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Submetering -- Diversity Makes It The Tool Of Choice For Energy Monitoring

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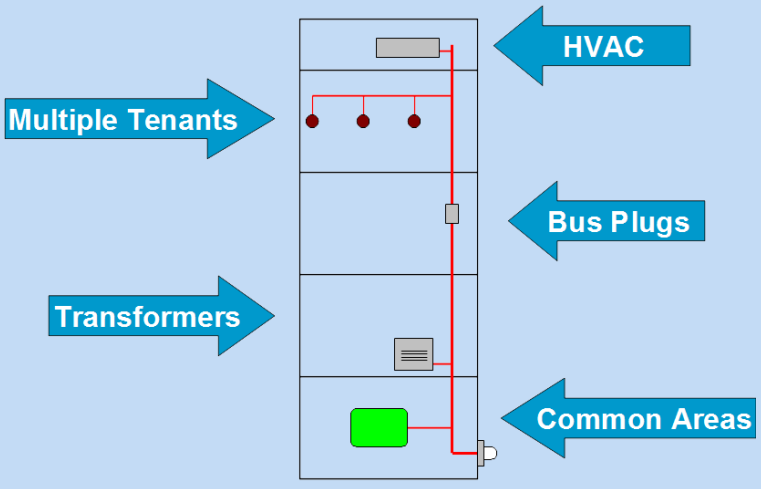
INTRODUCTION

In the 1980's, the electrical submetering industry was growing under the consideration that these devices are the tools of choice to register the energy use of facility tenants or departments so that each individual entity could be fairly billed or accounted for. Their flexibility and ease of installation made submeters a valuable choice for designers, engineers, and property managers who required accurate billing data. Today we find that submetering is no longer just a tool for billing, but has become the "Swiss Army Knife" of energy monitoring. It is not just for electrical energy any more because *submeters now can account for practically all forms of energy, and utilities* that are used in residential, commercial, and industrial facilities. Submeters can provide the user with valuable and actionable data on energy that can be used to lower both consumption and costs.

WHAT IS A SUBMETER?

A submeter is a metering device that is installed in a facility and placed behind the metering point that the serving Utility has installed. Typically, submeters are installed to monitor individual tenants, departments, and/or pieces of equipment. This provides detailed usage data that can be utilized for accounting, analysis, and control.



Typical electric submetering points

TYPES OF SUBMETERS

Today's submeters are available to monitor practically any form of energy or Utility service. While electric and water are the most common, the list also includes steam, oil, BTUs, gas and a number of others. Enhanced submetering applications provide time-of-use and interval data capabilities for greater detail in usage and costing.

electric

water

gas

steam

BTU

oil

SAVINGS POTENTIAL

Depending on cognizance and application, the installation of submeters can have a wide range of effects and savings potential. In many cases, just the knowledge that meters are in place often lowers energy usage. As billing comes into play, tenants typically become proactive in reducing their usage. As the meter data becomes available to the facility managers and engineers, steps can be taken to improve performance. And, at the final level, integration into a Building Management System allows continuous monitoring to provide the highest savings potentials.

Metering Savings Ranges

Action	Observed Savings
Installation of meters	0 to 2% (the "Hawthorne effect")[a]
Bill allocation only	2-1/2 to 5% (improved awareness)
Building tune-up	5 to 15% (improved awareness, and identification of simple O&M improvement)
Continuous Commissioning	15 to 45% (improved awareness, ID simple O&M improvements, project accomplishment, and continuing management attention)

