Finding Big Savings in Big Data:

UNLOCKING THE FULL VALUE OF ENERGY EFFICIENCY

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Key Insights:

- Data in context yields valuable energy information
- Energy information can uncover new efficiency opportunities, and increase confidence in savings projections
- Energy information may ultimately enable efficiency investments to be valued on par with energy generation

Unleashing Energy Potential

If you have been paying attention to the energy efficiency field in recent years, you have probably noticed a great deal of excitement about the potential of data. But those of us who work with it every day will tell you that it is not about data; it is about information. Energy data on its own can be illuminating to someone who is trained to analyze it, but it is not useful until it leads to actual energy saving projects. Beyond the immediate benefits of individual efficiency projects, information that can be used to unlock energy savings has a great deal of value in our energy dependent economy. Having concrete information about projected energy savings builds the case that efficiency investments will yield real and lasting value. Ultimately, the goal is to reach a "tipping point" when all actors in the market have confidence in the accuracy of projected energy savings. This will unlock the power of capital markets to support all cost effective investments in energy efficiency in much the same way that they support the development of other energy sources.

What is energy data – and why should we care about it?

Data, by itself, is a raw material, holding potential but not necessarily providing any value. In 2012, most of the electric utility meters in Vermont were converted to "smart" meters capable of recording hourly or 15 minute interval usage data. These meters have now begun to generate approximately 12 billion data points per year. Add to that the numerous monitoring points from building energy management systems, submeters, and the emergence of smart appliances, and we can expect a dramatic increase in the amount of energy data in the coming years. While this data undoubtedly holds some valuable insights, a simple representation of it provides barely a hint of its underlying meaning (see Figure 1).

