

Systemic Analysis Identifies Energy Opportunities

GlaxoSmithKline's Cidra, Puerto Rico, pharmaceutical plant used value stream mapping and interrelationship analysis to identify and prioritize 17 undesirable effects that affect energy consumption. From 2007 to 2008, energy consumption was cut 34% without capital investment, with a further 25% reduction coming for 2009.

In 2007, approximately \$5.8M was spent on electricity bills, consuming 36M kWh of energy. For 2008 and 2009, a target reduction of 25% in electrical consumption was established due to the increase in the price of electricity.

In January 2008, a value stream map was developed for all major utilities systems. From this assessment, 17 undesirable effects (UDE) that would affect the electrical consumption were identified.

Although several ideas were developed to optimize the systems, an interrelationship analysis exercise was used to prioritize the UDEs to be reduced or eliminated.

Whys method was used to prioritize the root causes to be eliminated. The following is a summary of the major root causes.

- 1.1. No challenge to actual temperature required on reheat coils.
- 1.2. No audit to the systems insulation. High Reheat Load.
- 1.3. No audits being done for steam leaks.
- 1.4. No challenge to actual temperature required on cooling coils.
- 1.5. No audits being done for compress air leaks.
- 1.6. No conscious use of end users.

To address the major root causes of wasted energy, a plan was developed to be completed by March of 2009. The plan can be divided in three major objectives:

- a. The incorporation of the current best engineering practices of the industry in the maintenance of utilities and facilities to establish a baseline of efficiency with the proper controls to sustain and even improve.
- b. The verification of all the utilities systems conditions and the challenge to all the operational control values to optimize the use of resources.
- c. The incorporation of the site population in the campaign to reduce energy consumption.

Being a regulated pharmaceutical industry, it was important to have the high management committed to the plan. After getting high management committed to the plan, the process of achieving the objectives was easy:

1. Maintenance Optimization

From the root-cause analysis, three major maintenance-related actions were required to reduce or eliminate the steam and compressed air leaks and heat loss through deteriorated insulation. The following is a summary of the actions completed.

- 1.1. An audit to all insulation of steam, reheat water, chilled water and HVAC ducts was executed and findings addressed. With this action the heat loss through deteriorated insulation in steam and reheat systems, in addition to the heat gained in the chilled water system, was minimized
- 1.2. An audit to detect steam leaks and defective steam traps using infrared tech was completed and the findings corrected. A maintenance plan was incorporated into the CMMS (SAP) to continue the audits on a monthly basis assuring the sustainability of the reduction of wasted energy due to this UDE. With this action the steam lost through leaks and failed steam traps is assured to be under control.
- 1.3. A compressed air leak detection utilizing ultrasound audits was completed and the findings corrected. A maintenance plan was incorporated into the CMMS (SAP) to continue the audits on a monthly basis assuring the sustainability of the reduction of wasted energy due to this UDE. Being the compressed air the utility of higher cost, it was a critical action to have under control the compressed air leaks. We were able to shut down a compressor of 2757 CFM. We are currently operating the smallest (1255 CFM) of the three compressors on site.

2. Operation Optimization

From the root-cause analysis, four major maintenance related actions were required to reduce the amount of diesel burned in the boilers to heat water for humidity control in addition to the emissions produced for the generation of the power required to operate the Air handling Units (AHU) and chillers in the HVAC system for temperature control. The following is a summary of the completed actions. Everything was performed in compliance with the established quality procedures.

- 2.1. Revise the room air temperature/humidity requirements and optimize cooling coil set points in the AHU resulting in the reduction of the energy required to cool down the fresh and recycled air. With the reduction in the refrigeration load, a hydraulic balance of the Chilled Water System was performed. Resulting in an additional benefit of shutting down a 150HP and two 60HP pumps.
- 2.2. Revise the room air temperature/humidity requirements and optimize reheat coil set points by minimizing the amount of heat from hot water required to heat up air for relative humidity (RH) control. With the reduction in the heat load, a hydraulic balance of the Re-Heat System was performed. Resulting in an additional benefit of shutting down a 60HP pump.
- 2.3. Revise the room's air changes requirements and optimize them by reducing the air changes. This way the amount of power used to cool down and steam to reheat is minimized.
- 2.4. Establish controls to shutdown AHU units when not required. This way the power to blow the air in the AHU, the refrigeration power to cool down the air and the steam to heat up the air for RH control is saved.

