offer any incentive to the infrastructure provider to undertake energy expense control measures.

The situation demanded a breakthrough proposition to be worked out for customized solutions as per site requirements. The target of the breakthrough solutions was to achieve an independent and reliable power source for Tata Teleservices Limited (TTL) as per "the pay per use" concept at an affordable near to grid power rate.

To comprehensively address this issue, TTL Technology team formed an "Applied Research" team during FY 2011 under the Technology Projects and Infrastructure department. The mandate of this team was to obtain good quality continuous power independent of grid reliability at about Rs. 10-12 per KWH against the existing average of Rs.20-30 per KWH for high DG running sites, thus becoming the lowest cost telecom operator. The name of the project was christened as "C2 Project" .This department was responsible for developing customized solutions working closely with vendors, carrying out proof of concept implementations (prototype and pilot projects) and developing models for rollouts and monitoring implementation.

Alternatives Identified

Free Cooling Unit (FCU)

The concept of Free Cooling is to use the ambient air to cool the equipment by drawing the external air into the shelter through a filter, when the ambient temperature is lower than the indoor set temperature of the site. Thus air-conditioning requirements would be reduced. Also, in case of power failure, the DG starting can be delayed till the FCU can maintain the temperature in the shelter. But, it is suitable for single tenancy sites and non-critical transmission sites only.

Solar Hybrid Solution

Solar Hybrid is useful for Outdoor Base station tower sites having bad grid connection so that DG running can be decreased to the minimum or eliminated completely. But the setup involves a high CAPEX along with other deployment issues like space constraint, angle of reflection etc. and so is not feasible for non-grid tower sites.

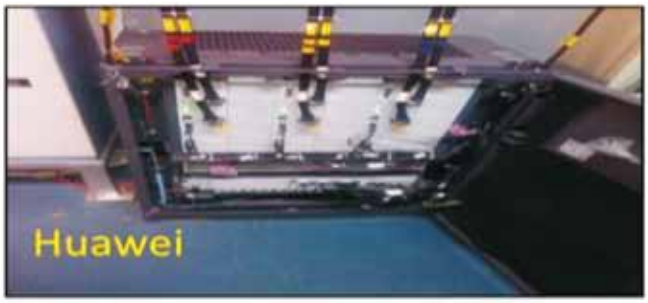
Outdoor Capsule for Indoor BTS

As all the Indoor Base station can withstand higher temperatures till 55 °C, it is proposed to move the feasible base station from inside the shelter to an Outdoor cabinet. But it is only suitable for contemporary base station subsystems with maximum load of less than 1.2KW.

Implementation

Out of the alternatives, 'Outdoor Capsule for Indoor Base station' started fetching good amount of savings. TTL had a fixed cost power and fuel tariff model with the Infrastructure provider and outdoor tariff was 20% less than indoor tariff. TTL planned to convert 4843 tower sites with Indoor Base station to outdoor by housing the Base station in Outdoor cabinet in FY13-14.

Conventional deployment of Indoor BTS inside shelter



Deployment of Indoor BTS inside an Outdoor cabinet

The tower site of mobile telephone network consists of base station equipment (electronics), tower to install the antennae and Diesel Generator with power interface unit including battery backup for standby backup power. The Indoor Base station was installed inside the shelter with air condition equipment to maintain the temperature up to 25 °C. The base station (indoor or Outdoor type) are capable to withstand higher temperatures till 55 °C and hence indoor Base station could be housed in outdoor cabinet equipped with heat exchanger/natural cooling systems without air-conditioning requirements. Thus the installed intervention eliminated the requirement of air-conditioning.

Total Investment: Rs 473.6 lakhs to install 4843 sites (FY 2013-14)

Total (OPEX) Savings: Rs 370.4 lakhs with estimated lifetime savings (6 years) of Rs 2222.1 lakhs

Annualized Carbon Savings: 22102 tCO2

With the implementation of Outdoor cabinet, existing Indoor Base station got converted to Outdoor Base station eliminating the air conditioning requirement which benefits the environment in two ways

- Due to the reduced CO2e emissions by lesser energy consumption for the same base station on account of reduction of power consumption as well as Diesel consumption; TTL estimated to achieve annualized carbon savings of 50039 TCO2e.
- Elimination/reduction of ozone depleting refrigeration gases by reduction of Air Conditioners in operation.

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Summary

The idea behind this compendium is to illustrate the best practices followed by organizations to incorporate the concept of sustainability in their operations. Practices can then be emulated by other organizations to make similar changes in their equipment or processes. If this happens collectively, Indian corporates can meet their goals of energy conservation and increased energy efficiency. Not only will meeting these goals have a positive effect on the environment but, it will also be beneficial for the balance sheet of the respective organizations.

Many organizations employed the strategy of making modifications to the existing equipment or processes. The results of these modifications were very encouraging. For example, many organizations installed Variable Frequency Drives in their plants. These devices regulated the consumption of power during the functioning of the plant thereby leading to drastic financial savings for the organizations. The noteworthy point about modifications like these was that the capital required for incorporating them was not much, leading to a short payback period.

We also witnessed examples of organizations which incorporated waste heat recovery as a strategy to save on their energy costs. There were many examples of organizations that installed equipment to put waste steam to use. They used the steam for heating purposes thereby saving energy. Some organizations used waste water, thereby leading to water saving.

Therefore, the business case for industrial energy efficiency is established from the best practice case studies that were elaborated in this section. It is important for other corporates to learn from and emulate these best practices of the leading Indian corporates who have championed the essence of incorporating energy efficiency in their organizations, both for establishing themselves as environmental stewards and for improving their operational efficiencies. To sum it up, energy efficiency measures reap savings.

Section II

Energy Efficiency in Buildings

Introduction

No longer can it be disputed that earth's resources are finite and that the capacity to absorb our wastes is limited. While an individual household may not appear to use much energy, one only has to multiply that by the population figure to appreciate the scale of building energy consumption.

Globally, buildings account for about 40% energy use, 42% water consumption, 40% solid waste, 50% raw material use, 50% of air pollution, 42% GHG emission and 50% water pollution.

The total installed power generating capacity in India has increased from 173 GW (as on March 2011) to 199 GW (as on March 2012) representing an increase of 15.1%, where the total electricity consumption in India is approximately 753 TWh per year. The major share of the electricity consumption in India comes from the industrial sector accounting for 39%, followed by the residential sector for 24%, and then by the agricultural (19%), commercial (10%) and traction and railway sector (2%). In the residential sector, fans accounts for 34% of the total electricity consumption, lighting for 28%, refrigeration for 13%, air conditioning for 7%, evaporative coolers for 4%, and television for another 4%.Whereas, in the commercial sector HVAC accounts for 55% of the total electricity consumption distribution, lighting for 25%, and internal loads for 15%. Additionally, the current trends in India also highlight that there has been an increase of 53% in the electricity consumption, whereas carbon di-oxide emission has increased to about 47% from the year 2004 to 2010.

All these statistics highlight the enormous energy and environmental footprint of the building sector. This growing energy use in buildings is majorly due to rapid economic development, increasing urbanization and improved lifestyles, predominantly due to increased space conditioning load. Energy efficiency, a possible solution to address to all these issues, can also directly connect the dots between health and social benefits, energy savings, energy security, industrial productivity, climate change mitigation, energy prices and improving the asset value.

Energy efficiency (EE) is a proven and cost effective measure to address rapidly increasing global greenhouse gas (GHG) emissions. There is great potential for improving EE across energy consuming sectors, particularly in developing countries. However, this potential remains largely unrealized due to the technical, financial, economic, and institutional barriers to EE Implementation. As, the electricity saving potential in the residential sector, by using energy efficient appliances is around 50% for lighting, 25% for refrigerators, 13% for televisions and 6% for both fans and air conditioning.

Therefore, In order to survive today, one must stop the ruthless exploitation of the environment, and move towards energy efficiency by choosing sustainable path.

Identifying this challenge and realizing operational efficiencies for their organizations, the Indian corporate is progressively undertaking numerous energy efficiency measures in the building sector. Therefore, there lies a need to share these corporate experiences and best practices while benchmarking them with global best standards. This compendium will be a ready compilation of practices for energy efficiency in buildings. It identifies, analyzes, categorizes, and describes the main elements of institutional models and practices that

have proved effective in promoting EE investments, particularly in the end-use (industry, buildings, residential) consuming sectors.

The compendium also suggests guidelines for designing new implementing institutions that can mobilize EE investments in India by enabling coordinated market activity by end users, utilities, equipment.

We hope that this section helps to deepen mutual understanding among various organizations for energy efficiency measures.

Saving energy and money: Resource Energy Efficiency Retrofit of the Godrej Bhavan Building by Godrej & Boyce

Location(s) of Intervention:
Godrej Bhavan, Mumbai

Type of Intervention:
Energy-Efficiency Retrofit of the Godrej Bhavan building in Mumbai.

Godrej & Boyce Mfg. Co. Ltd.

Company Profile

The Godrej Group is one of India's largest industrial conglomerates. Established in 1897, it includes seven major companies with interests in real estate, consumer goods, industrial engineering, appliances, furniture, security, and agricultural products. It is divided into two holding companies: Godrej & Boyce and Godrej Industries. The Godrej Group has a history of supporting sustainable development.

The Business Challenge as an Opportunity

As the country experiences rapid urbanization and its building occupied area skyrockets, from 8 billion square meters in 2005 to a projected 41 billion square meters in 2030, the country's real estate sector is racing to keep up with the demand for high-rise residential housing and commercial properties such as offices, hotels, and malls. Incorporating energy-efficiency measures in new and existing buildings will help India achieve a reliable energy future and save money while addressing the threat of climate change. Importantly, resource energy efficiency is a core characteristic of achieving sustainability in a building's operations.

Devising the Intervention

The Godrej Bhavan retrofit shows that greener, energy-saving retrofits are practical and profitable in India's rapidly transforming building market and provides replicable practices for cost and energy savings.

Figure 1 :Street View of Godrej Bhavan

Godrej Bhavan, built by Godrej & Boyce in 1972, is a six-story building that houses the company's chief management. After decades of high electricity bills, Godrej & Boyce upgraded Godrej Bhavan in 2010 to include comprehensive energy efficiency and sustainability features, such as efficient cooling and lighting systems.

Because of the upgrade, Godrej Bhavan is now an energy-saving building that is achieving significant financial and indoor environmental quality benefits for its owner and occupants.

The Business Case

The company's top management spearheaded the retrofit of Godrej Bhavan to meet high energy-efficiency standards and to create a model and healthy work space for its employees. The upgrades high performance measures, including the upgraded heating, ventilation, and air-conditioning (HVAC) system, are already yielding energy cost savings compared with fiscal year (FY) 2009-2010, the year before the upgrade. Godrej Bhavan's post-upgrade energy savings are on track to recover the retrofit costs of Rs. 53.8 Lakh(Table 1).Based on the electricity bill savings alone, the upgrade costs are expected to be paid back in 4.7 years.

In the first year after the upgrade (FY 2010-11), Godrej Bhavan's electricity use dropped to 527,160 kilowatt hours (kWh), for an 11.4 percent savings in electricity use. In the second year after the upgrade (FY 2011-12), Godrej Bhavan had even greater savings and electricity use dropped to 521,856 kWh, for a 12.3 percent savings in electricity use compared with the baseline.

Table 1: Energy-efficiency Retrofit Component Costs

Energy-Efficient Measures and Audit	Cost (Rs.)
HVAC-system replacement	
(including the building energy management system)	5,000,000
Water-flow meters	24,000
Energy audit	45,000
Energy-metering system	52,000
Auto blow down controller at the cooling tower	29,000
High-reflectance paint for the terrace surface	62,000
Lights with energy-efficient tube lights	172,000
Total Cost of the Energy-Efficiency	
Measures Installed	5,384,000

Other Energy-Saving Measures Installed

The HVAC and building management system was manufactured and installed by Trane, and the lighting system was manufactured and installed by Philips. Major innovation technological interventions are described below :

1) Building management systems:

- Installed the Trane Building Energy Management System (BMS) dashboard display with digital energy meters that continuously monitor energy use, check and rectify energy-use discrepancies, and increase maintenance staff accountability and productivity.
- Upgraded electrical systems to provide new information for greater building safety, more reliable operations for incoming and outgoing electricity supply, and circuit tripping and faults, which were previously unknown.

Figure 2: Energy-efficiency Technologies Installed

2) HVAC Chiller Upgrade with Building Management System Integration

- Upgraded the chiller compressor-condenser unit from a 35-year-old DX system with limited options for energy efficiency to a new Trane system with a screw chiller, water-cooled condenser, electronic expansion valve, and a high coefficient of performance (COP) of 5.5 from a previous COP of 2.2.
- Replaced the cooling tower motors and fills, installed a conductivity meter, a temperature controller, and a variable primary chiller water pumping system with Kirloskar
- Brothers Limited pumps and water-flow meters that control the minimum water-flow rate to increase energy efficiency.
- Improved fresh air circulation and indoor air quality by planting large trees around the AHU room and the fresh-air intake valves to provide shade during high temperatures. Also, installed operable windows to allow access to fresh air.
- Installed a Trane Tracer Summit building automation system to ensure that the new air-conditioning system delivered efficiency and reliability. Godrej Bhavan also signed a maintenance contract with Trane to ensure smooth HVAC systems operation.
- Increased efficiency by upgrading the refrigerant from HFC R-22 to HFC R-134a, dramatically reducing the refrigerant's ozone-depleting and global-warming potential.

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Enhance energy efficiency: Use of LED lighting system by replacing conventional lighting technologies by HUL

Locations of Intervention:
Vijayawada, Andhra Pradesh

Type of Intervention:
Replacement of high energy intensive conventional lamps with low energy consuming LED lamps for illumination of cold store inside

Hindustan Unilever Limited

Company Profile

Hindustan Unilever Limited (HUL) is an Indian consumer goods company and its products include foods, beverages, cleaning agents and personal care products. The Unilever Sustainable Living Plan has three major goals, which Unilever aims to achieve by 2020 namely help more than one billion people improve their health and well-being, halve the environmental impact of their products and source 100% of their agricultural raw materials through viable & ecological way.

