

# Using Software and Submeters to Manage Energy

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## Introduction

To be economically competitive in today's global marketplace, it is necessary to reduce the cost of production or services. A portion of this cost reduction can be realized with better management of energy consumption.

Over the past decade – as business turned toward labor, materials and processes to lower production and service costs in order to compete globally – energy costs were looked upon as fixed, untouchable overhead. Inside a facility, the technology and knowledge base often were not available to capture and process energy consumption data. Outside a facility, utilities set pricing, monitored usage and billed accordingly, without any input from the customer.

The continuing evolution of sophisticated meters and monitors, power management software, and non-proprietary systems to transmit data enables facilities to create practical energy profiles. Coupling this information with Building Automation Systems (BAS) that can act upon this data, facilities can now take actions to control their energy costs.

Concurrently, deregulation of the electrical industry has redefined the role of the utility customer. The benefits of deregulation are promised to all, but the power to negotiate with utilities for premium rates and service lies primarily with larger users of electricity.

These circumstances create an environment where an energy action plan can increase productivity, lower the overhead cost of energy consumption and, ultimately, improve profitability.

## Begin with an Energy Action Plan

With submetering and software products, businesses are now able to monitor energy usage on the plant floor and in the electrical distribution system. This energy monitoring can be pushed down to individual processes or machines. By doing so, energy intensive processes and inefficient machinery are uncovered and the overall cost of running plant operations during peak and non-peak hours can be determined.

By studying raw data gathered by meters, facility managers now understand for the first time that energy costs can be managed and controlled. They know how energy costs can be accurately allocated to individual groups or supervisors. And they're using this knowledge to drive down that overhead. An energy action plan is the application of energy consumption knowledge to manage and control energy costs.

As there are a number of good references available for developing an Energy Action Plan. One good source of information is the Association of Energy Engineers ([www.aeecenter.org](http://www.aeecenter.org)). Although a detailed description is outside the scope of this paper, the basic components of an Energy Action Plan include:

1. Establish Energy Management Program
  - Secure management commitment
  - Appoint an Energy Management Coordinator
  - Establish an Energy Management Organization
  - Develop a communication plan

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2. Establish an Energy Base Line
  - Historical energy usage analysis
  - Facility energy assessment/site survey
  - Implementation of no cost recommendations
3. Establish Measurement & Verification
  - Implementation of a submetering system
  - Real time data analysis
  - Departmental energy cost allocation
4. Ongoing Energy Projects
  - Identification of energy management opportunities
  - Economic justification
  - Project implementation

## Realizing Cost Savings

A typical commercial/industrial facility can save 10% to as much as 50% annually on energy costs by implementing a comprehensive energy action plan. There is no standard “off-the-shelf” solution; each facility or process will contain intricacies that require a customized approach.

As an example, one of Cutler-Hammer’s customers saved a million dollars a year by agreeing to an interruptible energy plan with the local utility. This was the result of its ability to effectively manage energy loads, turning off non-essential equipment such as HVAC or lights on demand. They also found they could reduce demand levels by turning off some equipment when starting up a production line or processes that consume high levels of energy.

Cost savings can also be realized in other ways. Production facilities must comply with increasingly stringent environmental standards to reduce air and water pollution. By implementing energy-efficient technologies, and utilizing better materials and manufacturing processes, companies can improve productivity and service and avoid paying hefty fines for exceeding environmental emissions standards.

The first step in developing an energy management program and realizing these financial returns is acquiring information.

## Submetering



*A Typical Submetering Device*

Having measurement and verification capabilities of energy usage is a prerequisite to a sound and workable energy management program. This can only be accomplished by permanently installing submetering products. The primary benefit of submetering is information. With that information comes the power to manage energy costs.



*A Typical Breaker Mounted Submetering Device*

Submetering devices will measure and communicate energy information back to a central point. These devices do not normally need a local display as all of the required data is transmitted and displayed by the energy software. Submetering devices can be applied to single and three phase loads and can be directly mounted on the load side of a circuit breaker. There are even intelligent circuit breaker trip units that act as submetering devices by measuring

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the energy flowing through the breaker and communicating this information.



*Example of Submetering Trip Unit*

An industrial facility with submeters in place can effectively determine equipment, line, process and departmental efficiencies. The ability to measure energy usage on different levels of the plant, right down to the factory floor, enables facility managers to pinpoint inefficiencies. Corrections can be made without guesswork.

Data gathered from submeters can shape load profiles to help identify problems that may occur at a later date. By reviewing load profiles, facilities can determine when a machine needs preventative maintenance or replacement.

