Continual Benchmarking

Energy Management

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It is a well known fact that mathematics is part of everyone's daily life. From paying for a cup of coffee to preparing a meal, everyone uses mathematics. Many professions such as engineers and accountants require a strong knowledge of mathematics to perform their daily tasks. This is the same for my profession as the Manager of Energy and Operational Efficiencies at a Pennsylvania school district. My position is not the typical position you would see in a Pennsylvania school district. My district saw value in employing someone with a focus on reducing energy and to provide an analytical review of other areas of operations to improve efficiencies. When operations are improved and become more efficient and energy consumption is reduced, this brings down expenditures and allows more of the limited school funds to be allocated to our main mission of educating students.

How is this accomplished?

Benchmarking

When approaching the review of an operation with the goal to streamline the operation and reduce cost there are simple steps to follow. Those steps include: establishing a baseline of performance, benchmark your performance against high performance operations and establish a performance gap. Once the performance gap is established, develop a plan to modify the operation, track your progress and repeat the steps.

Monitoring and Analyzing Data

As an energy manager, my role is to develop a program that combines mathematical analysis with practical solutions to reduce energy consumption. This combination will lead to the ultimate goal of expenditure reduction and the conservation of our natural resources. Following the example above, the first step establishing the baseline of performance, requires someone to accumulate one year's energy bills and develop a database for each building's utility, consumption and cost data. We then input that data into a benchmarking tool provided by the US EPA called Portfolio Manager found in the ENERGY STAR® website (www.energystar.gov).

ENERGY STAR® normalizes the energy data for weather, of all registered schools nationwide and uses mathematics to compare your energy consumption with other schools. This normalization

yields an ENERGY STAR® rating which is a percentile rating ranging from 0 to 100, very similar to test scores and grades. This fulfills the second step listed above; benchmark your performance.

To accomplish the third step; establish a performance gap, we take the data received and convert all of the utility consumption data to BTUs (British Thermal Units) and divide the BTUs by the square footage of the buildings to provide the number of BTU per square foot (BTU/sqft). This information will show which buildings are high consumers of energy. For example: Two similar elementary schools of similar size; one consumes 73,000 BTU/sqft and the other consumes 50,000 BU/sqft shows a minimum performance gap of 23,000 BTU/sqft (73,000 – 50,000 = 23,000). Knowing that there is a performance gap between two schools we then dissect the data to find which utility is causing the gap.

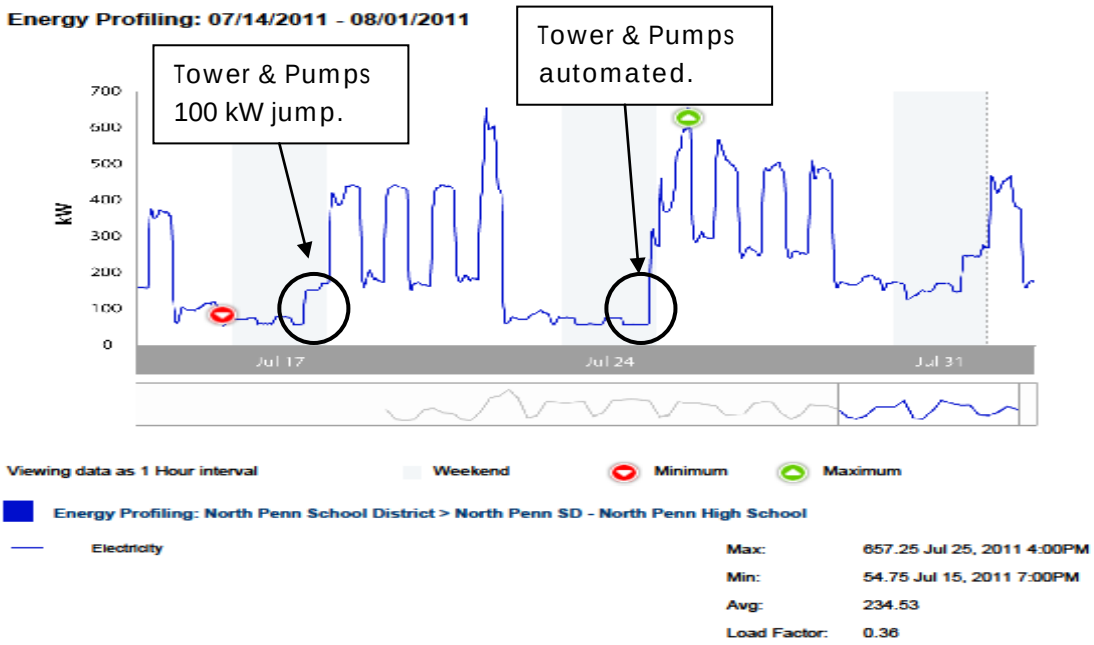
Next we develop a strategy to reduce the energy in the school. There are many methods that are successful ranging from ensuring equipment is operating correctly to engaging the students and teachers to help reduce the energy. In schools there is a higher ratio of persons per square foot in the building than many other facilities like offices, manufacturing facilities, and retail establishments. This must be considered when developing an energy management program because the occupants, if not supportive in reducing energy, could reverse many conservation efforts performed in the building. One example of how the student body and staff affect the success of energy management in schools is shown by the impact of turning off the lights in the hallways, classroom, gymnasium, library and cafeteria when the rooms are not in use. North Penn students from Penndale Middle School built a website (http://penndalegs.weebly.com/) to show the results. In addition they included ideas for the teachers to help conserve energy. Penndale Middle School has an ENERGY STAR® rating of 98. This means only 2% of the middle schools in the nation are more efficient than Penndale Middle School.