The Business Challenge as an Opportunity

HUL adopted a new business model which enabled responsible, equitable growth, decoupled from environmental impact and at heart of all its businesses.

HUL has a large Ice-cream & Frozen desserts business. Large cold stores are an integral part of this business category. Traditionally, HPMV/SV (High Pressure Mercury Vapour/ Sodium Vapour) lamps with glass enclosure were used for lighting purposes.

While the performance of these luminaries was outstanding in ambient conditions, these were not the best choice in cold stores operating at – 25 to -30'C.

Under the above framework, site searched for alternative opportunities to reduce energy consumption without compromising the illumination inside.

Devising the Intervention

It was proposed to fit LED lamps for illuminating inside the Cold room at Spectra, Vijayawada in place of conventional HPSV lamps. This proposal was not only expected to save power bill of the site but also comply with both Unilever Sustainable Living Plan & Glass policy as per Unilever GMP guidelines.

Figure 1: Cold Store for Ice Cream storage-Retrofit with LED Lighting

The Business Case

The following specifications & model of LED light fittings were identified:

Model- Mini-Atm, surface mount, 1X1ft (300*300mm) LED Square Down lighter in white powder coated Aluminium housing with sealed prismatic/CI lens

The operating temperature range of these fixtures was -40 to -50'C. The wattage of the fixtures was 30Watts + LED Driver wattage i.e. a total of 34Watts per fixture. The light output was 2700 lumens.

To get average lux level of 100lux in an area of 270sq m, it is required to install 16 such fixtures.

Following are the Advantages for above intervention:

- This LED light set operating temperature is up to -40'C
- It is complying with GMP-Glass Policy, no extra precaution is required
- Its power consumption was 34 watt per set compared to SPFL Fluorescent lamps of 40 watt and HPSV lamp of 250 watt. Total power requirement to have 100 lux illumination level are as below:

HPSV	4 nos	250*4=1000 watt
SPFL	16 nos	44*16=704 watt
LED set	16 nos	34*16=544 watt

- Cost of Special Fluorescent lamp (SPFL) was approx Rs. 20,000 per set
- LED lamp is safe as LED Luminaire input Voltage is 24V DC, powered by a centralised 24VDC power supply, which increases efficiency and also driver reliability and will have an advantage of allowing easy operation from 24VDC Floating battery or ultimately from SOLAR Power in future.
- As the heat energy emission for LED is lowest as compared to HPSV and SPFL lamps, the heat load contributed to the system is also low. This saves the refrigeration power as a BONUS.
- No Touch – No recurring maintenance requirement with service life warranty of 7 years.

Approximate cost of each set was Rs. 15,000 with all taxes and 7 years of warranty. With 16 such fixtures, total investment was of the order of Rs 240,000 along with 16 SPFL (Rs 20000 per set) adding another 320,000. Annualized saving from the project was Rs.30,000/- basis present power rates. In addition, savings due to no maintenance required + reduced thermal load on refrigeration system are estimated at Rs.15,000. This is expected to continue for next 7-10 years. As the power tariff will keep on increasing every year, savings are expected to increase.

Direct power saving of electrical annual power consumption is 3995 KWH which is equivalent of 14GJ in energy. Also, indirect power savings on a/c of low ambient temperature due to less heat dissipation thus less heat loads to chiller.

In addition with reduction in annual CO2 emission from site this is 3.7 Ton, 100% compliance to Glass Policy as per Unilever Good Manufacturing Practice guideline in Quality and less e-waste disposal (fused HPMV/SV lamps, chokes) creating important business opportunities.

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Enhancing energy efficiency optimization through Sky Pipe lighting at Food processing industry by Jain Irrigation

Locations of Intervention
Jalgaon, Maharashtra

Type of Intervention
Sky Pipe Lighting at the Food Processing Industry to reduce electricity load in lighting

Jain Irrigation Systems Ltd.

Company Profile

Jain Irrigation Systems Limited is the largest micro-irrigation company in India and the second largest in the world. It is also India's largest fruit and vegetable processor and the world's largest Mango fruit processor with manufacturing plants in Jalgaon, Vadodara and Chittoor. JISL has adopted a uniquely sustainable method to handle the waste generated in fruit processing unit waste which involves generation of biogas from the waste generated in fruit processing unit for power for captive consumption.

The Business Challenge as an Opportunity

Jain Irrigation's Mission statement is "Leave this world better than you found it". Although, energy is a key resource on which industrial activities depend, the prices for various sources have been soaring high in the recent past. The major drive to energy efficiency by Jain irrigation was reduction in operational cost and reduction in GHG emission. Energy efficiency programs and process modification have saved energy in monetary terms, reaping benefits throughout the life cycle of the machines or processes

Devising the Intervention

Plant officials installed sky pipe for lighting in both the plants and turbo ventilator to maintain the temperature as compared to baseline when turbo ventilators were not installed.

In advance these interventions had reduced their electricity load.

The Business Case

This solution so implemented provided a good stimulus to their production process efficiency in terms of reduced cost and decrease in specific energy levels.

Figure 1: Sky pipe lighting at the Food Processing industry

Light Pipe which are physical structures used for transporting or distributing natural or artificial light for the purpose of illumination for day time lighting. These interventions helped in heavy energy conservation hence translating into financial gains for the organization. The investment on this intervention was Rs 7.5 lakhs.

Effective implementation of Energy efficiency programs as per the strategy in the lighting system has resulted in saving of 26,400 KWh of energy consumption over one year's till date. Financial savings accrued through this intervention translates to Rs 1.98 lakhs per annum and Intervention started in year 2011-12.

For more information please contact:
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Resource energy efficiency optimization through awareness drive and technological innovations, by KPIT

Locations of Intervention:
Pune, Maharashtra

Type of Intervention:
Creating awareness in PC Shut down during non-working hours and reduction in fresh water consumption through technological innovations

KPIT Cummins

Company Profile

KPIT is a recognized technology leader in delivering Product Engineering services, ERP solutions and Enterprise IT consulting with focus on Automotive & Transportation, Manufacturing and Energy & Utilities verticals. KPIT is working with global corporations by leveraging technology and domain expertise to co-create transformational value and help them to build a sustainable world.

The Business Challenge as an Opportunity

India is currently the world's third largest country in terms of carbon dioxide emission. This is primarily due to the fact that more than 60% of the power is still generated by burning coal. KPIT too observed a high consumption of electricity due to long ON times of the systems & servers, they decided to tap their usage and cut off usage as per need.

Since computers and Data centers consume 41 % of the KPIT total power requirement. They took initiative to shut down the PC's during non-working hours & further with implementation of auto Hibernating software.

Devising the Intervention

KPIT provided a smart and sustainable technology solution to Automotive, Manufacturing, Energy & Utilities and Defense corporations globally.

Software installed on 70% of the PC's due to their technical limitations was not possible to install the software on 100% PC's and for remaining 30% PC they initiated a PC shut down drive.

In addition, with regular monitoring of PC's and awareness campaign amongst the employee fuelled the realization of the intervention objective of energy reduction.

Also, energy efficiency through fresh water & power reduction in consumption was carried out by revamping of irrigation system and adjusting low water flow at all outlets.

The Business Case

KPIT has undertaken various initiatives towards energy saving for specific energy reduction. Awareness amongst employees for PC Shut down during non-working hours to curtail power consumption was carried out to reduce power consumption. This saved man hours as it was otherwise a manual process. They also implemented effective power management tools.

Revamping of irrigation system and adjustment in water flow at all outlets helped in reduction of fresh water consumption used for gardening purpose and further engaged the employees by awareness. One of the important benefits of this intervention was an increase in nutrient value of soil due to use of recycled water in garden.

With an investment of Rs 9.95 lakhs for 2000 PCs, out of which the system was installed in 900 PCs. The intervention saved 1 unit of energy per system to add up to 900 units a day. Annual Savings were of the order of 4 21,000 units which amount to Rs 29,48,400. A total of 508 MT of CO_2 was saved too.

Best Practices Example

PC SHUT DOWN DURING NON-WORKING HOURS TO CURTAIL POWER CONSUMPTION

KPIT vision says that it does not consume non-renewable resources, nor does it generate process wastes and emissions on scales comparable to conventional manufacturing industries. However, they do acknowledge the impact on the environment caused by the nature of their business in terms of consumption of resources like energy. Implementation of Virtual Desktop is one more step towards that direction.

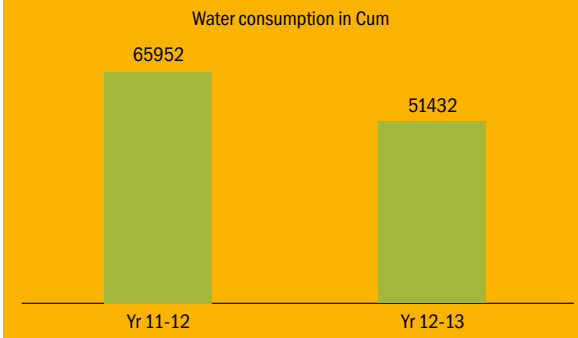
1. Saving of 4,21,200 MSEB units in a year

Total 1200 PC's were identified to carry out the activity. For which they created employee awareness through mailers and posters, informing them to switch off their PCs when not in use along with the installation of Auto PC hibernating software. They achieved a success rate of over 90% with this drive as 300 PCs were restricted to continuous 24hrs running due to project requirement.

Identified PC	Actual unit saving during non-working hrs. per PC	Daily saving	Saving during Weekdays (5 days)	Saving during weekend: (900x2:1800 Units a day (2 days)	Weekly Saving	Annual Saving
900	1	900	4500	3600	8100	421200

Total investment was around Rs 9.55 lakhs for hibernation software of 2000 pieces and expected savings due to the intervention close to the tune of Rs 29.5 Lac. Intervention was start from June 2010. This intervention at the pune office was expected to save 508 MT OF CO_2 emission annually from PC shut down drive.

REDUCTION IN FRESH WATER CONSUMPTION



To reduce fresh water consumption there are various initiatives taken specifically like revamp of sprinkler system by eliminating the use of fresh water for gardening purposes, detailed survey carried out for identifying and arresting water leakages in the premises, water pressure adjusted at different outlets for minimizing wastage of water, concept of dry toilets for reduction in consumption of water, employee engagement and education through posters, screen savers etc. to reduce consumption of water and third party employee education and engagement to reduce consumption of water.

Total investment was around Rs 1.5 lakhs for hibernation software of 2000 pieces and expected annual savings due to the intervention close to the tune of Rs 4.65 Lac. Intervention was start in the year 2012-13.With this intervention Savings of water consumption by 22% i.e. 14500 cum. Per annum.

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Encouraging energy efficiency product by adopting conservation measures in lighting system by Mahindra & Mahindra

Locations of Intervention:
Kandivili, Maharashtra

Type of Intervention:
Phase-wise change of metal halide and Installation of Voltage control for lighting system optimization.

Mahindra
Rise.

Company Profile

Mahindra & Mahindra is the number one tractor company in the world by volume and products made by the company are making farms prosperous in more than forty countries on six continents. Their Core Values inspire and encourage the Mahindra Group to enable the world to rise and lead by sustainability in social, economic, and environmental sector with amalgamation of what we have been, what we are, and what we want to be.

The Business Challenge as an Opportunity

Automotive and Farm industry is a competitive industry in India and the cost of manufacturing considerations affect the company's financial performance. Energy consumption is one of the major costs associated with manufacturing and assembly of automobiles and farm equipment's at Mahindra. In order to save energy costs, one opportunity identified was with regard to lighting.

Devising the Intervention

To change the metal halide lamp with electromagnetic induction lamps direct advantage is savings in energy consumption. Apart from that, there is also better quality of light and the life of the lighting system is also improved. So, phase-wise changing of metal halide lamps was one of the primary interventions.

Further, installation of voltage control for lighting system directly helps in savings in electricity consumption as voltage optimization is an electrical energy saving technique which is mainly installed in series with the mains electricity supply to provide a reduced supply voltage in lighting fixtures.

Typically, voltage optimization can improve power quality by balancing phase voltages and filtering harmonics and transients from the supply.

Also, replacement of Bus Bar Indication Lamps helps in reduction of electricity consumption by installing with increased luminous efficacy of the lighting fixtures.

Figure 1: Some Initiatives (Left to Right) Magnetic Induction Lamp, Voltage Control and 15 W indicator bulbs

The Business Case

Effective implementation of Energy efficiency programs as per the strategy in the lighting system has resulted in saving of 143,000 KWh of energy consumption over one year's till date. Financial savings accrued through this intervention translates to Rs. 9.8 lac per annum.

For more information please contact:
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Reduction in energy consumption by replacing conventional lighting technologies through energy efficiency in lighting systems, by Reliance Infrastructure

Locations of Intervention:
Mumbai, Maharashtra

Type of Intervention:
Installation of LED Tube Lights and motion sensor to enhance energy efficiency in lighting system

Company Profile

R-Infra is playing a pioneering role in Energy Conservation & Energy Efficiency practices, across its value chain – from Generation to Transmission and finally in its Distribution business. As recipient of first certification for ISO 50001:2011 – Energy Management System, across the world and Recipient of many national & international awards on Energy Management organization encourages and acknowledges every positive contribution in support of Energy Conservation.

The Business Challenge as an Opportunity

R-Infra Mumbai Distribution business, is the first electric supply utility in the country to establish an effective ISO-9001:2008 Quality Management System; and in FY 11-12, it has effectively established and implemented Environmental Management System based on ISO Standard 14001: 2004 with an ultimate objective to make all its operations and business activities eco-friendly, thereby reducing the Carbon Footprint of the business.

