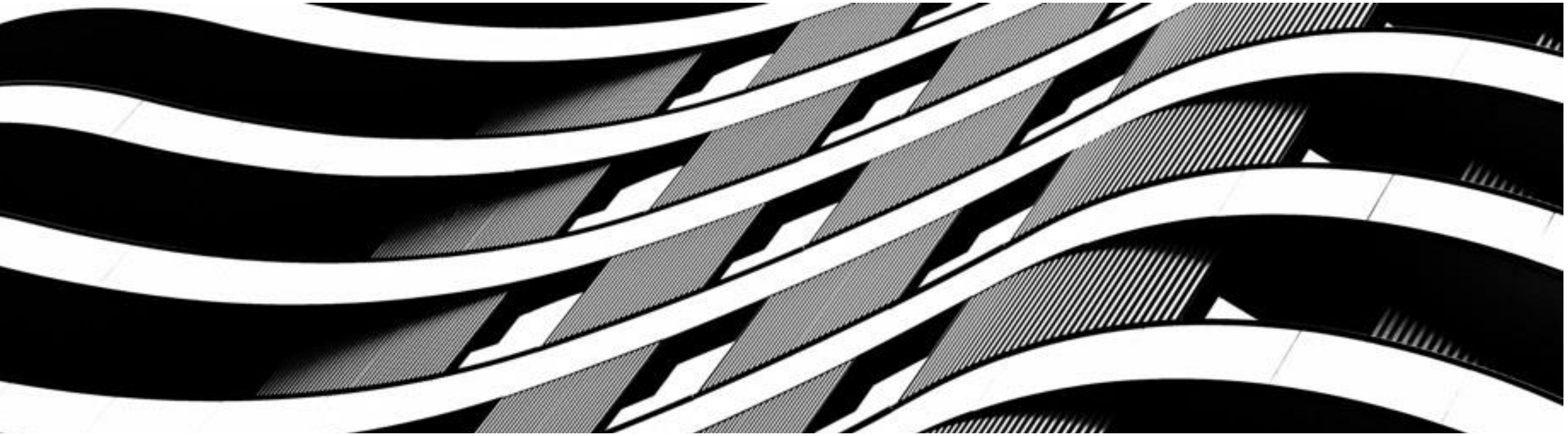

Submetering for Sustainable Intelligent Buildings in the IoT Age

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Submetering for Sustainable Intelligent Buildings in the IoT Age

Presented by: Triacta Power Solutions LP
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Description: Metering platforms are essential to understanding the use of energy within a building. Submetering is a vital part of sustainability programs and intelligent building design. This course discusses submetering and measurement and verification (M&V) technologies and products, and illustrates how they can be integrated into building management systems (BMS) to reduce energy consumption and overall operating costs.

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Purpose and Learning Objectives

Purpose: Metering platforms are essential to understanding the use of energy within a building. Submetering is a vital part of sustainability programs and intelligent building design. This course discusses submetering and measurement and verification (M&V) technologies and products, and illustrates how they can be integrated into building management systems (BMS) to reduce energy consumption and overall operating costs.

Learning Objectives:

At the end of this program, participants will be able to:

- explain how metering is a fundamental technology for building sustainability, and describe how measuring and monitoring electricity use provides environmental benefits and reduces the greenhouse gas (GHG) footprint of a building
- recognize the impact of changing regulations on electrical metering, and understand your role in complying with current and emerging energy measurement legislation
- discuss why resource consumption information should be made visible to a broad audience via web-centric management, and relay why this visibility cultivates ownership among all the stakeholders and promotes energy conservation through big data techniques and a thriving market of value-added applications, and
- describe the characteristics and performance functions of a modern multi-circuit meter, and detail how it integrates into and contributes to the Building Internet of Things (BIoT)—not only as a source of critical building resource data, but as an active component that helps make the BIoT vision happen.