3. Site Population Consciousness

With the aggressive plan that was going to be implemented, it was important to incorporate the major number of ideas and the help of the people with the implementation of them. Three steps were established with the goal of achieving the consciousness of the population:

- 3.1. Obtain the sponsorship of the Site Leadership Team on the program
- 3.2. Establish an energy conservation awareness communication program through intranet and Plasma TVs across the site.
- 3.3. The encouragement of a just do it (JDI) program for the implementation of ideas to reduce the energy consumption.
- 3.4. The incorporation of KPI communication on monthly EHS meetings and close circuit communication loop of Plasma TVs across the site.

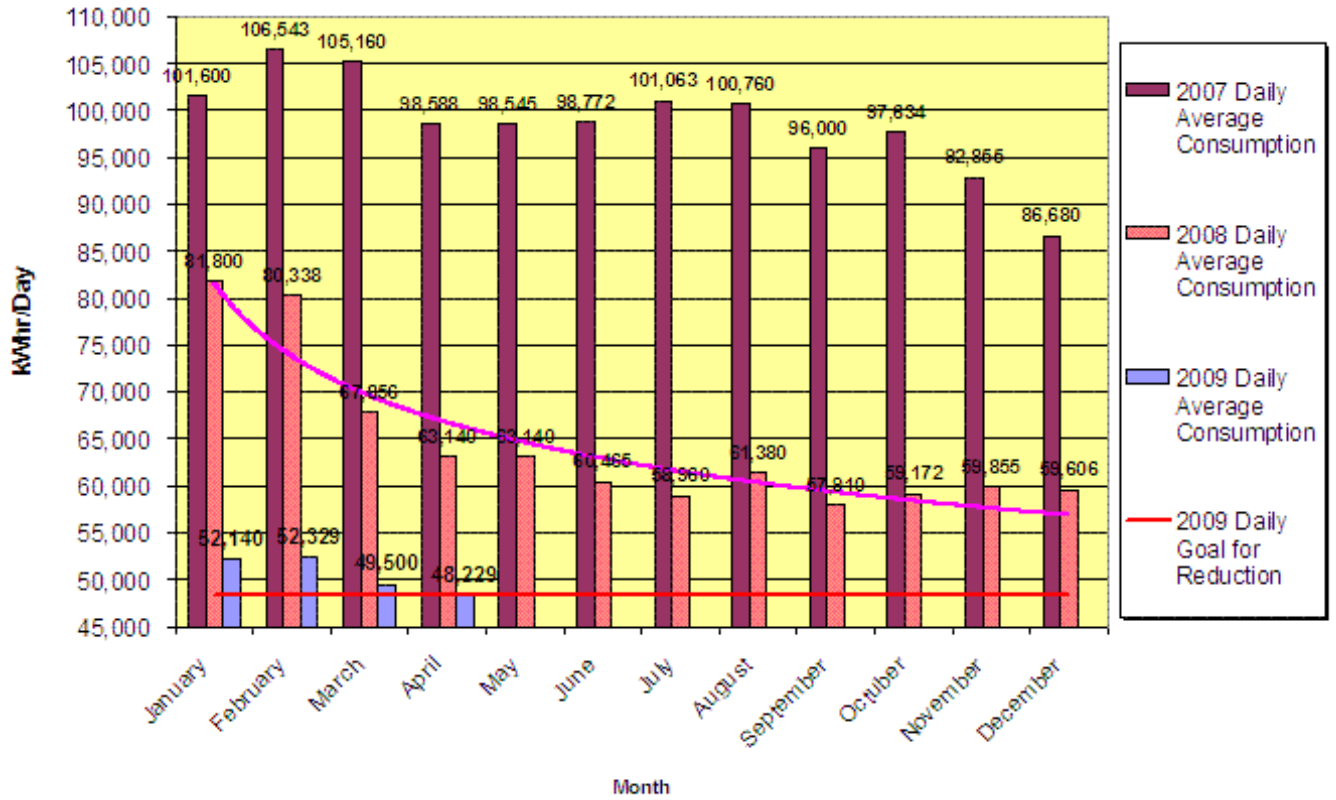
The year 2008 was a great year in terms of the reception of the people toward energy conservation ideas due to the high crude prices that were impacting each individual. Everyone was in search of opportunities to reduce energy in their homes and providing ideas to incorporate in our site. The IT department prepared e-mail trainings for end users to configure PC to go on sleep mode when not in use. The HR Department developed, in conjunction with the EHS team, the "THINK GREEN" campaign. Good environmental practices were embedded in the site culture.