Once a program is developed and initiated, the work has only begun. Continual monitoring of data and benchmarking the successes and failures is imperative. This requires continual efforts and requires continual assessment of the program. This is the last step listed above – track your progress. This step is the stepping stone back to repeat the process. This process is known as continual benchmarking.

At North Penn we continually monitor our energy consumption through live electricity meter data provided by our Demand Response Curtailment Service Provider, EnerNoc, Inc. (Demand Response is a program where North Penn reduces electricity consumption in the summer during the high power consuming days. In return for the reduction in power on specific emergency days PJM, the electrical grid operator, provides revenue to North Penn.) The meters that are provided as part of the Demand Response program show the electrical consumption in as little of 5 minute intervals. Observing real-time readings is valuable when reducing energy in any facility. It is impossible to understand what consumes electricity in a building and how it effects total consumption without specific real-time data. A perfect example of what the real-time data can show is:

> North Penn High School air conditions the building with large equipment to cool water that is pumped through the building. This equipment includes a chiller, chilled water pumps, a cooling tower and condensing water pumps. All of this equipment must operate to provide air conditioning and uses large amounts of electricity to function.

Reviewing the real-time data of a Sunday; the graph indicated a large jump in electricity Sunday afternoon.



What was found was that the chiller and chilled water pumps turned on automatically at 5:30 AM in the morning. The tower and pumps were not automatic so the person inspecting the building on Sunday afternoon turned this equipment on in preparation for the automatic activation of the chiller. What did this equate to?