Devising the Intervention

As a part of Energy Efficiency & Energy Conservation measures within organization, walkthrough Energy Audits have been conducted by in house team at major company offices. Installation of motion / occupancy sensors in some of the key areas with potential energy saving has been identified as one of the primary Energy saving proposals. This was followed by site survey along with vendor representative to identify the locations for sensor installation having maximum energy saving potential.

On the basis of site survey findings, key Energy Saving areas have been short-listed as mentioned below.

- Conference Room
- Wash Room & lobby Area
- Other areas UPS
- Store Rooms etc.

Around 150 Motion / Occupancy sensors have been installed at above mentioned locations in Phase – I and balance will be completed in 2013-14.

Also, Installation of LED lightings has been identified as one of the primary Energy saving proposals. For a pilot implementation, Divisional Office, E-7 Building has been identified. Here, Total 100 Nos. of FTLs had been retrofitted by 18W LED Tube Lights. Further, Replacement of balanced conventional FTLs will be completed in phased manner.

The Business Case

Lighting load contributes 20-30% of total energy consumption in a typical office building. In order to reduce energy consumption due to lighting load, replacement of conventional T12/T8 (40/36 watt) Fluorescent Tubular Lights (FTLs) by LED lights has been identified as one of the energy saving proposals. On a pilot basis, in one

of the divisional offices, 100 nos. of conventional T12/T8 (40/36 watt) FTLs have been replaced by 18 watt LED lights.

Also, The PIR Sensor senses the motion of a human body by the change in surrounding ambient temperature when a human body passes through. It turns on the lighting load/ fan to which is connected. The lighting load fan will remain ON until it senses motion. Once the motion is seized it switches OFF the lighting load.

As a part of Energy Efficiency and Energy Conservation (EE&EC) measures within Company Offices installation of motion / occupancy sensors has been identified as one of the primary Energy saving proposals in cabins / washrooms / passage area / conference rooms since such places are not monitored for switching off lights when not required.

Best Practices Example

INSTALLATION OF LED TUBE LIGHTS

Retrofitting of existing T12/T8 FTLs by 18W LED Tube Lights in a typical office setup had resulted in significant amount saving in terms of Energy consumption and demand of electricity.
Some saving accrued through the intervention are :
Total Expected Unit generation: 8,550 Units per annum
Estimated savings in terms of Rs (@ 13 Rs Flat): Rs 1, 10,600 per annum
Total estimated Co2 emission reduction per Year: 6.9 Metric Tons (MT)
Installation of LED lightings has resulted in savings around Rs 1, 66,700 /- till date.
The total investment was Rs 2.05 lakhs and Intervention started in Feb. 2012.

INSTALLATION OF MOTION SENSOR/ OCCUPANCY SENSOR AT CONFERENCE ROOMS, WASHROOMS, LOBBY AREA AND CABINS

Some saving accrued through the intervention are :
Total estimated Unit saving: 16,200 Units per annum
Estimated savings in terms of Rs @ Rs.13 : INR 2,10,000 per annum
By installing motion sensor, we have saved about INR 1,15,000 /- till date.
Co2 emission reduction of around 15 Metric Tonnes (MT).
The total investment was Rs 8.5 lakhs and Intervention started in Nov 2012.
Also, with enough natural lights enter to the floor so during day hours most of the lights will be on OFF condition thus it results in significant amount of Energy. The total investment was Rs 6.5 lakhs and Intervention started in July 2009.

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Resource energy efficiency and new technological innovations in HVAC and lighting systems, by SAP

Locations of Intervention
Bengaluru, Karnataka

Type of Intervention
Use of energy efficient product in lighting and to improve efficiency of chiller units with 3D Tracer systems and by eliminated descaling caused through water quality

Company Profile

SAP Labs India is SAP's second largest Research & Development and Global Services & Support center in the world. SAP Labs India is one of the four global development hubs (Germany, US and Israel being others) of SAP that contributes to all areas of the SAP product value chain- Research & Breakthrough Innovation, Product Development, Global Services & Support and Customer Solutions and Operations. Bridging the gap between local market demands and SAP's development organization, SAP Labs set standards for excellence in innovation, efficiency and reliability.

The Business Challenge as an Opportunity

SAP's vision is to help the world run better and improve people's lives. Their mission is to help every customer become a best-run business by delivering new technology innovations that address today's and tomorrow's challenges without disrupting customers' business operations. SAP's energy and resource management software can help in correlate energy use with production – and better manage demand and peak loads – with real-time visibility into your most valuable invisible assets.

Devising the Intervention

Apart from other Energy saving initiatives in Motors and Pumps, etc., SAP started to discover the Energy Efficient measures in Lighting areas by improving efficiency of lighting level without compromise the user comfort. Also, in any of the IT/BT industries around 50-60% of Energy goes to HVAC system and Chillers are the major Energy consumer under HVAC system so with introduction of Energy efficiency measure and found

Figure 1 : TCS Kalinga Park, One of LEED Platinum rated green building

out 3D Tracer system is the right solution which can help in reduction of HVAC energy consumption by around 30% and also it further helps to reduces the water consumption.

To carry out the intervention, officials worked & evaluated multiple service providers, who can provide the total solution to replace existing CFL 2*2 light fixtures with high energy efficient light fixtures. And also insisted some vendors to put up a mock measuring instrument like Energy meter, LUX meter, etc., and upon positive readings by finalizing to replace it with T5 Light fixtures.

3D Tracer could measure the scaling, corrosion & microbiological occurrence in critical coolers and exchangers (by 24 x 7). It not only maps the occurrence of scaling & corrosion through real time measurement but also replenishes chemical actives to the desired concentration bringing back the system in control.

Online simultaneous display and logging of pH, Conductivity, ORP and Turbidity to bring enhancement to the current mode of monitoring & control. Further, it provides the best form of communication alarm prompting immediate attention and web enabled expert advice cutting down response time to any contingency situation. Thus Water quality improvement in HVAC closed circuit system, thus greater improvement in the efficiency of HVAC Chiller

The Business Case

LED bulbs are long lasting which last up to 10 times as long as compact fluorescents and far longer than typical incandescent. As bulbs last for years, energy is saved in maintenance and replacement costs. One of the other major environmental benefits is no mercury is used in the manufacturing of LED's. Also, since LEDs do not have a filament, they are not damaged under circumstances when a regular incandescent bulb would be broken. Because they are solid, LED bulbs hold up well to jarring and bumping.

For water quality improvement in HVAC systems major benefits are enhancements of asset life, equipment run length, reliability improvement, system clean from corrosion, scaling, microbial and fouling.

Energy saving is also one of the important benefit as the efficiency of HVAC chiller improved a lot.

Best Practices Example

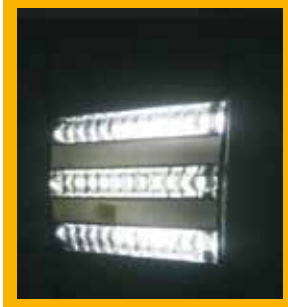
RETROFIT OF EXISTING 2X13WATTS CFL DOWN LIGHTS WITH 5.6WATTS LED LIGHT FIXTURES

Retrofitting of existing 2X13Watts CFL Spot light fixtures with high energy efficient 5.6watts LED lamps has resulted in significant amount saving in terms of Energy, Cost and carbon emission.
Estimated lift time of project is 10 Years

1) Saved 70% of energy in light fixtures, thus resulted in saving of 340,721 kWh
2) Also saving of Rs. 2,385,046 in Energy
3) Reduction of Carbon emission of 269 Tons.

Also, with enough natural lights enter to the floor so during day hours most of the lights will be on OFF condition thus it results in significant amount of Energy. The total investment was Rs 6.5 lakhs and Intervention started in July 2009.

REPLACEMENT OF EXISTING 2X36WATTS CFL FIXTURES TO 4X14WATTS T5 LAMPS FIXTURES



Before with 3X36Watts CFL light fixture

After with 4X14Watts T5 light fixture

Other Innovative technological interventions included

A Typical Chiller System

Typical 3D Trasar diagram

NOV 2010

July 2013

For more information please contact:

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Saving Money and Energy: Maximizing the energy conservation by use of energy efficient product in lighting, automation and HVAC system by Tata Motors

Locations of Intervention
Lucknow, Uttar Pradesh

Type of Intervention :
Use of energy efficient product in lighting, automation, telephone exchange, video conference and HVAC system

TATA MOTORS

Company Profile

Tata Motors Limited is India's largest automobile company, it is the leader in commercial vehicles in each segment, and among the top in passenger vehicles with winning products in the compact, midsize car and utility vehicle segments. It is also the world's fifth largest truck manufacturer and fourth largest bus manufacturer.

The Business Challenge as an Opportunity

Tata Motors' policy on energy and climate Change mention that the company is committed to maximizing the use of energy conservation through the use of eco-friendly technologies and energy efficiency products. The above drivers led to strengthen the

Devising the Intervention

The automotive industry in general is impacted by some key sustainability challenges like climate change, resource scarcity, product safety and reliability, occupational health and safety, supply-chain environmental and social issues and workforce management.

To maximize the use of energy conservation through energy efficient product there are many initiatives taken by TATA motors. They chose to use the energy saver for increasing the energy conservation. They have installed servo controlled lighting transformer, efficient telephone exchange systems, light pipes, timer controls, video conference systems and motion sensors.

The most important challenge while designing any energy system is that it needs to be effective as well as efficient. The primary choice of intervention includes use of energy saver for optimization of lighting and installation of servo controlled lighting transformer at shop floors which helps in 20% of energy saving from the base case. As extra supplied voltage to the system may be controlled which helps in reducing power consumption.

The Business Case

Use of 100 W LED street lighting system in place of 250 W HPSV (High Pressure Sodium Vapour)which helps in 66% of energy reduction with 4 times burning lamp hours and lesser maintenance cost.

In addition, video conferencing system transmits video, audio and presentations from which all locations can be virtually connected to each other. This helps in huge savings in the travelling expenditure. There are 28 video conferencing locations all over India in different cities.

Earlier in office & shop floor wash rooms, exhaust fans (each of 145 W) were used, which were 15 year old and many of them were rewound couple of times. This resulted in high operating cost. Replacing such exhaust fan with 55 W energy efficient exhaust fan and reduce the energy consumption by 62% and noise reduction by 10% use of eco-friendly technologies is encouraged.

Best Practices Examples

ENERGY SAVER FOR OPTIMIZATION OF LIGHTING CONSUMPTION AT SHOP FLOORS

Shop lighting consumption can be optimized by installing Energy saver at Shop Lighting Distribution Boards. 20% reduction in wattage supplied to a typical Gas discharge lamp would result in a measured lumens reduction of approx. 5% and reduction in brightness of just 2% which is not perceived by the human eyes. This intervention at the Lucknow plant was expected to save 18.49 Tons Oil Equivalent (TOE) till Aug 2013. Intervention started in Jan 2013.

The total investment was Rs 18 lakhs and savings accrued were Rs 80.62 lakhs through the life of the project (Assumed life cycle 5 years)

INSTALLATION OF ENERGY SAVER OF 30 KVA FOR STREET LIGHTING SYSTEM

Another Intervention, earlier street lighting system used to operate at full LT voltage, i.e., 415V. In order to reduce the energy consumption of the system, Energy Saver units were installed along with the
Feeder Pillars supplying power supply to the street lights. The energy saver works on voltage clipping technology which reduces the lighting energy consumption by up to 18-22%. They have installed Energy Savers (each of 30 KVA) in 17 nos. street lighting feeder pillars.
Total investment in the project was of the order of Rs 15.3 lakhs and savings accrued ranged around Rs 22.16 lakhs/annum with expected savings of Rs. 2.21 Cr over the assumed life cycle of 10 years. Intervention started in March 2012.

USE OF LED STREET LIGHT IN PLACE OF HPSV LIGHT

Use of energy-efficient 96W T5 Tube light fixtures (4 x 24W) and 100 W LED lights in place of HPSV streetlight of 250 W. Presently 250 W HPSV lamps are installed in all street lights. Each 250 W light consumes 300 W including ballast and starter. They have replaced 240 nos. of HPSV lamp with 100 W LED lights.This intervention at the Lucknow plant was expected to save 27 Tons Oil Equivalent (TOE) till Aug 2013. Intervention started in April 2012.

The total investment was Rs 60 lakhs and savings accrued were Rs 22.43 lakhs till August 2013 which would expect to save of Rs. 1.43 Crore through the life of the project.

OPTIMIZATION OF AIR CONDITIONING THRU TIMER BASED CONTROL IN AHU

Timer based control system has been adopted which helps in AC running hours to reduce by 18%. This result in Energy saving, reduction in operation cost and carbon abatement.

Most importantly, the total investment was only Rs. 0.1 lakhs and a total of Rs 1.04 lakhs was saved in 17 months starting from March 2012.

PRODUCTION PLANNING & RESCHEDULING BY 5 DAYS A WEEK WITH EXTENDED WORKING HOURS

By adopting a 5 days with extended hours working in a week result in energy savings and other variable elements like indirect material , transportation cost, canteen cost etc.

Power consumption will decrease, saving in transportation cost & other variable elements like fuel, indirect material will be lowered down further. Most importantly, the total investment was NIL and a total of Rs 37.75 lakhs was saved in 5 months starting from April 2013.

INSTALLATION OF PULL CORD SWITCH IN OFFICE LIGHTS

Switching of office lights was controlled from the stationary switches installed on the wall.Lights in offices would glow even when it was not required, i.e., when people were not in their seats.

Pull chord switches have been fitted in the individual light fixtures (near to users' seat) for switching ON/OFF of the lights from their seat itself instead of going to main switch board which is at a distance from the user's seat. This has increased the probability of switching off the lights by the user whenever it is not required. Through installation of 1020 nos. of pull cord switches in office lights. This resulted in energy saving of 40% in lighting system.