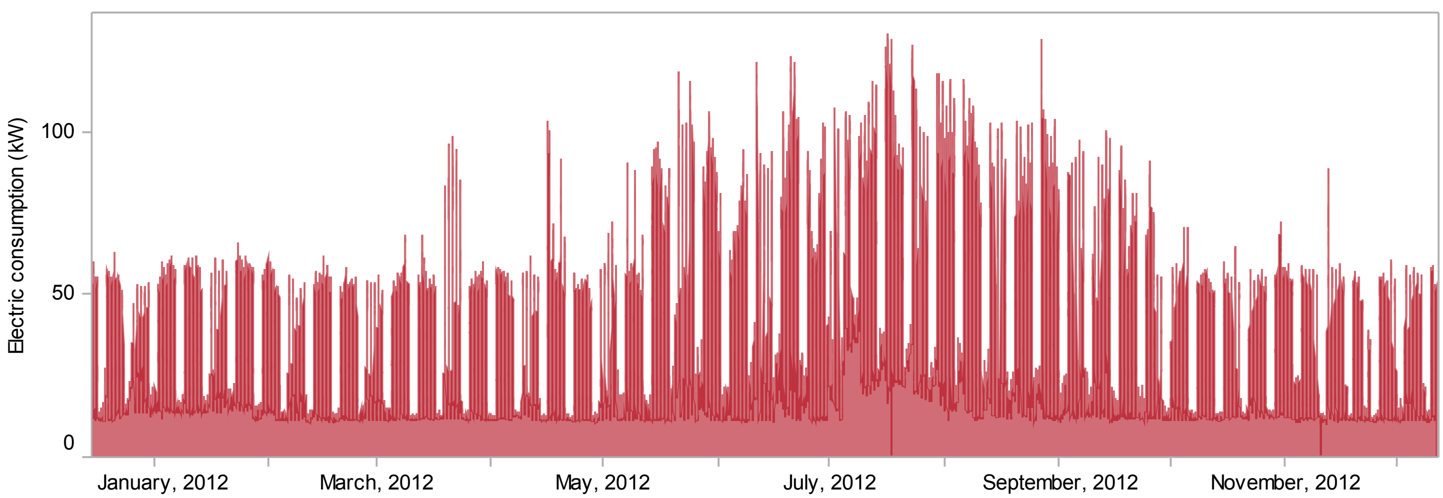

Figure 1: Energy usage at VEIC's Vermont offices over 12 months

The use of data producing technologies has largely been driven by the desire to improve the management of existing energy usage and infrastructure. The deployment of Vermont's Advanced Metering Infrastructure (AMI) or "smart" meters, for example, was primarily undertaken to enable the electric utilities to better understand and manage the grid. Similarly, the installation of electric submeters on individual pieces of building equipment or circuits, as well as networked temperature, light, and occupancy sensors and other building monitoring systems, has been embraced by building owners who want to better understand and manage their buildings' energy use. However, the data produced by AMI and building management systems can also be used to reveal energy saving opportunities. Unlocking the valuable insights encapsulated within energy data requires three critical tools: The data itself; contextual information about the building from which data was gathered (such as the operating schedule, specifications of installed equipment, etc.), and the expertise of an energy data analyst.

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Energy efficiency providers such as Efficiency Vermont have long used data to inform energy savings calculations. Sometimes referred to generally as "metering," this data acquisition activity produces such information as trends of power consumption in portions of buildings and particular pieces of equipment. Metering also reveals operating conditions like temperatures, pressures, flow rates, light levels, and other values that can predict energy usage or savings potential.

Due to the cost of the metering equipment and the labor involved in deploying it, temporary metering has most commonly been used as part of energy audits and savings verification, where two to six weeks of data is used to calibrate savings models. This approach to metering is typically used only on the largest projects, as it can typically cost several thousand dollars. However, the improved accuracy of this approach can provide both the building owner and the efficiency program with the confidence to move forward on projects where the uncertainty of new technology or atypical operating conditions (such as is the case with many industrial process improvements) would otherwise make it too risky to proceed. In other words, the information gleaned from metering and data analysis has long been a primary driver of energy efficiency decisions - even before the widespread deployment of AMI.

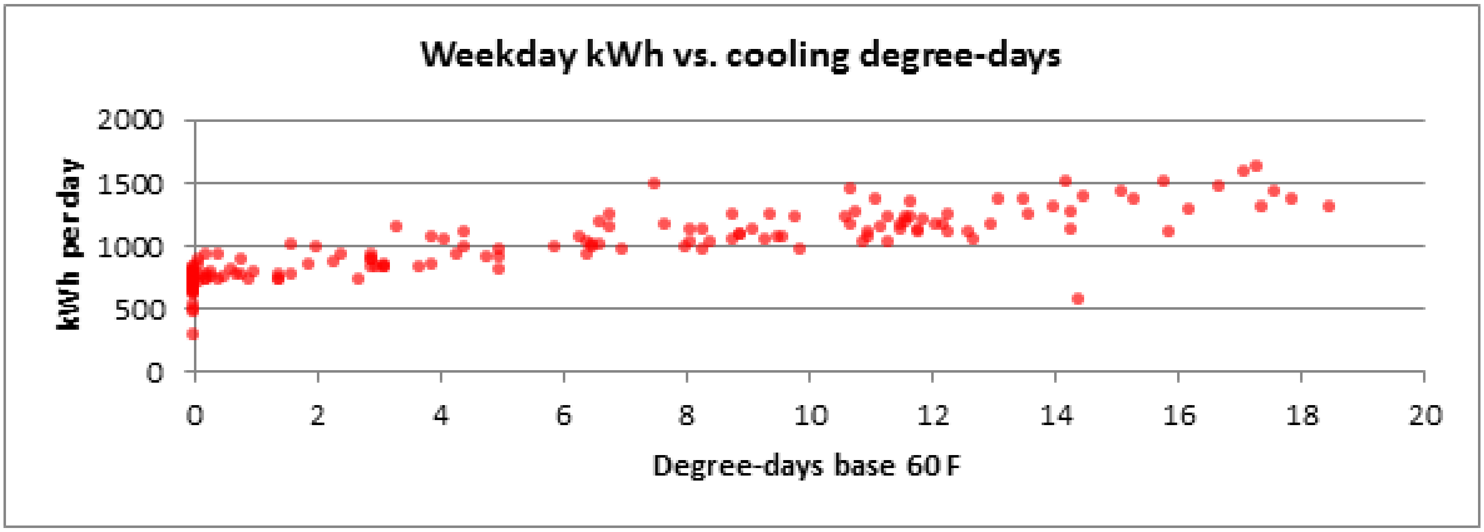

Figure 2: Beginning to transform the data from the chart in Figure 1 by applying analysis and context