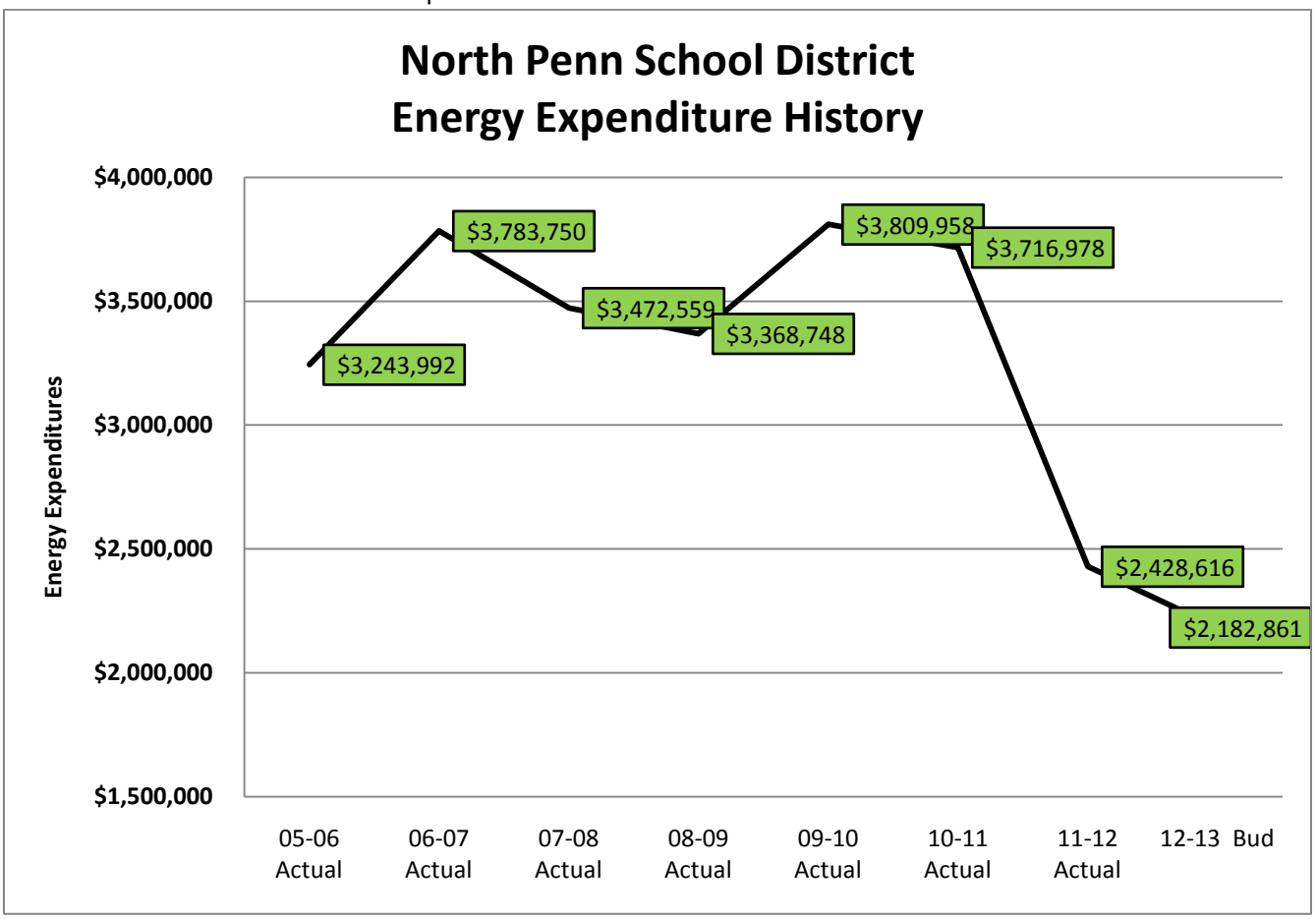
- The Tower and Pump Consumption
  - 100 kW for 12 hours = 1,200 kWh per weekend
  - 14 cooling weeks a year = 16,800 kWh per year
- The Tower and Pump Cost
  - 1,200 kWh at $0.10/kWh = $120 every weekend!
  - 14 cooling weeks a year = $1,680 per year
- The remedy?
  - Automating the Tower and Pumps.
  - Cost to perform work was less than one year's cost of electricity.

Note the following weekend, there is no jump in electrical consumption after the work was completed.

Budgeting

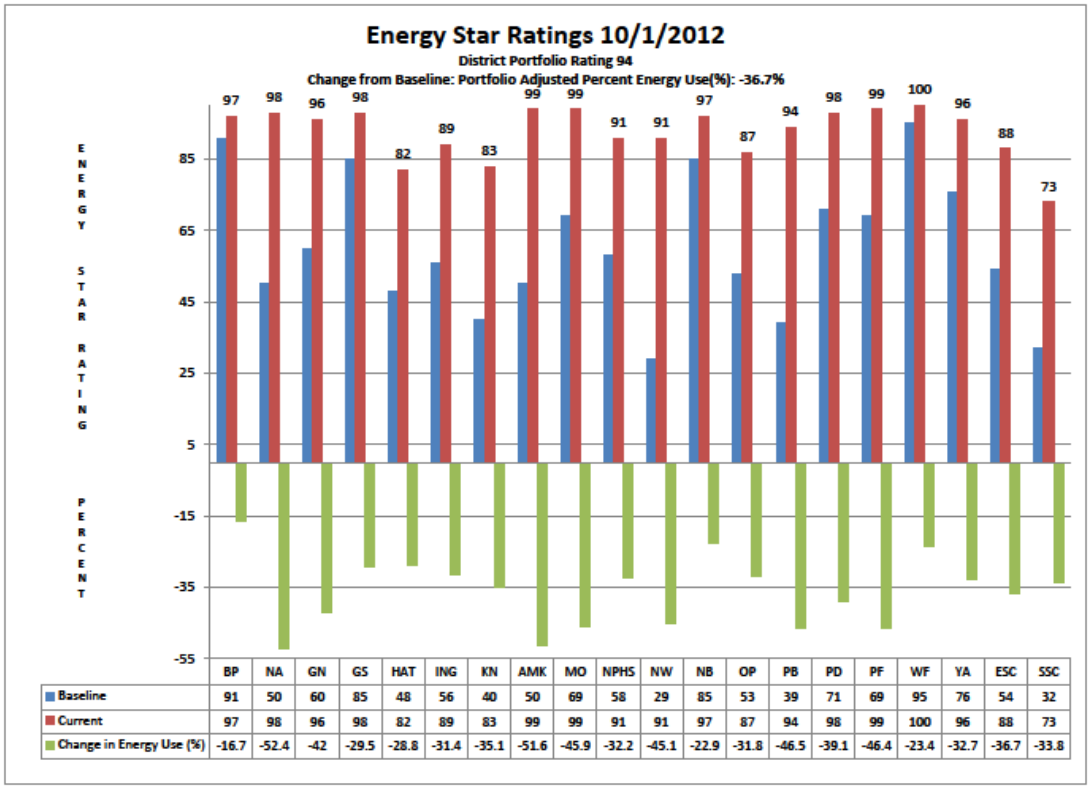
Another important responsibility for an energy manager is to establish yearly budgets for each building and type of energy. Historically, energy would increase and decrease in price based on basic predictable fundamentals. In the past 5 years these fundamentals have not been as predictable which requires more in depth knowledge of global energy markets. In addition, understanding the myriad of methods and products to purchase energy is critical. Recently a review of a current method of purchasing electricity was compared with a new method. The analysis showed that the new method could yield up to an 12% decrease in supply cost. This