Most importantly, the total investment was only Rs. 0.2 lakhs and a total of Rs 6.96 lakhs per year. Intervention starting from February 2012.

Other Innovative technological interventions included

Pit Light Automation at Engineering Research Center

Many tube lights fitted in inspection pits were normally found to be ON even when no work was being carried out in the pit. Installation of motion sensors was done in the inspection pit which detected human movement

and accordingly switched OFF the lights when no human movements were observed. Motion Sensors save energy, enhance comfort & convenience, increase productivity, while improving safety & security. With low investment and ease of operation it helped savings Rs 1.7 Lac over a period of 10 years. These savings were achieved with an investment of Rs 0.16 Lacs, which resulted in annual emission reduction of 0.29 Tons of CO2

Use of Siemens telephone exchange exchange

A intervention at the Lucknow Plant with use of Siemens telephone exchange and system capacity to handle the 1000 extension numbers which can be extended up to 2000.Its features like compact and small in size, easy in maintenance and IP AND digital set installation. Telephone exchange system loaded with many advanced features like New Digital phone and IP phone , Conference bridge, connectivity through IP.Total investment was around Rs 48 lakhs and savings due to the intervention were to the tune of Rs .95 lakhs till Aug 2013.

Use of Light Pipes to illuminate shop floor during day time

A intervention with use of light pipes to transfer light to shop floor without any electricity consumption. The Minimum Lux level required at the shop floor is 300-500 Lux, at present which is maintained by the help of shop lighting, these lights need to operate in day time also to maintain lux level. The energy required for each lamp is 400 W, the proposed Light pipes help us to eliminate the usage of Lights during day time and help us save 37 Lakh / annum apart from reducing carbon Footprint of tCo2.

Sunlight leads to better health of workers and with white light it also helps to provide better ambience.

In addition, Heat load reduction on shop floor, so there will be less load on the ventilation system.

Total investment was around Rs 28.51 lakhs and expected savings due to the intervention close to the tune of Rs 92.5 Lac with life cycle of 25 years. Intervention started from June 2013 and lasted until till Aug 2013.

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Environmentally sustainable business strategy: Reduction in carbon foot print through green building infrastructure and operational energy efficiency by TCS

Locations of Intervention:
Across all TCS offices globally

Type of Intervention:
Low carbon growth strategy in new building infrastructure

TATA CONSULTANCY SERVICES

Company Profile

Tata Consultancy Services is an Indian multinational (IT) services, consulting and business solutions providing organization that offers consultancy in the areas of IT, infrastructure, engineering and insurance services. A part of the Tata group, India's largest industrial conglomerate, TCS, strives to decouple the increase in business growth with the increase in environmental footprint.

The Business Challenge as an Opportunity

Through its Climate Change Policy, TATA group mandates monitoring and mitigating impact on climate and urges to strive in making operations more environment friendly. The commitment of TCS to energy management and mitigation of climate change has been highlighted in the Environment Policy. TCS has followed various strategic options to achieve Low Carbon Growth.

Devising the Intervention

To grow sustainably TCS invested in green buildings, green IT facility and Procurement of energy through renewable sources to achieve their target of 50% reduction in specific carbon footprint by 2020. The carbon strategy of TCS is based on the approach that all new offices being built since 2007-08 are designed as per LEED standards for higher resource efficiency and better energy management. This helps reduce the specific carbon footprint in operations. Green Buildings helps conserving key resources like energy and water.

Some features of all TCS buildings are higher energy efficiency with efficient HVAC system and optimum lighting which help in reducing power consumption by 40%. Optimum usage of daylight and natural ventilation is encouraged. There is extensive usage of solar power in form of – solar photovoltaic cells, solar based street lightings, solar water heaters, Remote Energy Monitoring and control system through integrated Building Management System, Sewage treatment and recycling plant to achieve zero water discharge. Use of recycled and regional materials, use of low VOC paints and adhesives and provision for public transport services in proximity to mitigate emissions from employee commute is something that TCS strongly believes in and implements. Indoor air quality and bio-gas generated through Bio-digester is used as renewable energy in canteen instead of LPG which helps them cut down their operational costs.

Figure 1 : TCS Kalinga Park, One of LEED Platinum rated green building

Energy efficiency initiatives include usage of higher energy efficiency equipment such as HVAC chillers

Figure 2: Some Initiatives (Left to Right) Data Centre Visualization, Data Centre consolidation, Energy Efficient Chillers

with high coefficient of performance. (COP) (Figure 2)Pumps and other utilities with higher energy efficiency are procured. Some of the other IT initiatives that have been a part of their sustainability initiatives include Aligning the Server Racks with help of TCS Developed Power Assess Tool, Server Virtualization & consolidation (Figure 2). All Desktop Computer are operated at 24 °C as room temperature instead of 20 °C.

The Business Case

The specific energy consumption were 319 kWh/FTE/month in 2007-08 which is reduced to 216 in 2012-13 while relative carbon footprint which was 3.00 tCO2e/FTE/annum in 2007-08 reduced to 1.99 in 2012-13 respectively.(Figure 3) Thus, fulfill the TCS commitment towards TATA Climate Change Policy (reduction in carbon footprint)as well as TCS Environment Policy (Energy Conservation).

Effective implementation of Energy Conservation programs as per the strategy has resulted in saving of

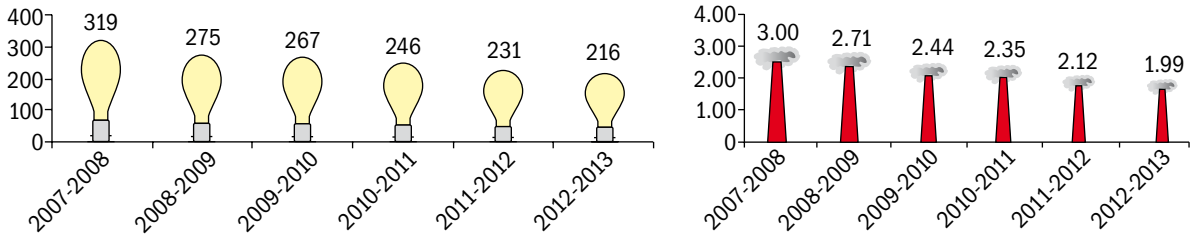

Figure 3: Specific Energy Consumption & Carbon Footprint Emission

609,939 MWh of energy consumption and 485,006 tCO2e of carbon emissions through efficiency measures over five years till date. Some other savings accrued to the organization are improved branding, improved carbon performance, higher customer and investor confidence and various awards and recognitions like ranking in the Global 500 Carbon Performance Leadership Index 2013, energy efficient building awards, sustainability awards, etc.

For more information please contact:
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Reduction in industrial energy consumption by use of energy efficient equipment & other low cost

Location(s) of Intervention:
All Offsite Lobby ATMs All across India

Type of Intervention:
Energy Efficiency measures via retrofitting & innovation

Company Profile

YES BANK is India's fourth largest private sector Bank. YES BANK is the only Greenfield license awarded by the RBI in the last 17 years, associated with the finest pedigree investors.

Since its inception in 2004, YES BANK has fructified into a 'Full Service Commercial Bank' that has steadily built Corporate and Institutional Banking, Financial Markets, Investment Banking, Corporate Finance, Branch Banking, Business and Transaction Banking, and Wealth Management business lines across the country.

The Business Challenge as an Opportunity

YES Bank realized that the Air Conditioning (AC) in Automated Teller Machines (ATMs) was a major contributor to energy consumption. They needed an intervention to conserve energy as well as save the cost that they incurred in air conditioning. They implemented a system that optimized the usage of AC without reducing the overall experience of using an ATM.

Devising the Intervention

Fuel is the major cost in production of electricity. In the offsite lobby ATM's; YES Bank Pvt. Ltd has implemented a device called Site Environment Monitoring System (SEMS). The device is connected to all the electrical equipment installed at the ATMs such as the Air Conditioner, UPS, Lights, Signage lights, UPS Batteries.

Implemention of the Site Environment Management System (SEMS) All Offsite Lobby ATMs across India

SEMS was controlled from the Yes Bank Outsourcing Partner Prizm Payments/AGS monitoring center. All the Air Conditioners were timed through SEMS which also included controlling of the temperature centrally individually for each ATM. This proves to be a highly effective strategy for specific geography like Near Capital Region (NCR) where it is extremely hot during summers and extremely cold during winters. All the lights are connected through SEMS for automated operations. The device also controls the battery levels of the UPS and sends auto alerts to the monitoring center. The system throws an alert when any of the lights or signages are not working.

The Business Case

The operational cost was Rs 400 month for maintaining the system. The estimated accrued savings were approximately Rs. 5000 per month. The above intervention helped YES Bank Pvt. Ltd helped in immense financial savings for the organization. Therefore these savings establish the business case for implementing the energy efficiency measures in the organization.

For more information please contact:
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Energy saved is energy produced: Enhancing energy efficiency of a lighting system through retrofitting by TERI

Location(s) of Intervention

IHC-6C,Darbari Seth BIlock, India Habitat Centre

Type of Intervention

Retrofit with LED lighting & Occupancy sensor by enhancing energy efficiency

Company Profile

The Energy and Resources Institute, commonly known as TERI established in 1974, is a research institute based in New Delhi. TERI is an independent, not-for-profit, research institute focused on energy, environment and sustainable development, devoted to efficient and sustainable use of natural resources. In its 38 years of existence, TERI has completed more than 2600 projects and has about 20 divisions.

The Business Challenge as an Opportunity

Lighting is an integrated component of buildings which brings liveliness to the architecture. Along with providing illumination and a sense of security, the lighting system should be durable, energy-efficient, and requiring low maintenance. The most important challenge while designing a lighting system is that it needs to be effective as well as efficient. An effective lighting system provides appropriate amount of light at specific locations and does not cause any visual discomfort, such as glare or dark/bright spots in the field of vision. Efficiency can be achieved by selecting appropriate luminaire consisting of lamp and mirror optics, and by better light distribution with optimum placement of luminaire. Energy optimization can also be achieved by adopting efficient ballast and proper integration of lighting controls.

Light Emitting Diode (LED) technology is improving at an exponential rate. The reduction in price clearly shows the transition path of traditional lighting technologies to LEDs.

Devising the Intervention

An energy-efficient lamp holds a significant role in conserving energy and saving the environment.

Luminaires play a significant role when it comes to generating energy-efficient light. With LED retrofit lamps, it can improve visual comfort and also reduce operating lighting power density. Here is a brief summary of a work exploring LED and occupancy sensor installation at IHC-6C, TERI–first floor.

A lighting retrofit can be one of the easiest and most cost effective methods to reduce a facility's energy consumption.

General offices have been principally lighted with fixtures using linear fluorescent lamps. So, to retrofit inefficient lighting fixtures with LED, a preliminary measurement and lighting analysis had been carried out.

Challenges: To design lighting system as per ECBC-2007, to reduce its lighting power density (LPD) and follow NBC-2005 to maintain visual comfort at work plane height.

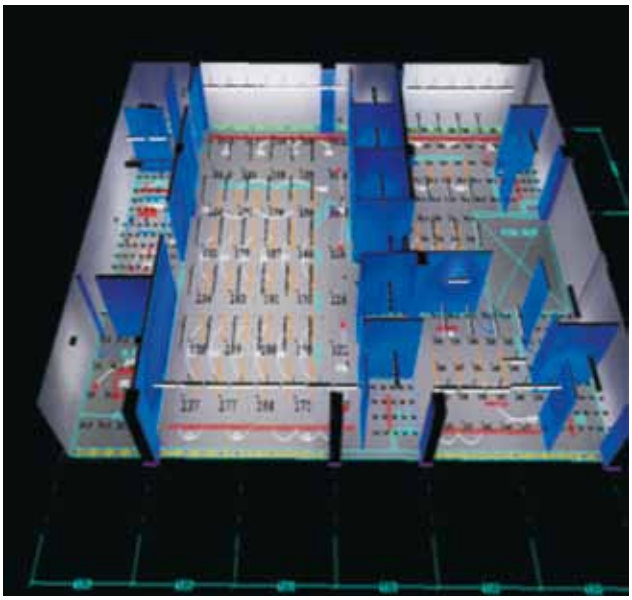
For this, a measurement is carried out and analysis is done for the existing lighting illumination level. The measured artificial lighting average lux level on work plane was 140 lux which is much lesser than NBC recommended 200-300 lux value. This was causing visual discomfort and strain to the user. The calculated LPD was below ECBC prescriptive values i.e., 8.76 W/m2, approx. 19 per cent lesser. The total operating lighting load was 3.67 KW.

Based on the existing lighting scheme, a planned efficient lighting with LED and control scheme strategies using occupancy sensor is greatly needed.

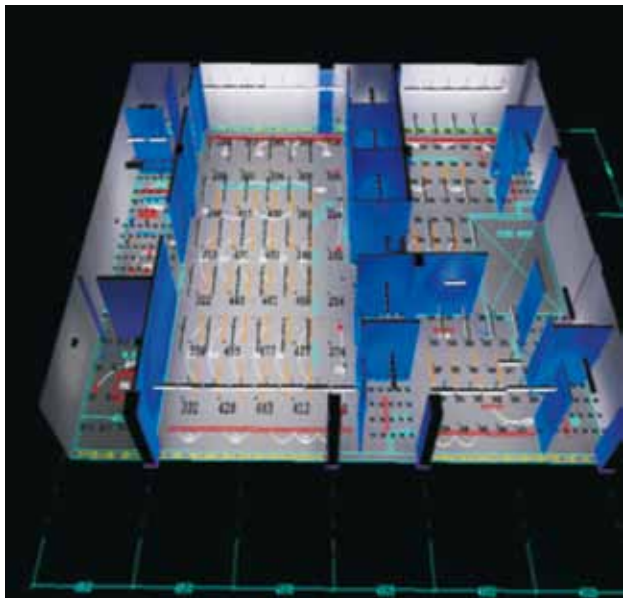
Conclusion: Based upon the existing design and wiring layout, it is decided to change only the lamp for most of the luminaries.