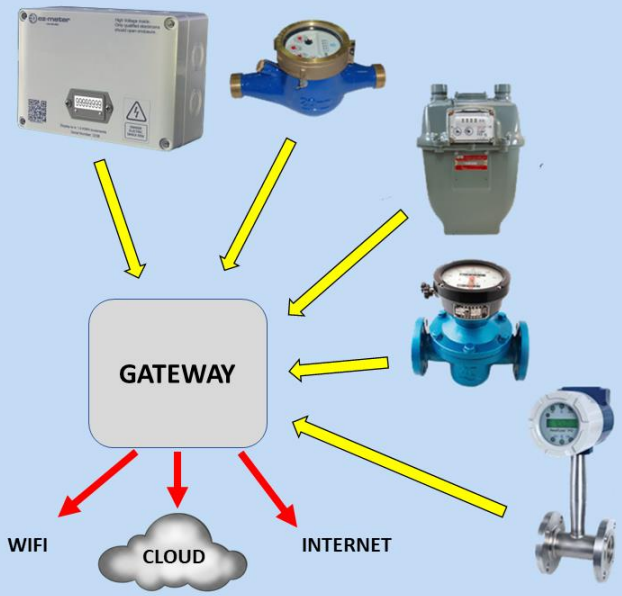
COMMUNICATION FLEXIBILITY

Submeter manufacturers make an abundant amount of communication paths available for their products. This will allow the users to choose the appropriate media for their application and interface requirements. Below are some of the communication options available from various manufacturers.

- •Power Line Carrier
- •Telephone Modem
- •Cellular Modem
- •RF (Radio Frequency)
- •Pulse Output
- •RS485
- •Ethernet
- •Lon “Free Topology”
- •IR Port

PROTOCOLS

While a number of submeters have proprietary protocols, they typically offer open protocols as well. These include Modbus, BACnet, and LonTalk, to name a few. This allows interfacing the metering into the Building Management System without need of converters or the cost of designing around a proprietary protocol. This also allows the users to choose the metering products that best suit their requirements. Some submeters allow the use of two different protocols simultaneously. This is valuable in segregating the control from the billing functions.



A Gateway is typically installed as the system foundation as it is utilized to collect pulses from meter types that are not powered – such as water, gas, steam, or oil meters. The data is stored in the Gateway and accessed through its media and protocol or placed in the cloud.

METERING MANDATES

With increased need for energy data, submetering is moving into the mandate category. In order to account for the types of electrical loads in a facility, ASHRAE and the California Energy Code both are calling for a breakdown (disaggregation) of the system loads in order to analyze the usage. With the flexibility of today's submeters, this task is much easier to be achieved.

Electric power monitoring and reporting (sub-metering). Section 8.4.3.1 is a new section of mandatory requirements for monitoring and reporting electrical data. Energy use of the following systems needs to be monitored separately: HVAC, interior and exterior lighting, and receptacles.

Important things to note:

- Up to 10 percent of the load for each of the subcategories may be miscategorized.
- Buildings with tenants must monitor each tenant area separately.
- Data must be recorded at least every 15 minutes, and reported hourly, daily, monthly, and annually.
- Maintain data for at least three years.
- Exceptions: buildings less than 25,000 ft^2, individual tenant spaces less than 10,000 ft^2, dwelling units, residential buildings with less than 10,000 ft^2 of common area, and critical and equipment branches of NEC Article 517.

ASHRAE

TABLE 130.5-B MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD

Load Type	Services rated 50 kVA or less	Services rated more than 50kVA and less than or equal to 250 kVA	Services rated more than 250 kVA and less than or equal to 1000kVA	Services rated more than 1000kVA
Lighting including exit and egress lighting and exterior lighting	Not required	All lighting in aggregate	All lighting disaggregated by floor, type or area	All lighting disaggregated by floor, type or area
HVAC systems and components including chillers, fans, heaters, furnaces, package units, cooling towers, and circulation pumps associated with HVAC	Not required	All HVAC in aggregate	All HVAC in aggregate and each HVAC load rated at least 50 kVA	All HVAC in aggregate and each HVAC load rated at least 50kVA
Domestic and service water system pumps and related systems and components	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Plug load including appliances rated less than 25 kVA	Not required	All plug load in aggregate Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area All groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf
Elevators, escalators, moving walks, and transit systems	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Other individual non-HVAC loads or appliances rated 25kVA or greater	Not required	All	Each	Each
Industrial and commercial load centers 25 kVA or greater including theatrical lighting installations and commercial kitchens	Not required	All	Each	Each
Renewable power source (net or total)	Each group	Each group	Each group	Each group
Loads associated with renewable power source	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Charging stations for electric vehicles	All loads in aggregate	All loads in aggregate	All loads in aggregate	All loads in aggregate