could yield a substantial savings in expenditure which equated to the equivalent of conserving an additional 12% of consumption. It is much easier to purchase at a lower rate than it is to conserve an additional 12% on top of our 37% reduction.

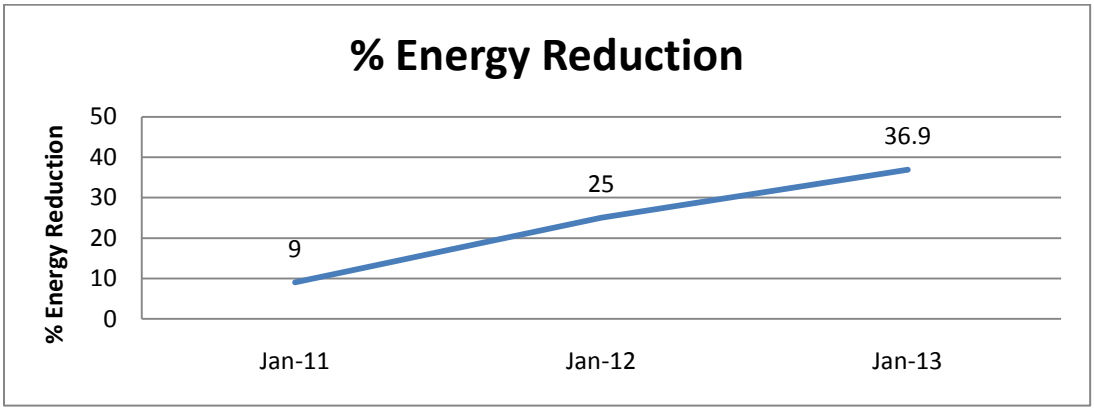


This process of continual benchmarking, energy management and informative purchasing practices has yielded favorable cost avoidance for North Penn School District. The reason "cost avoidance" is utilized is that we did not "save" money; we merely did not spend it on energy. The balance of the budgeted funds not spent on energy was used to preserve instructional programs that may have been cut as the result of the limited instructional funds. In fiscal year 2011/2012 alone, North Penn School District's energy management program had the following successes:

- Reduced expenditures by $1.29 million compared to 2010/2011.
- This reduction in expenditures and increased revenues, through Demand Response, benefited this year's budget by $900,000. This year's budget included a reduction in budgeted amounts for energy.
- Increased our District's ENERGY STAR® rating from 85 to 94.
- North Penn has 19 of 20 buildings performing at 75 or higher.
- North Penn has 14 buildings above 90 with 11 of those buildings above 95 and 1 building just hit 100!!
- Increased total energy reduction to 37% from our ENERGY STAR® baseline year of 2008.



	BP	NA	GN	GS	HAT	ING	KN	AMK	MO	NPHS	NW	NB	OP	PB	PD	PF	WF	YA	ESC	SSC
Baseline	91	50	60	85	48	56	40	50	69	58	29	85	53	39	71	69	95	76	54	32
Current	97	98	96	98	82	89	83	99	99	91	91	97	87	94	98	99	100	96	88	73
Change in Energy Use (%)	-16.7	-52.4	-42	-29.5	-28.8	-31.4	-35.1	-51.6	-45.9	-32.2	-45.1	-22.9	-31.8	-46.5	-39.1	-46.4	-23.4	-32.7	-36.7	-33.8



A successful energy manager must maintain historical data and be able to analyze that data to drive decision making. In many instances, decisions may not be decided based solely on the data but data is an important part of the process. Maintaining accurate databases and understanding the data is the most important aspect of my position.

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