By retrofitting existing fluorescent lamps with LED lamps, operating load is reduced to 2.13 KW, and a reduction of 42 per cent in lighting energy consumption. Post installation of LED, the calculated LPD was only 5.08 W/m2 which is 53 per cent lesser than ECBC prescriptive values.

Also, able to increase the measured average illumination level of work plane significantly to 245 lux. Further, occupancy sensor in each cabin helps in achieving 10 per cent additional energy saving during non-occupancy of user.



Before Replacement (70 to 170 lux)



After Replacement (180 lux to 350 lux)

T5/CFL (Before) replaced with LED Lighting (After)

The Business Case

Payback Calculations of building with 24 Hour Occupancy like BPO, Hospital etc. makes an important opportunity to realize the money spent within 2 years.

Earlier lighting details with operating load costs around Rs. 4.2 Lakh only but further with LED and occupancy sensor replacement, annual savings of about Rs. 1.95 lakh is achieved.

Here, Cost of LED product & occupancy sensor was Rs. 3.65 lakh only. So, Based on the electricity bill savings alone, the upgrade costs is expected to be paid back in 1.9 years. This intervention was done in September 2012.

For more information please contact:

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Summary

Worldwide, 1.3 billion people which are almost a quarter of the world's population live without access to electricity. Currently, off-grid households largely depend on conventional fuel burning for lighting and cooking (mainly kerosene) that are inefficient and are polluting and damaging both health and the environment. Replacing the millions of kerosene lamps, candles and flashlights used globally with renewable means of energy and provide an increasingly low-cost solution to reduce carbon emissions, indoor air pollution and health risks is the need of the hour.

With increase of building footprint and electricity transmission, improvement of energy efficiency offers many cost-effective opportunities to achieve energy security, to improve business productivity and to mitigate greenhouse gas emissions.

Going through this compendium, many organizations have developed Energy Efficiency frameworks covering policies and strategies to help address these barriers and have some interventions which are tabulated in the below table highlighting that the sustainability drive has already started but still with initiatives in solar passive architecture and renewable energy, a lot more can be achieved.

So, looking at the industries energy conservation measures makes business sense because in almost all the cases, the pay back period is less than 5 years. Also to be factored I are the rising fuel prices which augment savings in the long run.

Basically, some Energy Efficiency Measures such as Replacement of single glazing with double glazing, Provision of insulation in roof or utilization of high reflective paints on roof exposed surface, Replacement of existing lighting system with LED lighting and Replacement of constant speed (CSD) chiller with variable speed (VSD) chiller along with installation of plant optimizer were organized.

Hence, the following aspects of a green building design are looked to enhance energy efficiency in buildings and through an integrated way:

- Building envelope design
- Building system design (HVAC [heating ventilation and air conditioning], lighting, electrical, and water heating)
- Integration of renewable energy sources to generate energy on-site
- Water and waste management
- Selection of ecologically sustainable materials (with high recycled content, rapidly renewable resources with low emission potential, and so on)
- Indoor environmental quality (maintain indoor thermal and visual comfort and air quality)

There are many ways for industrial companies to improve their energy performance. These include:

- Identification of saving opportunities through energy surveys or audits, involving the physical inspection of plant facilities and process equipment

- Employee-focused activities, such as campaigns to increase awareness, motivation and involvement in energy management activities throughout the company
- Organizational practices, such as the formulation of policy, the assignment of energy responsibilities, the provision of training, etc.
- Facility and process retrofits, incorporating more efficient technology
- Implementation of operational and maintenance practices that take into account the Energy efficiency impact.

Thus Energy efficiency is widely recognized as the “low-hanging fruit” in a country’s pursuit of energy security, inclusive development, and transition to a low-carbon economy. Investment in energy efficiency could be very attractive as the incremental capital investment is recovered in a reasonable time period, energy cost is lowered, and energy productivity is enhanced.

Source: Centre of Research and Sustainable Building Science, TERI

Table 1 : Interventions of all organization (Green marked- Taken and Yellow marked –Not Taken)

S.No.	Organization (Dwelling)	Building Envelope (Passive features like high performance glass, shading, daylight etc.)	Energy Efficient equipment (Pumps, fans, computers etc.)	Efficient HVAC (Chillers, motors etc.)	Efficient Lighting System (luminaries, presence detector	Renewable energy (PV, Solar street light etc.)	Efficient Water technologies (Faucets, Rain water harvesting etc.	Remarks
1	Godrej & Boyce - Godrej Bhavan, Mumbai							Energy efficient in equipment with EEF1 pumps, BEE star rated fans and energy saver computers can be installed. Also through renewable slight load reduction can be achieved
2	HUL- Spectra,HUL-2P, Vijaywada							Solar passive architecture, efficient water ,HVAC and renewable can be intervene
3	Jain Irrigation- Jalgaon							Energy efficient equipment, water, renewable and lighting system interventions need to take
4	KPIT-Pune							Can take Water initiatives with better faucets, ground water recharging & solar passive architecture through shading, daylight etc.
5	Mahindra & Mahindra-Kandivili							Can take Building envelope, HVAC, Equipment's, water and renewable initiatives
6	Reliance Infrastructure-Mumbai							Can take Building envelope, HVAC, Equipment's, water and renewable initiatives
7	SAP-Bengaluru							Interventions in day lighting, shading i.e. solar passive design, equipment efficiency and renewable measures can be adopted.
8	TATA Motors- Lucknow							All major strategies are followed while still water conservation and renewable measures can be check.
9	TCS-Across all offices globally							Water, solar, renewable and HVAC energy efficiency measures can be check.
10	TERI-IHC,6C,Delhi							Renewable measures can be identified to offset some electrical load

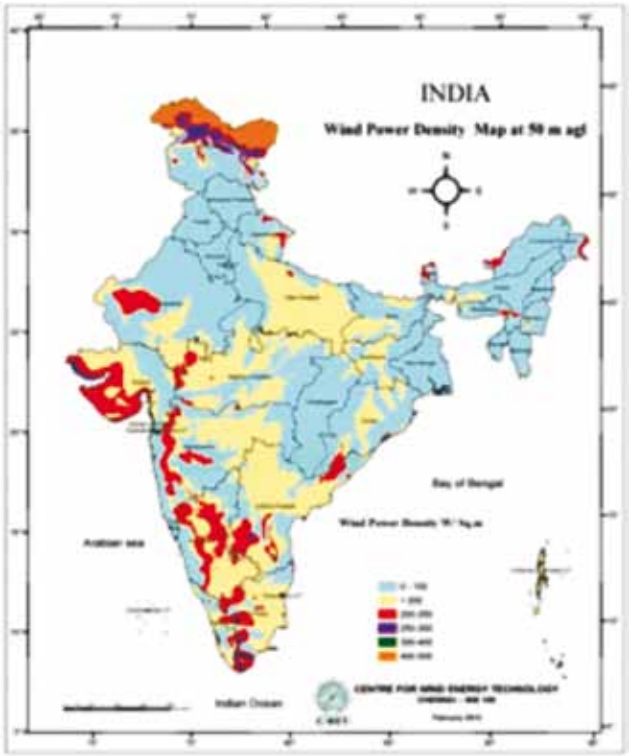
Section III

Renewable Energy

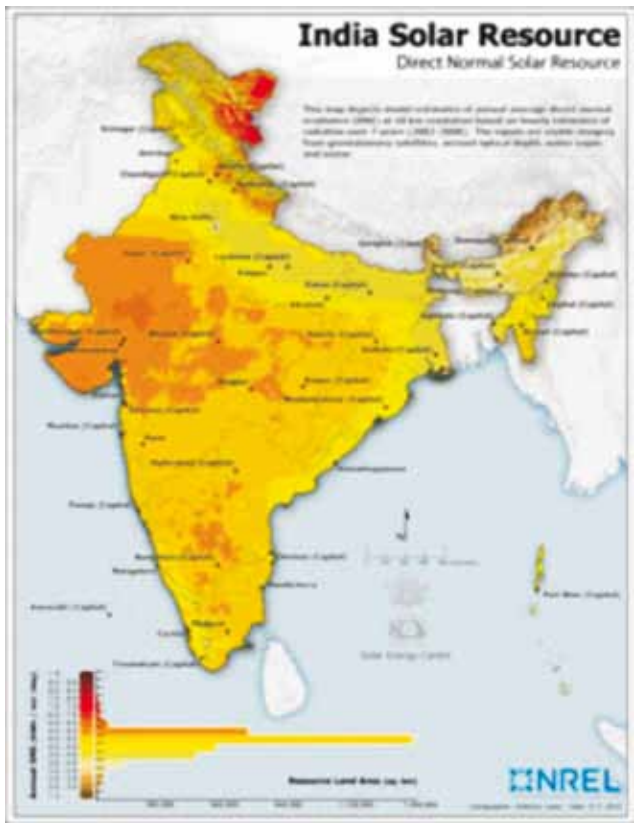
Introduction – Renewable Energy

India is the 4th largest country with regard to installed power generation capacity in the field of renewable energy. The country has realized the importance and relevance of renewable energy as a plausible option for catering the rising demand of energy. According to the official government estimates the renewable energy potential available in the country stands at 2,45,880 MW. However with the current level of development only 29,000 MW has been realized.

The drivers identified for the development of renewable energy in India are mainly energy security concerns, the high available potential of renewable energy resources, the pressure on the country to reduce its emission of greenhouse gasses, and interest towards developing and increasing share of clean energy technologies. India at the international level has committed a target of achieving 15% of renewables in the overall energy mix by 2020 under "National Action Plan on Climate Change (NAPCC)". Renewable energy from a larger point of view is basically seen as a method for solving India's Energy problem which is associated with non-renewable energy sources currently having majority share in the energy mix.



Wind power density map of India (at 50 m height) showing potential areas



Solar radiation map of India showing energy density

The government has established institutions for renewable energy which are aiding in technology development and bringing symmetry in information for the stakeholders. The institutions such as Alternate Hydro Energy Centre (AHEC), Centre for Wind Energy Technology (CWET) and Solar Energy Centre (SEC) have played a very crucial role in standardization and towards helping the sector to step-up.

Out of different renewable technologies – grid connected & off-grid, wind power has been in the forefront with around 20 GW of installed capacity and around 68% share; followed by small hydro power (<25 MW) having 3.7 GW of capacity addition. Solar power development which has government's greater emphasis has reached 2 GW of installed capacity, which included solar photovoltaic as well as solar thermal technology. In fact the government has dedicated mission towards development of solar energy in the country in the name of Jawaharlal National Solar Mission (JNNSM) according to which the country will add 20 GW of solar power by the year 2022. In the off-grid space the total installed capacity through different renewable energy technologies as of now is around 907 MW and growing.

Different states in the country stood differently with respect to the development and available resource of renewable energy. The states which are in forefront for wind power development in descending order are Tamil Nadu, Gujarat, Maharashtra, Rajasthan and Karnataka. The solar power development is majorly distributed in states like Rajasthan, Gujarat, Maharashtra, Tamil Nadu; whereas other states are following the trail.

The reason for the rapid development of renewable energy in the country is also because of constant support from the government. This has led the renewable energy businesses to grow at an average annual rate of 15 % in last few years. Besides, various policy and fiscal tools introduced by the government such as Accelerated Depreciation, Generation Based Incentives, Capital Subsidy, Feed-in-Tariff (FiT) etc. have given sufficient boost and confidence for investment in this sector. The newly introduced Renewable Purchase Obligation (RPO) and with the advent of renewable power exchanges like IEX and PXIL are expected to help in further capacity addition for renewable energy.

The government in its 12th year plan have further set aspiring target for developing 30 GW of renewable energy comprising 15 GW from wind, 10 GW from solar and 2.1 GW from small hydro and balance from biomass energy. The areas which government intend to focus on include renewable energy development for rural applications, research and development for finding new and efficient ways to generate renewable power and strengthening institutional mechanism for enhancing deployment of renewable energy and creation of public awareness.

The private sector has also shown positive attitude and has extended involvement in developing renewable energy sector throughout its value chain starting from in-house capacity addition, generation, manufacturing, transmission and research and development (R&D).

With years the overall development that took place for renewable energy has been phenomenal and according to various projections and forecasts the anticipated capacity addition and the influx of capital investment expected will follow a steep positive trend.

The Renewable Energy Section of this compendium will highlight the various organizations that have displayed their work in the renewable energy space and championed the cause of sustainable development. We have segregated the various case studies on the basis of the input sources or institutional arrangement or technological innovation under the following heads – Solar, Biomass, Natural gas, Wind, Waste-to-Wealth and Green Power Purchase.