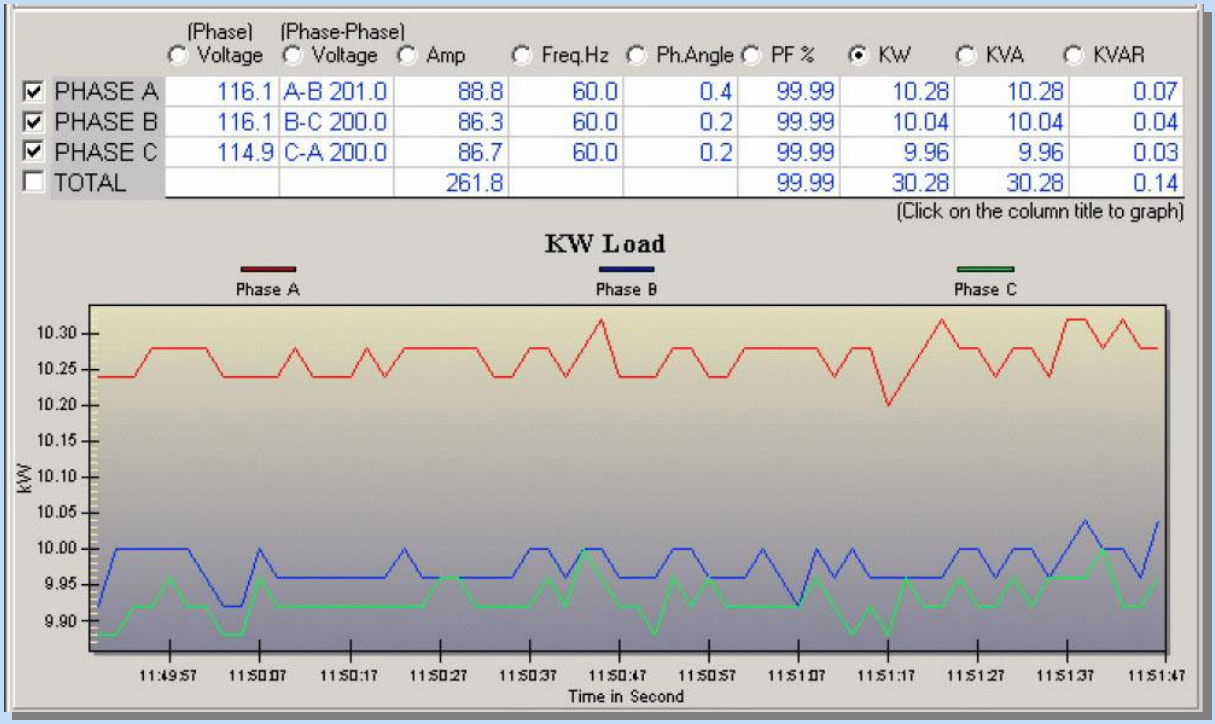
CALIFORNIA ENERGY CODE

Because of their flexible design, electric submeters can be utilized in multipurpose electrical panels to segregate the branch circuits by load types and therefore not require additional panels to be used in order to fulfill the mandated requirements. This greatly reduces the hardware and labor requirements, lowering installation costs.

ENHANCED ENERGY/UTILITY DATA

The utilization of submeters will provide enhanced data, not only in regard to electrical power, but also will expand the available information from other types of services. Where the serving Utilities provide billing on water and gas usage based on the total monthly consumption, this data is not valuable for analysis purposes. With the application of submeters, interval data as fine as 5 or 15 minutes (or less) is now available. This can now be broken down into time flow rates and load analysis, providing the user with actionable information -- such as possible equipment malfunction or failure in an automation system.

