Energy Saving by Energy Management

Introduction

When speaking about energy saving and increasing energy efficiency the first thought goes to more efficient loads, such as LED lighting, variable speed drives or high efficiency motors. Some people may think about reducing the usage of existing loads or even renewable energy generation such as PV. However, the experience, as demonstrated in many publications, shows that in order to achieve sustainable energy reduction results, energy monitoring is a must.

The best way to understand the importance of continuous energy monitoring is to think about losing weight. A person that goes on diet can lose weight in the short term, but only by continuously monitoring his/her weight, the targets can be met. Moreover, in many cases without proper monitoring the final weight will be higher than the original one, due to the feeling that “we are doing ok”, letting ourselves eating more.

The analogy explains why in some cases without energy monitoring, energy saving projects led to higher energy consumption.

Achievable Saving Targets

Various publications evaluate the potential of energy saving from energy management, as well as other energy saving techniques. Two common figures among different articles are the potential of up to 30% saving and the average of 12% saving.

Energy Star organization, a U.S. Environmental Protection Agency that declares that it "helps businesses and individuals save money through superior energy efficiency", stated in their publication Assessing Plant Performance for Energy Savings that “Organizations achieving the greatest results have:

- A top-down commitment to energy management
- A commitment to continuous improvement
- Embraced an approach that integrates energy management across all aspects of the business
- Management systems in place
- A system to **regularly assess** and track energy performance
- Set measurable performance goals
- An effective reward system for energy performance
- An empowered energy staff”

While energy star elaborate about the process, IEC provides targets in their white paper "Coping with the Energy Challenge: The IEC's role from 2010 to 2030": "Proven technologies can today save up to 30%, so energy efficiency should be implemented immediately and massively".

ACEEE (American Council for an Energy-Efficient Economy) published a paper "Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities" that evaluates the average saving based on the thoroughness of the energy monitoring system in place (Figure 1). While household consumptions and savings are more predictable, industry saving can vary much more and can be from few percents only to 30%.

The conclusion is that continuous energy monitoring down to appliance level with online feedback will provide on average 12% energy saving, can be as high as 30% and is the baseline for any other energy saving projects.