Biomass

Need for cleaner, greener and cost efficient fuel led development of 'Gasification Technology' for baking application by ITC

Location of intervention
Vellakovil, Tamil Nadu

Type of intervention
Power generation

ITC Limited

Introduction

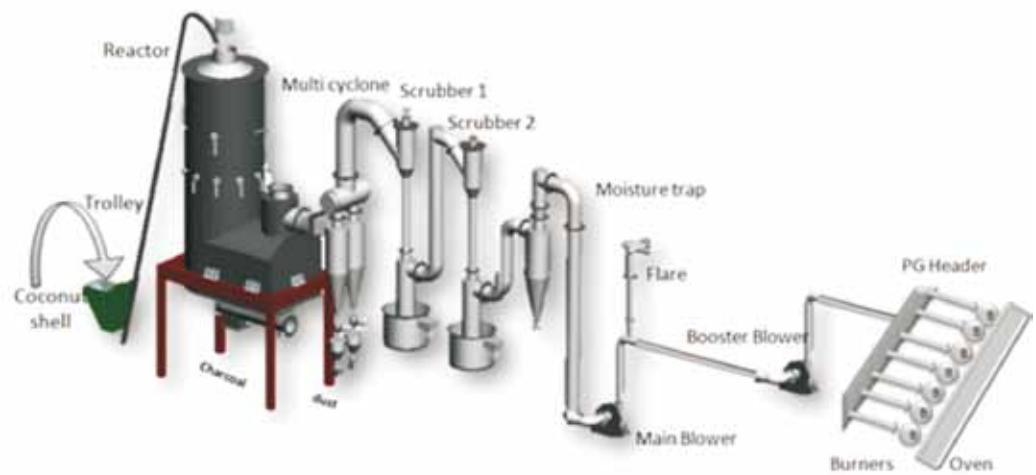
ITC is a business conglomerate having presence in FMCG, Hotels, Paper and Agri-business. This company which is rated among the World's Best Big Companies as per Forbes magazine and India's Most Valuable Companies by Business Today has been Carbon positive, along with Water positive and Solid Waste Recycling Positive since many years.

The FMCG division of ITC is a Rs. 7,000 crore business spread across foods, personal care, education and stationary. Out of these the packaged food business is one of the fastest growing food businesses in India and its manufacturing facilities are spread across different places. One of the facility manufacturing baked products for ITC is Rangaa Foods sited at Vellakovil, Tamil Nadu which has installed gasifier to serve their energy demand.

The Business Challenge as an Opportunity

With increasing industry demand, there has been an upward movement in carbon fuel prices posing challenges in achieve economies of scale in manufacturing. The key thrust for the business is to therefore continually strive for energy costs reduction initiatives in line with ITC's triple bottom line philosophy of building economic, social and environmental capital.

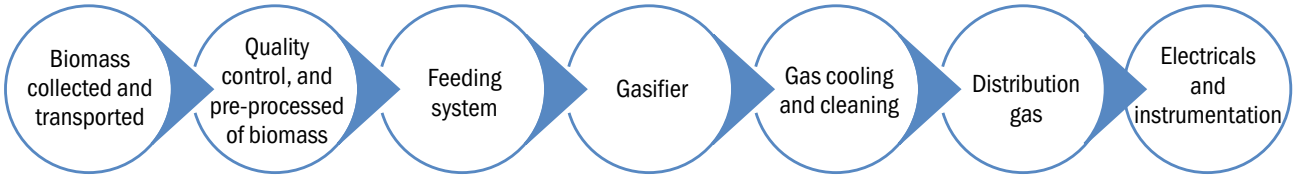
The need for cleaner, greener and cost efficient fuel therefore drove the need to invent 'Gasification Technology' for baking application. Successful adoption of this technology would pave path for replication across all manufacturing locations where biomass is available in abundance resulting in substantial reduction in energy costs while significantly reducing the carbon foot print of the business.



Devising the Intervention

Gasification is a process which makes use of renewable biomass to generate energy. The challenge was to customize the gasification system to generate producer gas, which will fire in different zones of the baking oven to bring about a set temperature profile. Such a type of temperature modulation using completely automated logic control was used for the first time for such a composite application.

The Process



The Business Case

Coconut shells in the region around Vellakovil were obtainable in plenty as compared to wood which is a generic raw material used in gasifier. For that reason gasifier design from Indian Institute of Science (IISC) was chosen to produces gas efficiently out of coconut shell. In the due course, pricing mechanism for coconut shell was devised to stay immune, from rate fluctuation; hence to maintain the integrity of intervention besides keeping the generation cost at par with the conventional methods.

The principal benefits were: reduction in 2000 tons of Carbon Dioxide per year and cost saving of INR 0.5 per kg of finished good. The total investment was INR 1.6 Crore with pay back in approximately two years.

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First of its kind biomethanation project capable of delivering biogas for generation of electricity and refrigeration by Jain Irrigation

Location of intervention
Jain Valley, Shirsoli Road, Jalgaon.

Type of intervention
Biogas based power generation

Jain Irrigation Systems Ltd.

Introduction

Jain Irrigation Systems is a multinational organization based in Jalgaon, India. The corporation has multi product industrial profile and in manufacturing such as drip and sprinkler irrigation systems and components; PVC, Polyethylene (HDPE, MDPE) & Polypropylene piping systems; plastic sheets (PVC & PC sheets); agro processed products includes dehydrated onions and vegetables; processed fruits etc.

Jain Irrigation's mission statement is to "leave this world better than you found it". Thus, they are meaningfully oriented towards sustainability and allied activities.

The Business Challenge as an Opportunity

In waste to wealth program of Jain Irrigation a Biomethanation project was established which is capable of producing power up to a capacity of 1.68MW, 24 MT of manure per day and 400 tons of Refrigeration. It's one of its kind project which support reduction of in-situ methane emission while capturing it and using it for various application.

Devising the intervention

In the present venture commissioned on June, 2009, biomethanation took place in two stages. In Stage I, complex proteins, carbohydrates, lipids are converted to amino acids, sugars, fatty acids and acetate, whereas in Stage II the products of stage I are broken down aerobically to form biogas. These two stages are carried out in separate digesters so as to allow for maximum utilization of the provided feed material.

Other significant aspects of the project are:

- The temperature is controlled in the entire system
- Multiple substrate can be digested in the same cycle through Pulsating feed system
- The complete system is automated
- No scum formation takes place
- Innovate material application such as use of HDPE pipe for scrubber
- No use of chemicals to adjust pH
- Use of waste heat in Vapor Absorption Machine (VAM) to produce 400 tone refrigeration
- Digested slurry is used for making organic soil conditioners
- Hydrolyzed gas is collected and biologically treated to reduce odor.

The Business Case

The total project outlay was INR 34.90 crores. The estimated electricity saving potential from biogas generation as well as from VAM was around 10,000 MWh, which in monetary terms translates into INR 6 crores per

annum. Further, the saleable digested slurry has a market of around INR 2 crore per annum. Factoring various expenditures including O&M, the saving per annum is approximately at INR 3.5 crores.

Biogas based energy generation

Vapor Absorption Machine (VAM)

For more information please contact:
Dr. Santosh K Deshmukh; Email: deshmukh.santosh@jains.com

Replacing furnace oil based boiler with biomass boiler by Sanofi India Limited

Location of intervention
Goa

Type of intervention
Bio Mass Boiler

Introduction

Sanofi, a global and diversified healthcare leader, discovers, develops and distributes therapeutic solutions focused on patients' needs; offering a wide range of essential healthcare assets, including a broad-based product portfolio and a presence worldwide.

Since 1956, Sanofi has aligned itself with India's healthcare needs by building expertise, capability and capacity, through continued investments, strategic partnerships, and a shared commitment towards patients.

As a large global business, Sanofi is focused on reducing carbon footprint, using energy responsibly and preserving important natural resources. In addition, Sanofi seek to analyze the environmental fate of pharmaceuticals.

The Business Challenge as an Opportunity

Manufacturing sites of Sanofi require steam for heating applications and for humidity control in air conditioning. The steam is generated from boilers using Furnace oil as a primary source of fuel due to its high calorific value and lower cost as compared to other fossil fuels like Diesel, Kerosene, Naphtha and LPG.

Biomass was available from nearby places. Hence it was planned to use this biomass to generate heat while replacing furnace oil.

Devising the intervention

The Goa plant took the initiative of reducing its dependence on fossil fuels by installing biomass boiler driven on agricultural waste for steam generation.

Agro waste is a combination of various agricultural residues viz. coconut husks, husks of cashew nut, groundnuts. These wastes are compacted from loose raw material into high density fuel briquettes through

a compaction/extrusion process. This results in higher specific density of the material which increases its calorific value. The states around Goa viz. Maharashtra & Karnataka have agriculture wastes available which can be sources and can be used to making briquettes.

The advantages of Agro waste briquettes are:

a. Easy of availability
b. Environment friendly
c. Provide employment opportunities to rural communities.

The Business Case

At only 25% of the cost of furnace oil i.e. INR 4.90 per Mega calorie against biomass's cost of INR 1.20 INR per Mega calorie, this intervention provided a cheaper means of steam generation using renewable energy at much lower costs.

The total investment outlay for the installation in the year November, 2011 was INR 75 Lakh. The estimated payback was in 22 months, which originally was realized in only 12 months. The total savings accrued so far is INR 1.9 crores.

Other benefits accrued to the organization

Subsequent to the intervention the manufacturing plant became the proud recipient of the 'Sanofi CSR Award - Planet'. The recognition was given for the outstanding contribution towards protecting the environment and creating employment for the rural population. It created employment to 4000 man-days/year. The award money was given to a NGO (Matruchayya) which shelters orphaned and abandoned children.

For more information please contact:
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Natural Gas

The world's first Bio-Natural Gas plant to power telecom towers by RBS

Location of intervention
Mahbubnagar, Andhra Pradesh

RBS
The Royal Bank of Scotland

Introduction

RBS Group is a large international banking and financial services company. From its headquarters in Edinburgh, the Group serves over 30 million customers in the United Kingdom, Europe, the Middle East, the Americas and Asia.

As a Strategy, RBS Foundation India works to create sustainable income generating models for communities that are dependent on critical eco systems. Since inception in 2007, it has supported around 76,000 Households in 16 states across the country.

The Business Challenge as an Opportunity

For creating economically sustainable enterprise with a positive impact on the environment, RBS initiated a pilot with the help of CONARE, an NGO.

The fundamental idea behind was to replace diesel with Bio-Natural Gas for powering telecom towers. The technology used in this intervention was developed by NextGen.

Devising the intervention

RBS Foundation India supports Conservation of Nature through Rural Awakening

(CONARE), a local NGO to create sustainable and alternate livelihood options for communities residing in 16 villages on the periphery of the Nagaarjuna Sagar Tiger Reserve.

NextGen has incubated first of its kind Bio-CNG plants to deliver clean energy at a costs substantially lower than conventional energy sources.

CONARE was engaged with NextGen to set up the plant that would be owned and managed by the community, which will run the system while earning livelihood leading to a sustainable model encapsulating economic viability of the intervention.

The plant consists of a proprietary plug flow bio-reactor that converts a host of locally generated agro waste to high grade natural gas through anaerobic digestion process. The high grade natural gas which contained nearly 95% methane is bottled under high pressure (~ 200 bars) in standard CNG cylinders which can be transported to telecom towers in the vicinity. At the telecom tower, the gas is converted to electricity by standard gas generators.

To ensure better operational efficiency, partnerships with industry leaders developed across the supply chain. For conversion of gas to power, partnership was developed with Mahindra Powerol, one of India's largest suppliers of gensets to telecom towers. Similarly for utilizing manure partnership was developed with Coromandel, one of India's largest fertilizer companies to produce bio fertilizer. For business plan advisory,

partnership was developed with IFC and GSMA (GSM Association). These partnerships helped to solve teething problems while evolution.

The Business Case

The installation which took an investment of INR 30 lakh in August, 2012 would yield around INR 4 to 6 lakh per annum for community and a diesel savings costing up to INR 50 Lakh for 10 years for a telecom tower within its life time of 15 years.

Picture courtesy NextGen (source: http://nextgenpms.com/)

Besides, the intervention would lead to (a) emission reduction of around 800 tons of CO2e every year, and (b) generation of around 200 tons per year of high quality organic fertilizer.

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Solar

Solar solution for oil pipeline application by BPCL

Location of intervention
Madhya Pradesh & Rajasthan

Type of intervention
Solar PV plant

Introduction

Bharat Petroleum Corporation Limited (BPCL) is integrated oil and Gas Company engaged in refining crude oil and marketing of petroleum products. BPCL owns refinery units in Mumbai and Kochi. It has been ranked 225th in the Fortune Global 500 rankings of the world's biggest corporations for the year 2012.

The Business Challenge as an Opportunity

Bina Kota Pipeline (BKPL) is a 259 KM long multi-product cross country pipeline from Bina Refinery to Kota Terminal. This pipeline is used for evacuation of MS/SKO/HSD production at the Bina Refinery. Reliable continuous power supply to all 7 SV stations is essential for smooth and safe operation of the pipeline. However, power failure occur for 12 to 18 hours on a daily basis in the Madhya Pradesh and Rajasthan SV sites. DG sets were installed at the SV stations as emergency power backup which were consuming large quantity of diesel and polluting the environment.

Hence, in order to follow BPCL's objective to stay environmentally benign solar power was installed.

Devising the intervention

The consequence of power failure which used to occur on a daily basis for an average 17.7 hours/day might lead to:

- Non-functioning of telecom panel resulting in communication cut-off to respective control rooms,
- Non-functioning of SCADA panels resulting in failure of data transfer to the control rooms,
- Non-functioning of Cathodic protection system, affecting health of the pipelines,
- During exigency MOVs at SV & I/P, stations could not be closed which seriously defeat the purpose of the SV station, and
- Erratic performance of electronic cards resulting in its replacement, thus extra investment.

The immediate alternative realized was emergency diesel generators. However, it was consuming a large quantity of diesel.Large amount of environmentally hazardous chemicals were also being emitted. The installation of SPV plant was began in January, 2013.

48 volts DC , 6.4 KWp capacity Solar systems of 48 volts DC and 6.4 KWp capacity were installed, which approximately met the individual power requirements of seven SV stations The DGs were kept as emergency backup source (as per the design standard).

The Business Case

The investment incurred was INR 92.32 lakhs. The savings accrued were Rs.18 Lakh on an annual basis. Emmission of harmful gases was avoided thereby keeping intact the integrity of BPCL towards their mission of environmental sustainability.