In the electrical metering component, data on volts, amps, kWh, kW, frequency, harmonics, Power Factor, kVa, kVAR, and more, will allow very detailed analysis of the energy usage and provide the foundation for quality decisions to be made that will lower usage and costs.



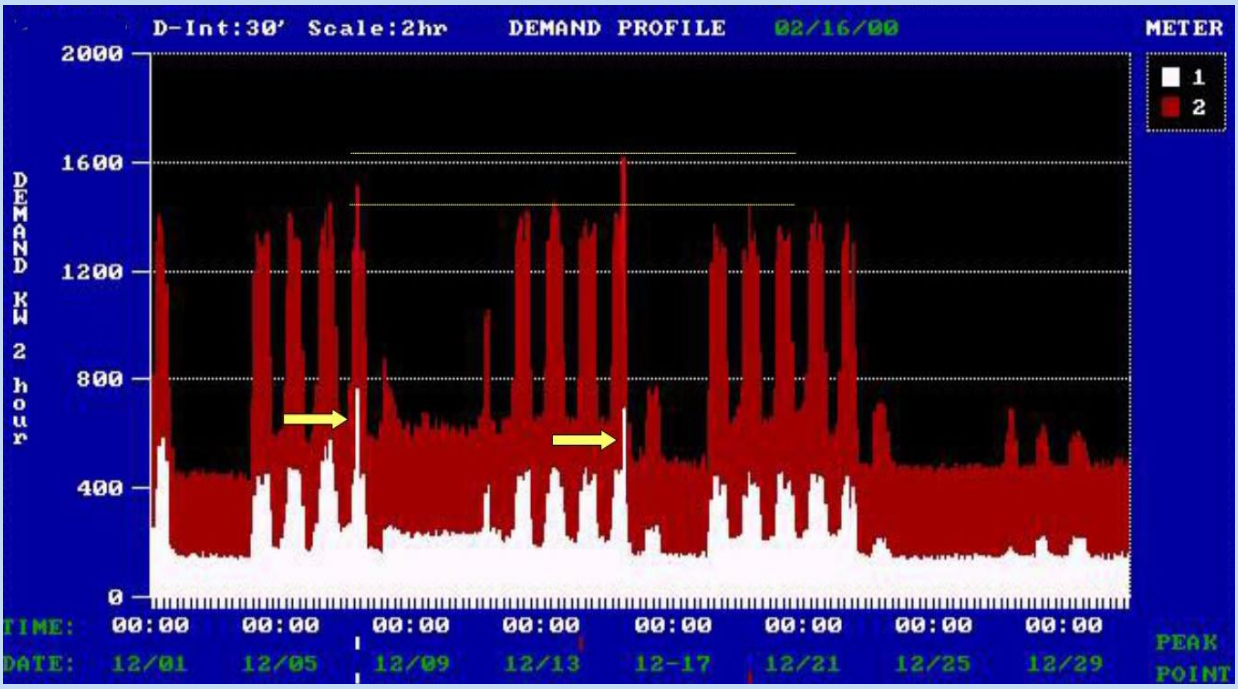
Enhanced electrical data can be utilized to determine possible maintenance issues -- in addition to finding ways to lower usage and costs. In many cases, data only on kW is insufficient to determine whether the system is overloaded – especially on loads with poor *Power Factor* where transformers can exceed their kVA rating.

ELECTRICAL DEMAND SAVINGS

Demand can be a major component of the electrical bill, especially in facilities where the load varies greatly. Demand is typically accounted for in 15 or 30 minute peak usage. Measured in kW (kilowatts) the demand cost can be over $20.00 with some commercial tariffs. Simply put, turning on ten 100 watt light bulbs can add $20.00 to the electric bill in only 15 minutes -- even though the actual consumption (kWh) was only around three cents during this period. Keeping the Demand peaks down can provide considerable savings each month. The use of submeters can determine when and where these costly peaks occur. Once the data is analyzed, the appropriate steps of load shifting or automated control can be put into play to reduce these costs.