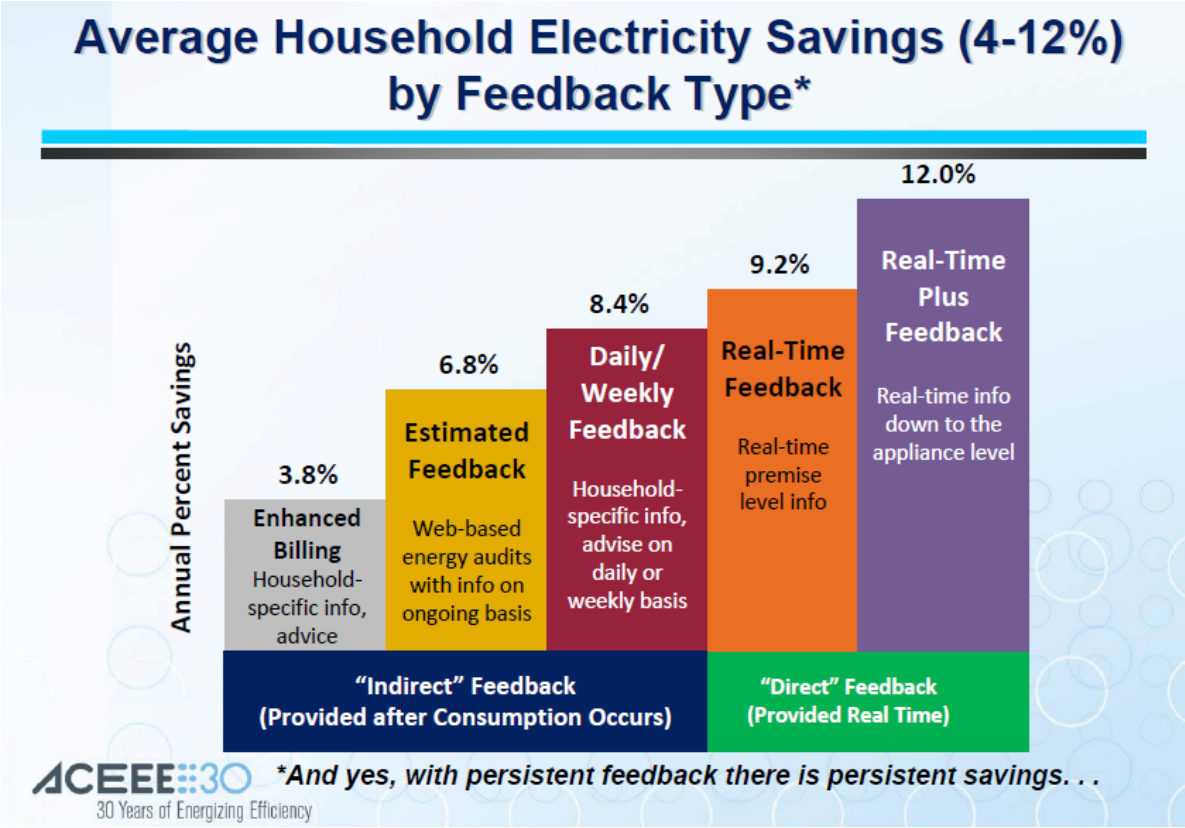

Figure 1: Annual Percent Savings

Meter Accuracy

Averaging saving of 12% is accumulated from various savings of few percents each. For example, 200kW high efficiency (IE3) motor is 95.8% efficient compared to 95.3% efficiency for normal (IE2) motor. This means that in order to monitor the saving, the measurement accuracy should be less than 1%. An application note named "Accuracy Class: a Small 'S' That Makes a Big Difference" from SATEC explains the accuracy standards and the outcome that the accuracy class 0.5 means measurement inaccuracy of ±1.58%. This means that in order to maximize savings a class 0.2S or 0.5S is required and class 1 or higher cannot be used, especially for creating energy baseline.

SATEC Energy Management

SATEC provides comprehensive solution for energy management since 1987 in over 60 countries. Typical energy management system architecture is shown in Figure 2:

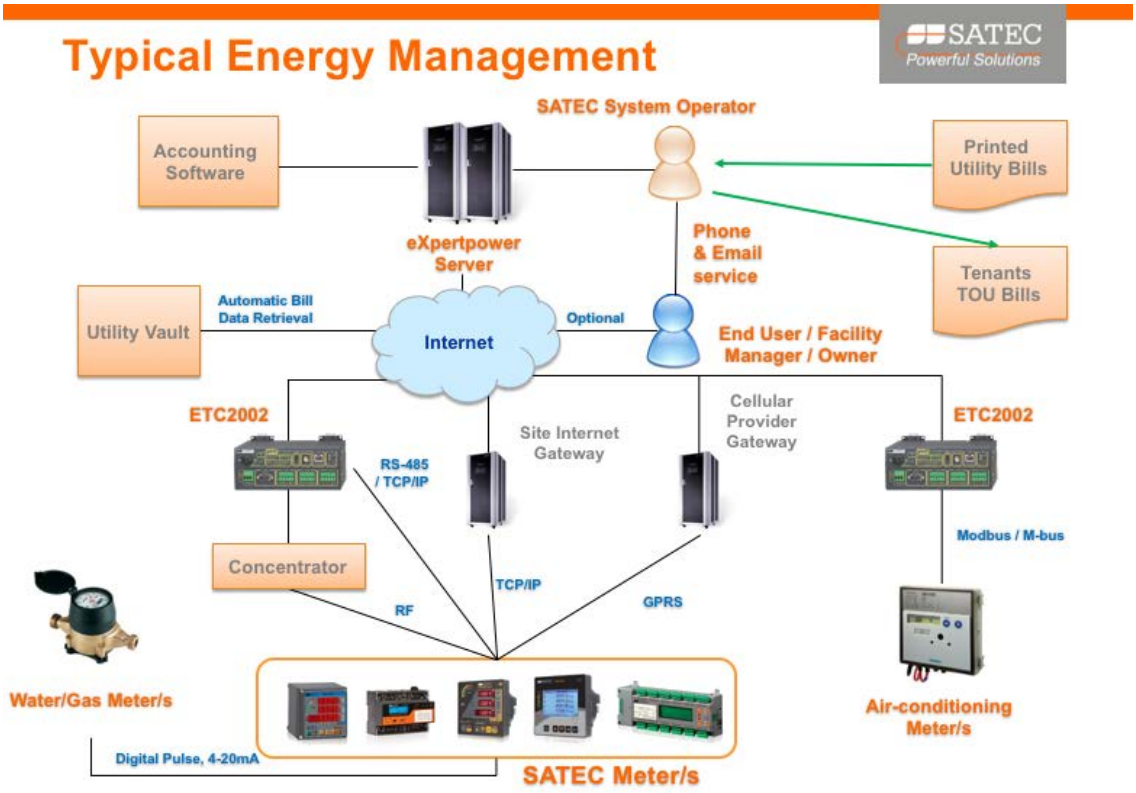

Figure 2: Typical Energy Management System

The system includes various SATEC Power Meters for Energy Measurement that allows connection to other energy meters such as water, gas and air condition. There are standard 3-phase meters in DIN rail or panel mounted, With LED or LCD displays. In addition, the BFM136 allows monitoring up to 36 single phase loads (or 12 3-phase loads) in one compact device.

The information is sent over the Internet, cellular network or physical communication channels to the ExpertPower EMS (Energy Management System). ExpertPower allows various displays, monitoring, trending, comparison as well as billing on all energy parameters. ExpertPower converts the data into knowledge that is accessed online, via various reports or directly into other computer software.

Case studies

Optimizing Compressor Operation

A Coca Cola bottle blowing factory in South Africa wanted to reduce the consumption of the compressors that provide the air flow to the blowing machines.

SATEC's four step process was implemented: Measurement, Analysis, Optimization and Verification.

Step 1: Measurement

The first step was to measure the consumption of each one of the compressors using SATEC PM130 PLUS that was installed on each compressor.

Step 2: Analysis

The second step was to analyze the data and see how much energy is consumed depending on the load. The load is measured by means of flow, which is what the blow machines need. A plot of consumption in kW vs. flow in kg/m3 was plotted, identifying the average kW per cubic meter consumption (Figure 3).

Step 3: Optimization

The third step was to optimize the operation of the compressors based on the required flow, as their efficiency is not the same at all loading conditions.

Step 4: Verification

The final step was to evaluate the performance and another chart was plotted with new data and new kW/kg/m3 that showed reducing the energy consumption by (kWh) 37% and the peak demand (KVA) by 25%.

