Sustainability, Fundamental Measurement

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Through comprehensive investigation of energy and natural resource consumption, a plan or set of plans can be devised for a long-term approach to energy and natural resource conservation. The ability to maintain energy and natural resources at a *Fundamental Measured* rate of consumption could be characterized as sustainable. Could we imagine a fundamental goal of increased participation in conserving the use of energy and natural resources that results in declining consumption? Can we constructively create an action plan for improving the efficiencies of energy and natural resources used by participants? Can we capture unrealized financial and environmental gains through identifying and implementing cost-efficient and cost-effective improvements?

Efforts to reduce electrical energy consumption will not only lower expenses; they can also increase potential interest in developing a directive to decisively measure energy use as part of a specific fundamental measurement approach. Consequently, the most fundamental understanding of a measurement goal could be the start of our approach.

Utility providers measure variables with utility-grade billable meters calibrated with high accuracy. For this example, note that a kilowatt-hour (kWh) and a kilowatt (kW) may seem like the same thing, but they are interrelated units of measurement. The important difference between kWh and kW is that a kWh reflects the *total amount of electricity used*, whereas a kW reflects the *rate of electricity usage*. The kWh (symbolized by an SI [International System of Units] designation) is a composite unit of energy equivalent to 1 kW of power sustained for 1 hour.

FUNDAMENTAL MEASUREMENT ANALYSIS: "THE START PART SIMPLIFIED"

A single building's energy consumption can be analyzed to establish a baseline, point "A," if you will consider "A" as a starting point. This is the first year of consumption as a measured, 12-month period for this example. We normalize data as gross consumption per total gross square feet in order to fundamentally begin the "Start Part" for a specific group of personnel. This can incorporate divisions later for breakout of individual area usage by designed permanent meter or temporary metered measurement.

But first we must have a solid baseline of group understanding with variables that everyone, including trade and craft personnel in the field, can understand. Most of our building operating/renovating personnel (the select group of line managers/supervisors we use here) are not "building scientists," and we need to share conservation information that inspires performance from their prior trade and craft personnel efforts.

Fundamental Measurement "Start Part Simplified" Gross Variables—Electricity:

- kWhs
- Gross square feet
- Monthly expense—dollars

With such simple variables to consistently observe month to month for this group of employees, it is interesting to observe their reactions when the "lightbulb" turns on as they see the true effects of electricity conservation measures as they directly relate to their project work and the expense conserved. This is only relevant to our trade-related group here, not to formal accounting, budget, or administration processes, and the data input for this group is handled separately from those groups. However, it is affected considerably by positive results from labor production.

After reviewing trends in data and information on the energy consumption of individual buildings, a designated conservation group of reviewers may conclude that a realistic 1 to 2 percent reduction effort in annual energy use as a goal could be successful and would be necessary to keep pace with the growing student occupancy. This reduction may be

possible by focusing on the most easily achievable conservation efforts for perhaps 10 years (amounting to a 10 to 20 percent reduction per decade). Building to Leadership in Energy and Environmental Design (LEED) certification standards can be productive with the assistance of up-to-date operations and maintenance practices.

This beginning understanding of fundamental measurement is important for any university or school district educational institution, as it establishes fundamental measurement processes that may help reorganize and reprioritize projects so they result in expense-saving improvements. Once we get the conservation ball rolling, we would like to stay on the path of continued and even compounded savings annually.

Constrained capital combined with successful measurement conservation goals will ensure the effectiveness and efficiency of investments and also make certain they are given fair consideration among competing projects. An analysis can be performed to determine the financial feasibility for each potential energy-saving project, by evaluating return on investment and net present value saved back into our energy checkbook.

POTENTIAL RESULTS EXAMPLE

While many of the potential no-cost/low-cost energy efficiency improvements recommended may have already been implemented by Management, there are significant savings available from projects requiring some capital investment. The table on page 12 lists examples of energy savings and paybacks associated with projects in various categories.

RECOMMENDATIONS

In addition to laying out potential goals as shown above, an action plan example is recommended to prioritize projects. After weighting projects by payback period and initial investment, and after discussing priorities with management for approach, the staff should adopt a timeline for achieving those goals.

Projects can be based on the greatest ROI while replacing the oldest technology or components in a system. Energy efficiency standards can assist in

SIMPLE PAY BACK	Project	Simple
Item	Cost, $	Payback, Yrs
Replace Incandescent to Compact FI	$48	1.0
Replace Fluorescent and Incandescent	$350	1.5
Reduced Lighting Operating Hours	$1,000	4.1
Install Occupancy Sensors	$2,500	6.9
Disconnect Vending Machine Lights	$5,000	9.7
Convert T12 to T8 Fluorescent	$800	2.1
Convert Metal Halide to T8 or T5 Fluorescent	$17,500	4.6
Task Lighting	$1,000	5.7
TOTALS	$28,198	4.9

Incentive	Simple PB
$	w/ incentive
NA	**NA**
NA	**NA**
$444	2.27
$951	4.31
$325	9.07
$12	2.08
$357	4.53
$684	1.80
$2,773	4.43

For the incentive $, if simple payback without incentive is <2 or >10 years, there typically is no incentive.

choosing the most successful projects. A great example of one of these standards is ANSI/ASHRAE/IES Standard 100-2015, "Energy Efficiency in Existing Buildings." (This standard supersedes ANSI/ASHRAE/IESNA Standard 100-2006.) Management analyzes, chooses, and explains to staff the potential target and helps trade and craft staff stay focused on the goal consistently. Long-term task repetition brings long-term task accomplishment and a better understanding of the benefits of human effort in the task. We want this thinking process to be automatic—an automaticity response in human performance, learned in trade and craft repetitive labor projects. Labor repetition promotes automaticity in human thought processes, increasing the quality and efficiency of human performance.

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