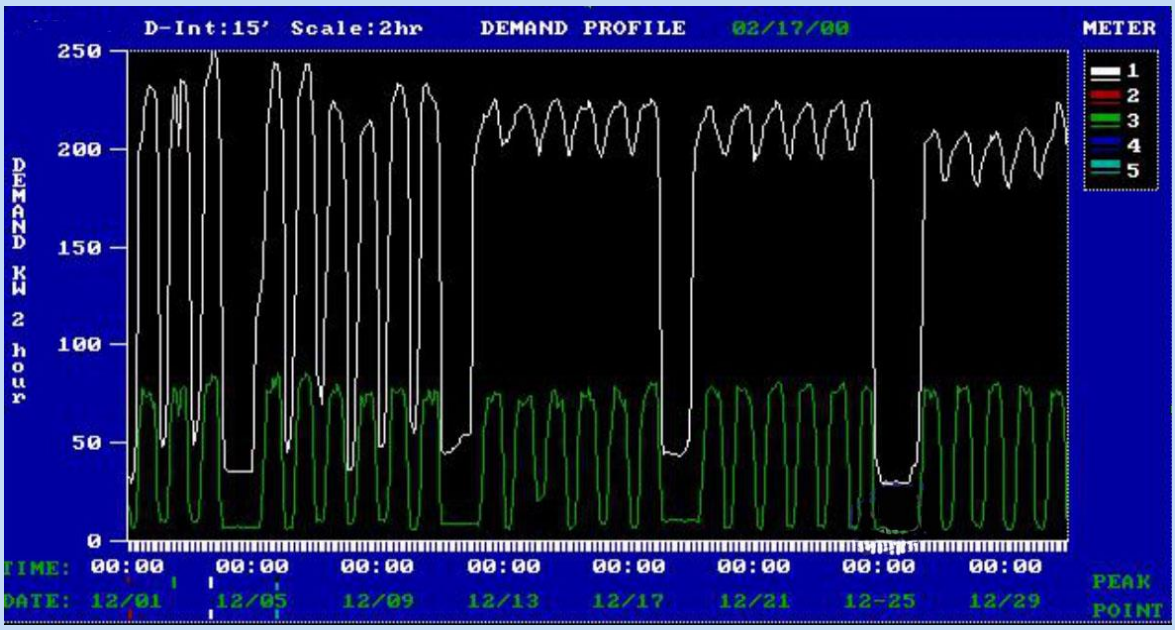
INDUSTRIAL DEMAND SAVINGS EXAMPLE

In the sample below, it was discovered, through submetering analysis, that the monthly demand cost was influenced by a 175 kW peak that occurred during a short daytime operation at the end of the work week. If you utilize a $20.00 demand cost, this adds $3500.00 to each month's bill. Moving that operation to a later shift -- or Saturday -- would save the company $42,000.00 per year.



COMMERCIAL ENERGY SAVINGS EXAMPLE

A load profile obtained from a submetering system in a commercial store showed the reason for a significant energy increase in the month of December. Failure in either the programming or a bypass being activated caused the lighting control system to *not* turn the store's lights off after normal retail hours. This works out to approximately 16,800 kWh in excess usage. At $0.08 per kWh the overage is around $1300.00