For more information please contact:
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Alternate powering solution based on Solar Photovoltaic (SPV) system for remote fuel dispensing stations by Indian Oil Corporation Limited (IOCL)

Location of intervention
Retail Outlets / Kisan Sewa Kendra across the country

Type of intervention
Solar Photovoltaic (SPV) system with battery back-up

Introduction

Indian Oil Corporation Limited (IOCL), or IndianOil, is world's 88th largest corporations, according to the Fortune Global 500 list, and the largest public corporation in India when ranked by revenue. IOCL operates the largest and the widest network of fuel stations in India, numbering about 20,575.

IOCL obligates itself to develop techno-economically viable and environment-friendly products to maintain the highest standards with respect of safety, environment protection and occupational health at their production units.

The Business Challenge as an Opportunity

The IOCL's retail outlets (RO)/Kisan Sewa Kendra (KSK) were facing a problem with the erratic power supply. The problem was primarily because of the location of the plants in remote & rural areas.. Erratic power supply and caused severe damage to dispensing units resulting in downtime escalation.

As a long term strategy to provide power to these remote & rural fuel dispensing stations Solar Photovoltaic systems with battery back-up were installed.

Devising the intervention

The inception of this intervention took place during dealer-IOCL general meetings. In these meetings, the dealers were enlightened about benefits of SPV system. The dealers were encouraged to procure these solar systems from MNRE certified system integrators. The system integrators take up the entire process from installation to commissioning till availing subsidy. Further, IOCL's nodal senior level officer in Marketing Division and nodal division at head office kept a check on the progress at every state office. It made a complete business sense, as the initiative led to increase in sales; it reduced the overall operational expenditure for dealers, eventually escalating the profitability. It also helped in lessening usage of the subsidized diesel.

The systems were sized to cater lighting and dispenser unit load. At select locations, the dealers were impressed and were ready to install larger systems to energize extra load.

The Business Case

The systems were installed by individual dealers at their own capacity, whereas IOCL only provided the knowledge and sensitized them. The cost of installation was approximately INR 7 lakh per kWp, and the estimated savings were around INR 12 lakh per kWp of diesel for 20 years.

For more information please contact:
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The use of solar energy offered a convenient replacement of Waste Heat Recovery system by ITC

Location of intervention
ITC Limited, Bangalore

Type of intervention
Thermal energy generation

ITC Limited

Introduction

ITC's state-of-the-art manufacturing facilities are located in Bangalore, Munger, Saharanpur, Kolkata and Pune. This particular intervention was carried out in their cigarette manufacturing facility established in year 1912 in Bangalore. The factory has earned various accolades, including "National Award for Excellence in Energy Management" in 2010.

The Business Challenge as an Opportunity

In ITC's Bangalore factory power was generated using Base-load engines till it was replaced by 66 kV dedicated power supply from the Grid. The base-load generator exhaust was used to generate steam through Waste Heat Recovery Boiler (WHRB), which was eventually used to heat boiler feed water.

The generators were shut down once the factory was energized by Grid power, which led to the cut off of the waste heat recovery loop. In order to provide heated boiler feed water, solar technology was used which provided convenient replacement to the WHRB.

Devising the intervention

The requirement was to pre-heat the ambient water temperature from 25 °C to 80 °C in order to reduce the fossil fuel consumption for steam generation. For that solar water heating method was used.

Bangalore is a cloudy place, with lesser sun shine hours. Hence prior technology assessment of different solar options was essential and it was carried out diligently. The options considered were: Parabolic Trough/Solar Dish, Flat Plate Collectors (FPC) and Compound Parabolic Collector (CPC).

Parabolic Trough Collector (PTC)

Solar Dish

Compound Parabolic Collector (CPC)

Comparison between CPC and FPC was carried out as per following		
Parameters	Compound Parabolic Collector (CPC)	Flat Plate Collector (FPC)
Temp range	60-120	30-60
Max efficiency (per gross area)	59.2	45
Efficiency (at ΔT=100 °C)	43	30
Lifetime	> 20 yrs	< 10 yrs
Secondary energy	<0.5% of heat gain	>5% of heat gain
Time Required (Tube change)	15 mints	2 Hours

The final selected technology was CPC due to following reasons: (a) CPC is proven technology and widely used, (b) CPC offer higher efficiency as compared to FPC, and (c) High cost of Solar Through/Solar Dish technology.

The Business Case

A CPC system of 21 kiloliters per day (KLD) was installed with an expenditure of 1.24 Crore in May, 2012. The saving accrued so far is around 26.25 Lakh. The IRR calculated based on estimated annual savings of 22 Lakh per annum was around 18.23%.

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Rooftop Solar Photovoltaic (SPV) system by Mahindra Lifespaces

Location of intervention
Chennai, Tamil Nadu

Type of intervention
Solar Photovoltaic (SPV) based power generation

Introduction

Mahindra Lifespaces is a real estate company and is an integral part of Mahindra Group. As the name suggests, Mahindra Lifespaces creates spaces for healthy living, focusing on quality and true value offerings to customers. Of the investments, Mahindra World City spread across 1861.554 hectares has two integrated business cities with futuristic amenities, facilities and numerous career opportunities that stem from the prestigious MNCs housed there.

From the sustainability point of view, Mahindra started implementing interventions in-house by building their factories and facilities as zero water discharge, by using green energy solutions etc. Besides, Mahindra in 2008 developed comprehensive sustainability roadmaps within each of the sectors they have standing-in, which they are currently implementing.

The Business Challenge as an Opportunity

Mahindra Lifespaces is synonymous with sustainable buildings. It strives to build green buildings that not only save energy, but also promote healthy living. In its quest for sustainability, Mahindra identified an opportunity to build a rooftop solar power plant at Mahindra World City, Chennai.

Devising the intervention

While realizing the uncertainty in electricity supply and to lessen dependency on power utilities, Mahindra Lifespaces installed a 75 kW Solar Photovoltaic (SPV) power generation plant at their site.

Power cuts and demand cuts imposed by the state electricity board due to power shortages had forced Mahindra World City to use Diesel generators so that they can provide uninterrupted supply to their customers. But due to frequent diesel price hikes the cost of energy generated is kept on increasing which is passed on to the customer. Besides, there was problem regarding air and noise pollution with the use of diesel generators. To address these concerns, a 75kW rooftop solar power plant was installed for supplying power to the customers.

The Business Case

The plant capacity of 75 kW was estimated to generate approximately 116,000 kWh of clean energy annually. In the establishment year 2012-13, 97,982 kWh of electricity was generated which amounted to 8% savings in electricity bills.

Besides, it helped in offsetting nearly 60 tonnes of CO which would otherwise be emitted by diesel generators.

Photo credit: The enviromental blog (ref.: http://remsol.me/2013/03/25/budget-backlash/)

For more information please contact:
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Solar PV system to substitute energy demand by Reliance Infrastructure Limited

Location of intervention
Andheri (East), Mumbai

Type of intervention
Solar PV Plant

Introduction

Reliance Infrastructure Limited is one of the largest private sector enterprises in power utility and infrastructure business. Enjoying a premier brand image, Reliance Infrastructure in partnership with the government has funded and launched a number of roads, metro, airports, ports and real estate projects. In power business the company is committed to provide an uninterrupted, affordable, quality, reliable and clean power to millions of its customers.

From sustainability point of view, Reliance Infrastructure believes in preservation and promotion of environment is of fundamental concern in all of their business activities. With sound environmental policy in place, the company continually strives towards safeguarding environment through Energy Efficiency, Conservation and Demand Side Management (EE/EC/DSM) while focusing on sustainable development.

The Business Challenge as an Opportunity

In order to reduce energy demand in the building solar PV system was used. This ultimately led to extensive cost saving for the organization.

Devising the intervention

A suitable roof top area for solar power generation was identified. Besides, load requirement and load profile of the same building was analyzed so that the power generated can be utilized fully without any storage requirement, discounting initial capital investment.

As a pilot project, SPV plant of 5 kWp was set up on the rooftop in March, 2012. 'Tandom' solar technology was used which is a mixture of thin film and polycrystalline. The panels were oriented in East-West direction instead of conventional south facing, to yield power for longer duration as well as from a wide spectrum of radiations.

The Business Case

The initial investment incurred was INR 6.8 lakh. The total expected generation over 20 years is 1,38,000 kWh, which in monetary terms give a savings up to INR 17.9 Lakh. The energy generation till date is more than 7000 kWh which means saving of INR 91, 000.

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Solar ATMs by State Bank of India (SBI)

Location of intervention
Across India

Type of intervention
Solar powered ATMs

Introduction

State Bank of India is India's largest lender with (the group's) asset base of INR Rs 21,33,158 crore (USD 392.92 Billion) as on March 31, 2013. State Bank Group with a network 20,325 branches including 5,509 branches of its five associate banks dominates the banking Industry in India. In addition to banking, the group, through its various subsidiaries provides a whole range of financial services including Life Insurance, Merchant Banking, Mutual Funds, Credit Cards, Factoring, Security Trading, Pension and Fund Management, Custodial Services etc.

SBI had initiated "Green Banking" activities in the year 2007 by way of putting in place a comprehensive board approved policy. This policy enunciates two pronged approaches viz. Internal Greening and External Greening. As part of internal greening, SBI had initiated several measures aimed at reducing its carbon foot print such as switching over to energy efficient lighting systems and gadgets across all the branches, paper less banking viz. ATMs and Green Channel Counters, usage of video conferencing and other electronic modes for conducting meeting and communications, water and waste management, tree plantation at all the premises of the Bank etc.

The Business Challenge as an Opportunity

In order to provide ATM services at rural places which faces actuate power shortages, the solution arrived was by the use of renewable energy technology and an innovative ATM machine. These ATMs are specially designed that consumes less power than conventional ATMs and does not need air-conditioning during operation.

Devising the intervention

A total of 232 solar ATMs were installed in pan India under SBI's Green Banking Initiatives. This was a very important initiative from SBI so as to penetrate into the rural markets and to bring swift banking which was prevalent in the urban areas. Some of the ATMs installed in urban centers were too powered by solar energy, though as a back-up to keep the machines functional at times of load shedding.

The Business Case

The total financial outlay for Solar ATMs till March, 2013 was around INR 10.44 crores. The total savings accrued is around INR 4.64 crores in installation cost as compared to conventional ATMs. The major benefit is towards its sustainability, relevance and savings in operating cost due to non-requirement of air-conditioning.

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Addition of solar power in existing street lights by Tata Motors

Location of intervention
Lucknow

Type of intervention
Solar PV street lights

Introduction

Tata Motors Limited is India's premium automobile company with its product portfolio spread across passenger cars, trucks, vans, coaches, buses and military vehicles. The company is world's fifth largest truck manufacturer and fourth largest bus manufacturer.

Tata Motors' energy policy mentions that the company is committed to maximizing the use of renewable energy and eco-friendly technologies. Moreover, Tata Motor believes that businesses should provide goods and services that are safe and contribute to sustainability throughout their life cycle.

The Business Challenge as an Opportunity

To fulfill their commitment towards sustainability, TATA Motors installed solar street lights in Tata Motors – Lucknow. This project helped them in meeting their sustainability goals, and also helped them save financially.

Devising the intervention

In its quest for implementing inclusive sustainability, Tata Motors have installed solar street lights in their Lukhnow facility. To enable further savings the cost of erecting additional poles which carries the bulk cost, 25 existing street lights were fabricated and solar panels were mounted, converting them into solar street lights.

The Business Case

The total investment gone into the intervention was INR 7.5 lakhs in April, 2012. The savings accrued as on August, 2013 was INR 2.6 Lakh, whereas the estimated savings throughout the life cycle of the product i.e. 25 years is INR 47.5 lakhs. Besides the emission reduction achieved so far is 2.33 tons of CO_2.

For more information please contact:
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Solar power plant without battery backup by Tata Motors

Location of intervention
Lucknow

Type of intervention
Solar PV power pack

Introduction

Tata Motors Limited is India's premium automobile company with its product portfolio spread across passenger cars, trucks, vans, coaches, buses and military vehicles. The company is world's fifth largest truck manufacturer and fourth largest bus manufacturer.

Tata Motors' renewable energy policy mentions that the company is committed to maximizing the use of renewable energy and eco-friendly technologies. Moreover, Tata Motor believes that businesses should provide goods and services that are safe and contribute to sustainability throughout their life cycle.

The Business Challenge as an Opportunity

In order to save electricity and keep up to its commitment towards Renewable Energy generation Tata Motors installed a 25 kW SPV power pack without any battery backup.

Devising the intervention

To counter the rising power demand and to find an alternate power generating option Tata Motors installed a 25 kW solar photovoltaic power generation system.

The solar plant is installed on the roof of main receiving substation building which has 12 module mounting structures, embracing 144 solar modules. The plant is designed to generate a peak power output of 25 kW without battery bank. In other words, the output is in 3 phase 415 V, synchronized with LT feeder such that during night time only grid electricity will flow without solar power. By eliminating battery bank from the system, the requirement of maintenance and hence additional spare cost is abridged.

The Business Case

In absence of the battery bank, the total system cost arrived is INR 45.46 lakhs. Government incentives amounting to 30% of the capital cost i.e. INR 13.63 lakhs were availed which reduced the outlay up to INR 31.86 lakhs. Since its installation in February, 2012 the savings accrued is INR 3.76 lakhs, which in energy terms accounting to 62,767 kWh. However, during its life time of 20 years, the estimated savings are INR 35.16 lakhs.

Besides, reduction in carbon footprint achieved till August, 2013 is 45 tCO_2.

For more information please contact:
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Alternative Sources

Recovering waste energy from kitchen exhaust fan by KPIT

Location of intervention
Hinjawadi, Pune

Type of intervention
Waste energy recovery

KPIT Cummins

Introduction

KPIT is a global IT consulting and product engineering firm providing technology solutions for corporations specializing in automotive & transportation, manufacturing, and energy & utilities. The company (joint venture KPIT Cummins) which has lifted several accolade including 'Best Performing in Service Delivery' ushered by SAP in 2013, is committed to giving future generations a sustainable world through efficiency and conservation of natural resources.