Submetering can also help manage budgets. Energy usage data collected from submeters can be utilized to create process or departmental billing systems, and the same data can be used to substantiate those energy budgets. In addition, submeters can help verify the utility bill by confirming

energy usage. This insures proper billing from the supply side.

Submeters can be equally effective in office space or commercial buildings. Energy usage data collected from submeters can identify energy-consuming loads or tenants. Tenant-billing systems that reward energy efficient tenants while accurately charging those companies using the most energy are easily created.

The development of energy profiles can be used as a powerful incentive to educate inefficient tenants on wasteful energy practices and help them develop internal energy management plans to lower energy bills. Submetering data can then used to substantiate energy budgets.

A recent example of identifying wasteful energy usage involved a new 140,000 sq. ft. corporate headquarters building in the Pittsburgh area. The HVAC system in this building is integrated with the electrical distribution system and offers occupants zone-temperature monitoring with automatic adjustment of occupied or unoccupied zones. The energy management system offers local and remote monitoring of all major electrical loads via submeters. After analyzing the historical energy trending of this system, the corporation was able to alter its morning warm-up cycle and cut 150 kW from monthly peak demand charges. This action resulted in a \$5,000 cost savings each month.

## **Main Metering**

Properly monitoring the main incoming utility power is an important requirement of any energy-efficient facility.

In every submetering system a main meter should be placed at the point of common coupling with the utility. Larger facilities many times have more than one utility tie point. At a minimum each main meter should be an ANSI 12.16, class 10 revenue-accurate meter that can measure Watt-hours, VAR-hours, VA-hours, demand, and power factor. This meter will confirm the

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usage readings from the utility's revenue meter to insure proper utility billing.

When selecting a main meter the susceptibility of the facility to power quality disturbances should also be considered. Facilities or processes that could be adversely affected by short and long term voltage fluctuations, transients and harmonics should be equipped with main meters that have power quality metering functions. These functions include the ability to capture voltage and current waveforms, detect sub-cycle voltage disturbances, measure voltage and current harmonic distortion and trend important electrical system parameters.



*A Typical Main Meter With Power Quality Features.*

As more and more states move toward utility deregulation time-of-use energy metering becomes another important consideration. Meters with time-of-use capabilities capture not only the total energy used in a given period but on what day and what time of day that energy was consumed. Some meters will keep track of energy used based upon the day of the

week. Seasonal rate changes can also be tracked.

All meters must have communication capabilities to transmit information to and from powerful software. Data alone will not help a facility conserve energy. Importing the data into software solutions is the final step in developing an effective energy management plan.

## Software Solutions

Power monitoring software programs turn the raw numbers collected from meters into a powerful analysis tool that can increase productivity and lower overall production costs.

This software must be able to store and analyze energy information from both main meters and submeters. It is often desirable to import non-electrical energy information from utilities such as gas or steam into this software. The software must also have the ability to aggregate the readings of many submeters. By combining or aggregating energy data from multiple meters the facility manager can determine the total energy used by a particular process or department served by many submeters.



*Typical Energy Software*

The Cutler-Hammer plant in Asheville, North Carolina, installed an energy management system in early 1997 as part of its energy action plan. Its energy bills had been running nearly \$45,000 a month. In the first six months, the plant was able to successfully reduce its energy costs by

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\$40,000 and the system paid for itself within 14 months after installation.

In this example Cutler-Hammer's PowerNet power monitoring system was used to accomplish this reduction by communicating over an open Ethernet network with metering devices, protective relays, circuit breaker trip units and motor starters. PowerNet provided historical profiles of energy events, identifies faults, coordinates power quality events and allocates energy costs.

Asheville continues to realize savings. In 1998, the plant's electric energy bill was cut by nearly \$70,000 and in the last few years comparable savings have been realized. The two charts at the end of this paper graphically demonstrate the energy savings attained by installing this system.

Good power monitoring software can analyze and emulate utility rate structures and verify utility billing. These features are critical in a deregulated environment. Facility managers can insure the best utility rates, calculate cost savings of switching to a less expensive supplier and guarantee the accuracy of current charges.

Software programs can store and analyze data gathered by submeters to allocate energy costs to the process, department, and product level or, in the case of a commercial building, to the tenants. The benefit here is twofold: properly bill those areas that are using the most energy and pinpoint inefficiencies so they can be corrected.