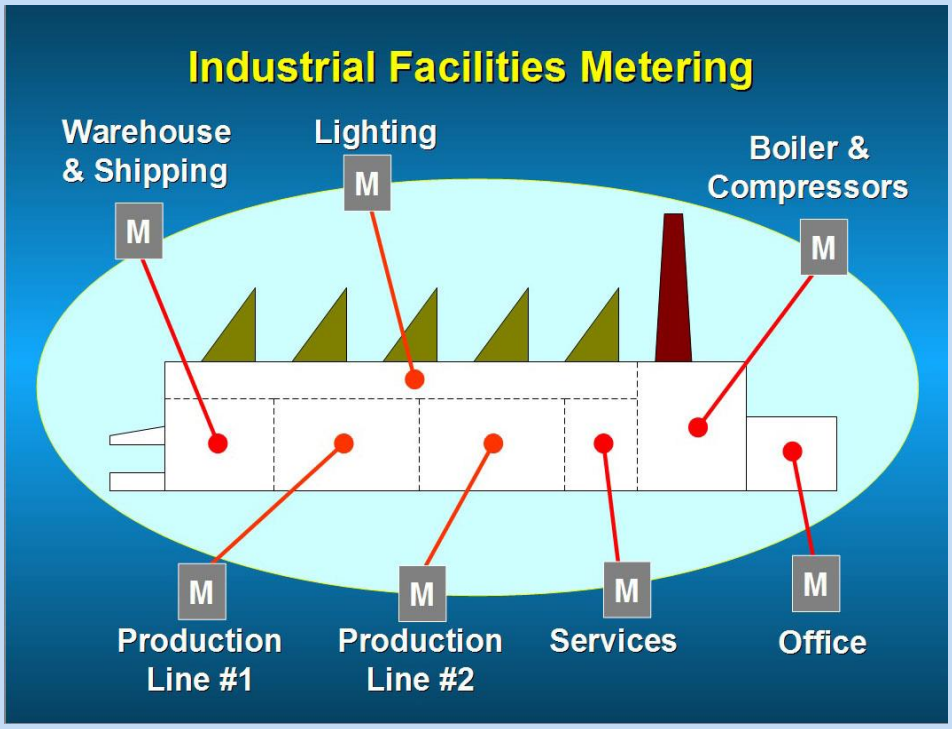


WATER SUBMETER SAVINGS

The installation of submetering for water consumption will also pay dividends to the user. Load profiling of water usage can provide data on when water is being consumed. This can be useful in determining if it is outside of the norm, such as a possible stuck toilet valve in the middle of the night – causing abnormal usage. Another valuable asset from water submetering is its installation on makeup water for chillers and fountains. Since this water is not passed through the sewer connections there would be no sewer charge associated with it. Submetering is the only accurate way to calculate the *deductible* amount for cost savings.

INDUSTRIAL SUBMETERING

Submeters are also valuable tools in the industrial environment. There are numerous departments in an industrial production facility that can be monitored for both accounting and savings. Accurate accounting can be useful in producing better budgeting steps for the next year. Savings can come from applying the data from the metering in order to formulate quality decisions such as shift changes or better control of idling equipment. The picture below lists some of the areas that can be monitored in industrial facilities.



All types of energy and utilities are open to be submetered in an industrial facility. This data can be used to provide an accurate per piece cost to manufacture a product.

SUBMETERS AND SALES TAX

A number of States have sales tax laws that exempt charging sales tax on energy used in the manufacturing of "tangible personal property". What this basically means is that is that the manufacturing of consumer goods -- items that are designed to be sold to consumers – can qualify as having reduced or no sales tax applied to that specific manufacturing energy usage. Submeters can be installed to accurately pinpoint the qualifying energy for use in sales tax reduction.

THE SWISS ARMY KNIFE

Today's submeters can be compared to the proverbial "Swiss Army Knife" in their flexibility and ability to do many tasks. By providing enhance electrical energy parameters, a single submeter can replace independent amp meters, volt meters, watt meters, VAR meters, power factor meters, and more. With the addition of pulse input capability, the submeter system can also provide data on all forms of energy and utilities used in the Commercial and Industrial environment. Through analysis and control, the meters provide the user with a firm foundation of energy and cost savings. Properly utilized, submetering can supply a substantially short ROI and then continue to provide dividends for years to come.

FINAL WORD

This presentation has only discussed a very few of the versatile applications of submetering. Hopefully, it has opened up some thought and provided a starting point to further enter into the numerous savings possibilities that these devices can provide to the user. The phrase "think outside the box" can very easily be applied to submetering and its application as an energy savings tool.