A New Paradigm for Energy Data Analysis

Today we are working with inexpensive metering devices that can send data over the Internet and with analysis software that can pull data from building systems and weather stations, perform a variety of calculations, and produce charts and efficiency metrics in a matter of seconds. More and more, the same inexpensive measurement and communication technology that is allowing utilities to record energy usage in real time is being added to buildings systems, industrial equipment, and even residential appliances. This not only replaces a labor intensive process that can involve driving to distant buildings to retrieve and then manually process the data, it also allows the analysts to perform more sophisticated calculations with fewer errors and to explore data more deeply.

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For some efficiency calculations, these developments may allow for almost fully automated analysis, freeing analysts to focus on novel technologies and more complex projects. The widespread integration of Internet connected energy meters and other sensors, plus the development of more automated efficiency calculations, has led to a democratization of energy assessments. In the near future, it will be possible for facility managers and building operators to oversee basic efficiency assessments and savings verification for their own sites.

The advent of broadly accessible customized savings reports would do far more than to assure building owners that they are making prudent investments. A sufficiently accurate measurement of energy savings could make efficiency as valuable as utility-delivered energy or energy supplied by renewables. In other words, if you can prove your efficiency service saved me $100 last month, I should be willing to pay you up to $100 for that service. This is not new; energy savings contracts already exist, but the typical measurement and verification (M&V) cost to achieve the necessary accuracy is still a significant limiting factor. Consequently, the only projects which energy service companies can afford to finance are quite large, and also tend to focus on the few types of efficiency upgrades that are easiest to measure.

As sources of energy data become ubiquitous, the initial investment required to automate data analysis can be justified by the scale of the opportunity. The reduced cost and increased accuracy of M&V could make efficiency a marketable energy resource, giving efficiency providers far greater access to capital. Current estimates of available, cost effective opportunities indicate a possible $1.2 trillion in savings from investments of $520 billion,[1] of which only a fifth is currently expected to be captured by 2020.[2]

Today's Energy Data will Drive Tomorrow's Investment Decisions

Data, on its own, is nothing more than a digital representation of a narrow slice of the world. However, when data is put in context and expertly analyzed, it can generate information that unlocks significant – and lucrative - energy savings. As the cost of this information decreases, it can be used to identify and quantify many more efficiency opportunities. It is conceivable that, in the not-too-distant future, the accuracy of such assessments will increase to the point where data can be used to justify investments and project financing. Historically, energy efficiency investments have been held to a very high cost effectiveness standard, and have sometimes been perceived as financially risky. The new paradigm of energy information will enable these projects to compete fairly in a world of data-driven investment decisions, shifting the landscape entirely. Ultimately, the power of the capital markets may ensure that building owners will no longer have to bear all the risk and initial cost of efficiency upgrades, allowing for a much more rapid and thorough utilization of least-cost energy resources. So, what will change when the information revolution hits energy efficiency? Everything.

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[1] Granade, Hannah, et al, *Unlocking Energy Efficiency in the U.S. Economy* (McKinsey & Company: 2009)

[2] Stahl, Jeremy, *Welcome to the Negawatt Revolution* (Slate: 2012)

Ethan Goldman is the Energy Informatics Architect at VEIC. He holds a BS from Hampshire College and an MS in Green Informatics from Carnegie Mellon University. His 2001 thesis was entitled "Cultivating Energy Consciousness through Feedback: Designing Home Energy Use Monitors for Conservation." His graduate research focused on the development of a non-intrusive load monitoring system for disaggregating end-use appliance use from whole-house meter data, using machine-learning algorithms. Ethan is responsible for developing systems for acquiring, storing, and analyzing AMI data from utilities and also for Efficiency Vermont's submetering activities. He is also supporting an ongoing consumer behavior study on the benefits of in home displays and proactive customer service.