The aggressive energy conservation plan without major capital investment was started during 2008. Best engineering practices were incorporated in the operations and maintenance of the steam, HVAC, compressed air and lightning systems achieved a 34% reduction in the kW-hr consumption and 39% reduction in the diesel burned on boilers in 2008. YTD a 25% reduction in the daily average of fuel consumption and the daily average of power consumption have been accomplished.

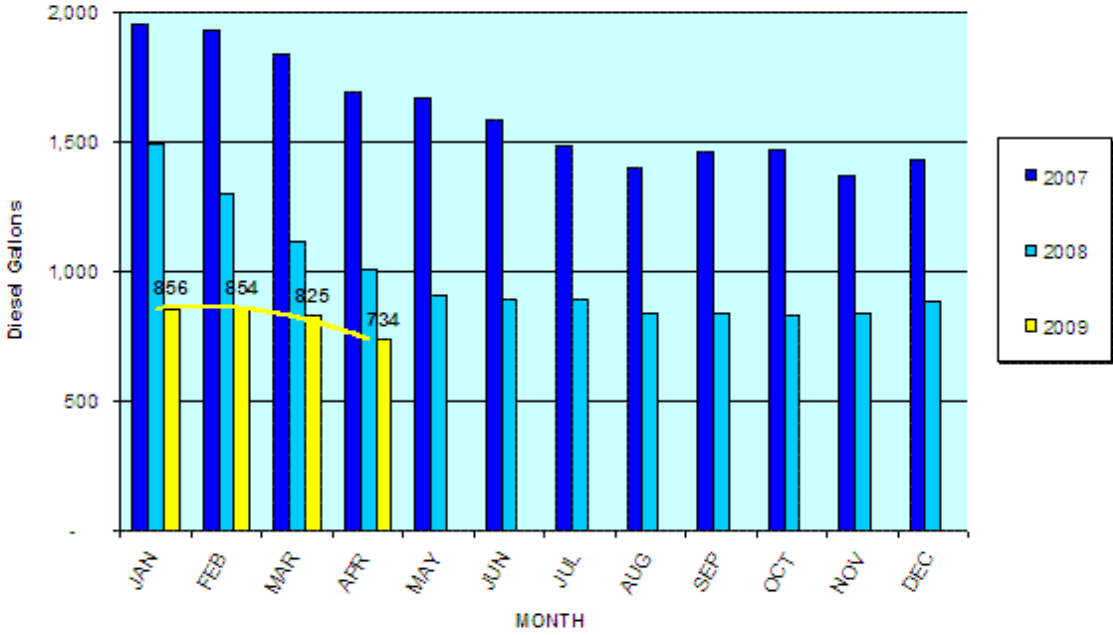
In 2007, a total of 35,917,200kW-hr was consumed, and a total of \$5.8M was paid at an average of \$0.16/kW-hr. In 2008, 23,547,664kW-hr were consumed, an amazing energy reduction of 34% without capital investment. An average power price increase of 29% was experienced throughout the year, ranging from \$0.16 to \$0.26/kW-hr. For this reason, even with the power consumption reduction we paid \$5.7M in power bills. If we had continue with a daily average of 98,674kW-hr as in 2007, with the monthly power prices of 2008 we would have paid \$2.5M more. This represents a cost avoidance of more than 56% of the site power budget. The daily average power consumption in April 2009 was of 48,229 kW-hr. It represents a 25% reduction compared to the daily average consumption of 64,514 kW-hr in 2008. With the current power prices it has represent a cost avoidance of \$254K YTD.

In 2007, a total of 582,303GAL of diesel were burned to produce steam. We paid \$1,505,981. In 2008, a total of 358,041GAL of diesel was consumed, a total reduction of 39% in diesel consumption. We paid \$1,258,318 in 2008 for the diesel consumed. If we had continued with a daily average consumption of 1,595GAL, we would have paid \$782,488 more. A total cost avoidance of 38% in 2008. By April 2009, the daily average consumption was of 734 GAL. Compared to the daily average consumption of 984GAL in 2008, it represents a 25% reduction in fuel consumption, and with the actual fuel prices, it represents a cost avoidance of \$21K YTD.

Monthly Average Power Consumption per Day



Monthly Average Diesel Consumption per Day



Monthly Average CO₂ Emissions per Day