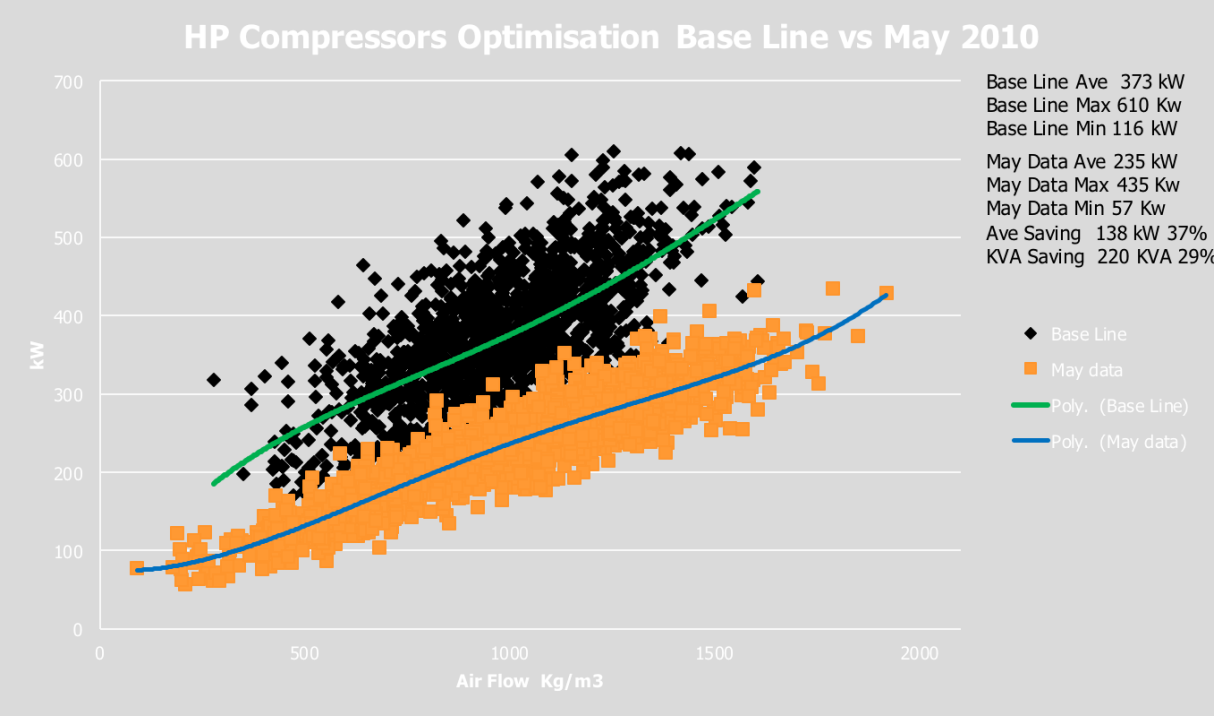

Figure 3: Consumption vs. Air Flow

Improving PV Throughput

Solar energy becomes more and more popular and efficiency of the energy generation is important in order to maximize profit.

ExpertPower EMS allows continuous monitoring of the performance of the system as well as the environmental conditions of the place. It calculates the best scenario energy production and compares it to the measured production. When a major difference is detected, a notification is sent via email or SMS. Figure 4 shows yearly comparison. On February a low generation was detected and a notification was sent by the system. Maintenance personnel were sent to the site. They found out that some panels were covered due to environmental conditions and others were damaged. They removed the obstructions and ordered replacement panels (which explains the lower generation on February). The immediate increase of generation and shortening the maintenance cycle retuned the cost of the system immediately.

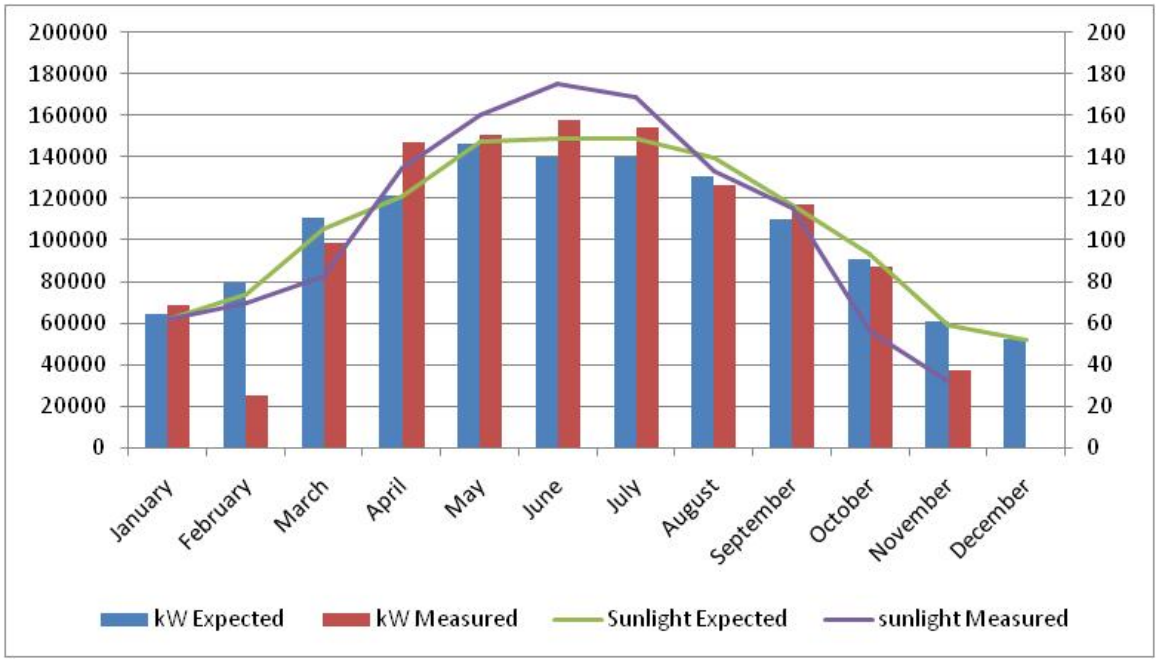

Figure 4: kWh Comparison

Summary

It is possible to save an average of 12% of the energy consumption and the first stage is the most important one – establishing **permanent** measurement system that **measures all loads** that consume 5% or more of the overall consumption with **high accuracy** (class 0.5S or better).