KPIT runs many Corporate Social Responsibility (CSR) programs in the field of environment, education, and energy.

The Business Challenge as an Opportunity

The air discharge from the kitchen exhaust system was harnessing by installing small wind turbine for generating electricity. In addition, solar photovoltaic system (SPV) was installed at unused roof space for electricity generation, and is integrated with the small wind turbine system.

Devising the intervention

In this particular intervention kinetic energy of the kitchen air exhaust was utilized and converted into electrical energy.

The kitchen on the top floor of the building had an exhaust which produced hot contaminated air keeping the area safe and comfortable for the staff. The exhaust system installed was designed to discharge the air at a rate of 5000 Cubic feet per min (83 cuf per sec) which was sufficient to drive a wind turbine to produce electricity.

In this case conventionally available horizontal or vertical axis wind turbine could not be deployed because of aerodynamic challenges and back pressure due to obstruction in air flow. Hence, certain modifications were carried-out in the vertical axis machine as well as in the kitchen exhaust system duct such that no back pressure was created and at the same time turbine gets the required momentum to generate electricity.

The power generated through turbine was put on use to light tube-lights in toilets and fire exit signage. Additionally, photovoltaic (PV) system was installed on the vacant roof area which was also integrated later.

The Business Case

At the end around 17% of energy was recovered from wind turbine. Along with solar photovoltaic system, the total savings were around 1500 units of electricity. In monetary terms the savings on annual bases was around INR 1.26 lakhs at an investment of INR 7.9 lakhs underwent in August, 2012.

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Waste to Wealth: Use of spent coffee waste as fuel in biomass based boiler by Hindustan Unilever Limited

Location of intervention
Hosur, Tamil Nadu

Type of intervention
Biomass based boiler

Hindustan Unilever Limited

Introduction

Hindustan Unilever Limited (HUL) is India's largest Fast Moving Consumer Good (FMCG) Company, with presence in over 20 consumer goods categories ranging from soaps, tea, detergents etc. Acknowledged as "one of the world's most innovative companies" by Forbes in 2012, HUL lays emphasis on sustainability alongside their core business. In an effort to decouple the growth from environmental impact, HUL has formulated "Unilever Sustainable Living Plan (USLP)" which tries to set goals spanning social, environmental and economic performance across their value chain.

HUL strongly believes that businesses that address both the direct concerns of citizens and the needs of the environment will prosper over the long term.

The Business Challenge as an Opportunity

In order to reduce the adverse environmental impact and cut high operational costs due to extensive use of High Speed Diesel (HSD) for steam generation, the biomass based boiler is used. It burns locally available low ash agriculture waste or other waste coming out as a byproduct of the manufacturing process.

Devising the intervention

HUL's facility located in Hosur is one of the two factories manufacturing Instant Coffee (IC). Steam is required extensively in the coffee manufacturing process. This steam is generated in the in HSD fired boiler. This oil fired steam generation was coming out to be very expensive. It was decided to replace the existing system with a biomass based boiler. This boiler ran on different type of biomasses. Some of them are listed below:

Fuel proposed: part or full	
Loose fuel	In-house 16 MT/day spend coffee-chicory at 75% moisture
	2 MT/day STP sludge at 75% moisture
	Groundnut shells
	Saw dust/wood chips
	Corn cobs
	Palm fronds
Briquettes	Corn cob & palm fronds
	Spent coffee, groundnut shells, saw dust & tamarind seeds
	Spend coffee & bagasse
Pellets	Corn cob & palm fronds
	Spent coffee & groundnut shells

The Business Case

The generation cost of steam using HSD fired boiler was coming at around INR 2.4 per kg, whereas the investment took place for installing biomass based boiler was INR 8.26 crore in September, 2013. Based on estimation, the annual HSD saving potential would be about INR 3.10 crore, which could bring the investment back in approximately 3 years. This was an acceptable strategy. It was chosen as the strategy to be implemented as it was competitive as compared to any other renewable energy intervention.

Additional benefits include:

- HSD saving of around 1580 KL on annual bases.
- Curtailment of carbon emissions in the order of 4100 tons per annum.
- Overall decrease in emission of SOx.

For more information please contact:
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Waste to Energy: Electricity generation using gas from digested ETP sludge by Hindustan Unilever Limited

Location of intervention
Nasik, Maharashtra

Type of intervention
Waste to energy from gas produced though ETP's sludge digestion

Hindustan Unilever Limited

Introduction

Hindustan Unilever Limited (HUL) is India's largest Fast Moving Consumer Good (FMCG) Company, with presence in over 20 consumer goods categories ranging from soaps, tea, detergents etc. Manufacturing facilities of HUL are spread across 40 locations in India. There are around 2000 suppliers & associates, along with 2900 stockists committed to HUL.

As a part of the "Project Neutral" HUL is working on ways & means to reduce environmental footprint while doubling business volume.

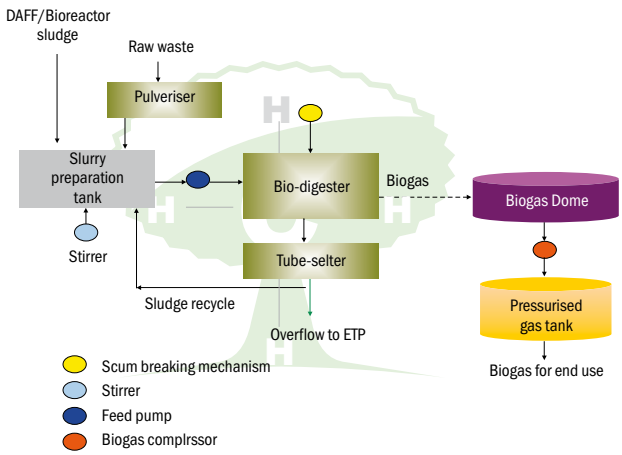
The Business Challenge as an Opportunity

HUL's Nasik factory manufactures frozen desserts & sweet spreads. The Effluent Treatment Plant (ETP) in the factory produces waste/sludge which if passed through anaerobic digestion process. Methane gas is produced which is then used to generate electricity. The process leads to substantial cost savings and lessens the stress on the environment.

Devising the intervention

Waste to energy using sludge digestion has many advantages. 100% recycling of ETP waste is possible and as a result there is no need for a landfill. Green energy is generated from the waste and the project has a modest payback period.

In this particular intervention a Sludge Digester was installed in the ETP. This could facilitate anaerobic digestion, thereby converting a part of the organic waste into Methane gas. The methane gas is then fed into the engine for generating electricity and used to power street lights.



The amount of waste processed on a daily basis is around 1000 kg, whereas the biogas plant capacity is around 2500 kg/day. The gas produced is approximately 175 m^3 per day which is equivalent to 78 kg of LPG or 315 kWh per day of electricity.

The Business Case

The installation of digester took an investment of INR 56 Lakh in March, 2013. The estimated annualized electricity generation potential was estimated to be 57600 kWh. Annually around 55 tons of CO was avoided with this intervention. The savings expected throughout the life time of the project is around INR 100 lakhs.

For more information please contact:
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Green Power Purchase

Green power purchase by SAP

Location of intervention
Bangalore

Type of intervention
RE Power Purchase Agreement (PPA)

Company Profile

SAP Labs India is SAP's second largest Research & Development (R&D) and Global Services & Support center in the world. Founded in November, 1998, SAP Labs India is one of the four global development hubs (Germany, US and Israel being others) These development centers contribute to all areas of the SAP product value chain – Research & Breakthrough Innovation, Product Development, Global Services & Support and Customer Solutions and Operations.

SAP's vision is to help the world run better and improve people's lives. They aim to help every customer become a best run business. They achieve this by delivering new technology innovations that they believe will address today's and tomorrow's challenges without disrupting the customers' business operations. Innovation and sustainability are the two pillars which are core to their business – from our solutions to operations to social investments.

The Business Challenge as an Opportunity

With the ever increasing carbon emission levels from the conventional methods of power generation, there been an urgent need for a shift to substituting them with Non-Conventional Energy projects like Small Hydro, wind, Biomass, Solar and Co-generation

In order to contribute for this cause, SAP has signed a power purchase agreement with a private hydro power developer to purchase green power.

Devising the intervention

SAP buys electricity from the electricity utilities for powering their Bangalore facility. In order to be become a green campus SAP signed a Power Purchase Agreement (PPA) with a small hydro power plant to wheel electricity through existing transmission and distribution network developed by utilities and the government. Since 2007, the share of electricity purchased through this mode has been in excess of 60%.

The Business Case

The commercial electricity bought from the utilities is charged more as compared to other users. The electricity charge agreed upon in the PPA singed with this Independent Power Producer (IPP) has been cheaper, which helped in shaving the electricity bill up to INR 12 lakh.

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Wind

Captive consumption of wind power by CLP India

Location of intervention
Samana, Gujarat

Type of intervention
Wind power for captive consumption

CLP INDIA
The power of new standards

Introduction

CLP India Pvt. Ltd is a wholly owned subsidiary of Asia-pacific utility CLP. CLP India power generation portfolio comprises of 655 MW gas based power plant in Bharuch, Gujarat, 1320 MW Supercritical coal power plant in Jhajjar district, Haryana. CLP India is also the largest Independent Power Producer (IPP) in wind sector with around 1000 MW capacity in various stages of implementation in states like Gujarat, Tamil Nadu, Karnataka, Rajasthan and Maharashtra.

CLP feels strongly for their social, economic and environmental responsibility. The concept of sustainability is firmly embedded in their corporate culture. They strongly believe in sustainable development – the kind of development which meets the requirements of today's generation without compromising on those of the future.

The Business Challenge as an Opportunity

The water requirement at CLP's Paguthan power plant is catered from river Narmada. The electricity consumed by Angareshwar pump house to deliver water was taken from the state utility. In order to use renewable energy CLP installed a committed wind power plant for substituting grid electricity.

Devising the intervention

The power plant operated at around 90% loading factor and required around 17000 cum/day of water to meet its process requirements for (Cooling water, DM water, Service water, potable water etc.). The power supply for operating the pumping station was taken from the state's distribution utility DGVCL.

CLP installed a 0.8 MW wind turbine at Samana, Gujarat which started transmitting electricity from April, 2008 for captive consumption in the pump house. Using open access, the electricity was wheeled (using state utility's transmission and distribution network) to fulfill the requirements of the internal pump house. The surplus generation of 121% over and above the captive consumption after factoring 4% wheeling losses was supplied and sold to the electricity grid.

The Business Case

The initial investment incurred for installing the wind power plant was INR 4 crores. The approximate savings accrued for the year 2012-13 was INR 22 Lakh, whereas for the year 2013, the savings till August is INR 5 Lakh. Besides, the reduction in CO achieved so far from this intervention is 2797 tones.

For more information please contact:
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Wind power for captive use by State Bank of India (SBI)

Location of intervention
Maharashtra, Tamil Nadu and Gujarat

Type of intervention
Wind energy

Introduction

State Bank of India is India's largest lender with (the group's) asset base of INR Rs 21,33,158 crore (USD 392.92 Billion) as on March 31, 2013. State Bank Group with a network 20,325 branches including 5,509 branches of its five associate banks dominates the banking Industry in India. In addition to banking, the group, through its various subsidiaries provides a whole range of financial services including Life Insurance, Merchant Banking, Mutual Funds, Credit Cards, Factoring, Security Trading, Pension and Fund Management, Custodial Services etc.

SBI had initiated "Green Banking" activities in the year 2007 by way of putting in place a comprehensive board approved policy. This policy enunciates two pronged approaches viz. Internal Greening and External Greening. As part of internal greening, SBI had initiated several measures aimed at reducing its carbon foot print such as switching over to energy efficient lighting systems and gadgets across all the branches, paper less banking viz. ATMs and Green Channel Counters, usage of video conferencing and other electronic modes for conducting meeting and communications, water and waste management, tree plantation at all the premises of the Bank etc.

The Business Challenge as an Opportunity

As a direct attempt to reduce dependence on polluting thermal power, SBI invested in windmills generating green power for own use.

Devising the intervention

The dual purpose of this intervention was (a) saving energy cost, and (b) contributing to renewable energy and reducing dependence on conventional power. The power generated was used as captive and wheeled to SBI's branch offices in Maharashtra, Gujarat and Tamil Nadu through existing transmission and distribution network.

Under this intervention 10 wind mills were commissioned in the states of Maharashtra (6), Tamil Nadu (3) and Gujarat (1) aggregating to a capacity of 15 MW.

The Business Case

The total investment incurred was INR 100 crores in March, 2010. As an output, the total generation from these machines during FY 2012-13 was around 51 million units (kWh), whereas the payback estimated as 10 years.

For more information please contact:
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Summary

India is well endowed with natural resources that have the potential to sufficiently meet the energy needs of the entire nation. For instance the electricity needs of the nation that can be met using renewable energy technologies. In India, the peak power deficit is nearly 10%, causing economic loss to the country. Renewable energy can aid to offer a realistic solution to reduce this shortfall of electric power.

Corporates and industrial houses should ideally play a pivotal role in the development of renewable energy technologies and their capacity in the nation. This compendium is a way to showcase some of the initiatives that were taken-up by various corporates to incorporate renewable energy technologies in their operations. These initiatives have made them frontrunners in adopting renewable energy technologies and inculcating them directly into their businesses. By serving as a way forward to all of those organizations which are in the process of adopting renewable energy technologies in their operations this compendium aims at encouraging and applauding them do be able to do the same.

The type and the scale of the interventions shown in this compendium in the form of case studies are highly laudable. The kind of initiatives that have been mentioned in this compendium makes it apparent that organizations view adoption of renewable energy technologies as not merely as an onus upon themselves but also as an incentive and profit driven exercise which can bring in additional revenues and have a positive impact on their balance sheets. The internalization of this philosophy is important as it can be instrumental for driving renewable technologies to the process of commercialization.