Power monitoring software can also generate daily, weekly, monthly and yearly load profiles for a facility. These load profiles are very useful when negotiating power supply contracts in the deregulated marketplace. When an energy supplier bids to supply energy to a facility with a known load profile there is less risk and therefore greater likelihood of obtaining the best price.

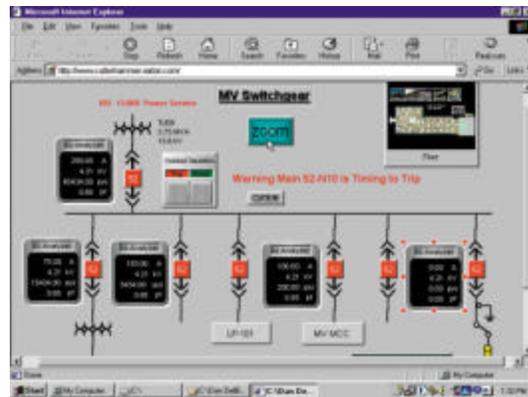
## Software Options

Just as any new car will get you there and back, although some are more dependable than others, many basic power monitoring software packages provide simple functionality. But when evaluating software, as in car buying, selecting the right options is the key to being satisfied in the long term.

An optional software module aggregates multiple incoming utility service profiles and calculates the potential savings if a facility consolidates its load profile. Facilities with this information have gained increased buying power can then take this information and negotiate better rates with a utility.

In addition, these programs will track energy efficiency and store equipment profiles to develop predictive and preventative maintenance schedules.

Most software packages have options that graphically display the facility's electrical distribution system. These can include "intelligent" single line electrical drawings that display data in real time as well as facility floor plans indicating energy usage and problem areas. These graphic screens are customized for each installation.



*Typical Graphical Display Screen*

Working together, meters and power management software programs can have a positive impact on lowering energy consumption and costs by shaping a sound energy management plan.

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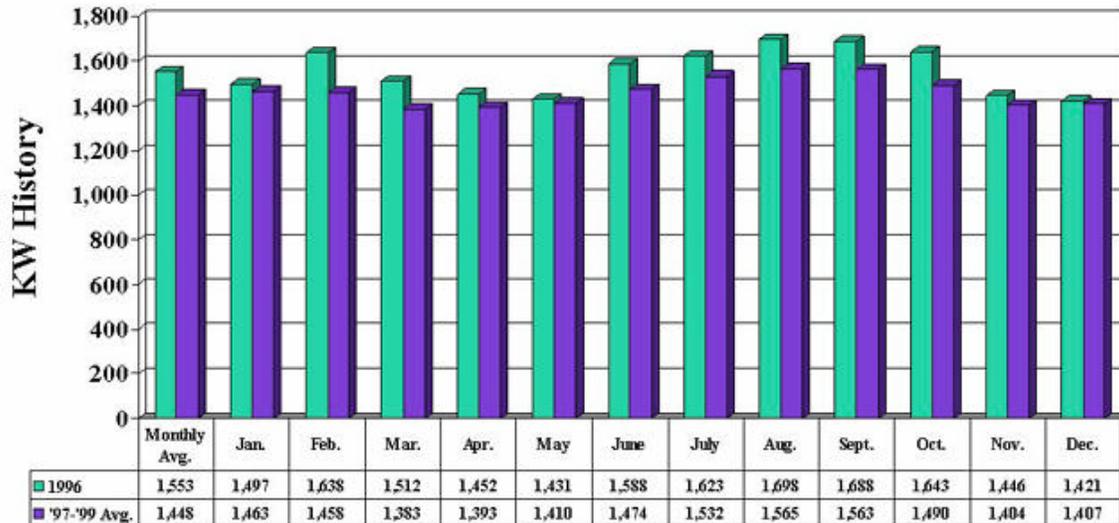
## Changing Worlds

Deregulation and burgeoning technologies offer industrial/commercial facilities a unique opportunity to control energy costs – a concept that a decade ago seemed unattainable. Facilities can now implement energy management programs that will result in increased productivity and reliability, while lowering overhead and cost.

Those companies that succeed in implementing an effective and comprehensive energy action plan will be better able to compete in a deregulated environment and, more importantly, in the global marketplace.

## CUTLER-HAMMER, ASHEVILLE, N.C. KW DEMAND HISTORY

*1996 PRIOR TO POWERNET INSTALLATION  
VERSUS  
1997-99 WITH POWERNET ENERGY MANAGEMENT*



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## CUTLER-HAMMER, ASHEVILLE, N.C. KWH CONSUMPTION HISTORY

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