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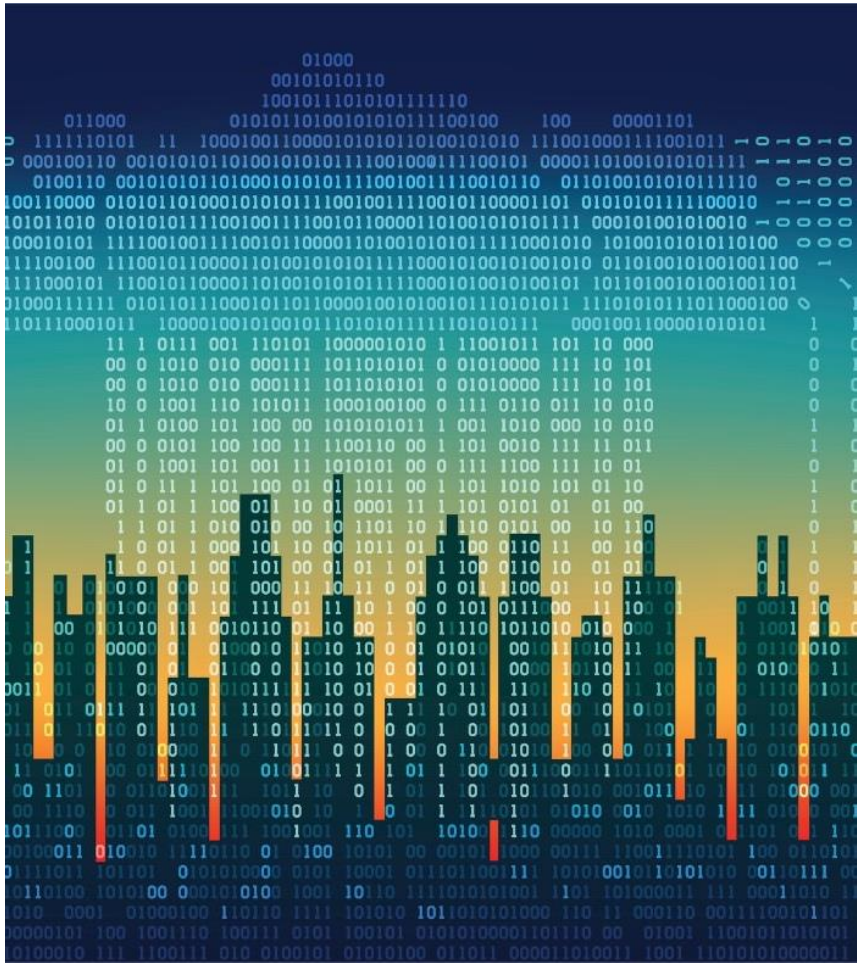


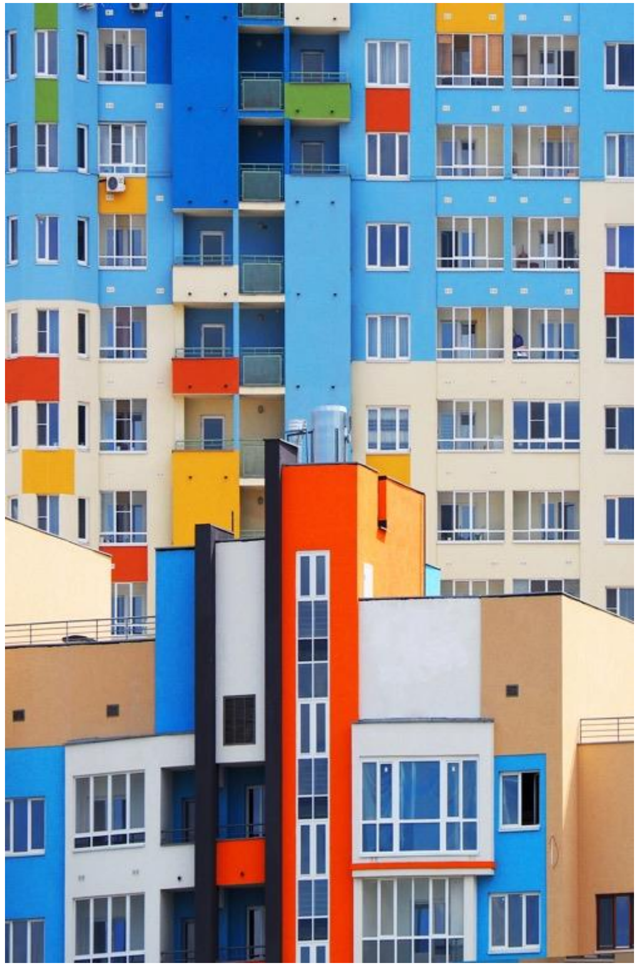
Measurement and Verification (M&V)

Buildings as Energy Drains

In the United States, buildings account for 39% of total energy use, 68% of total electricity, and 38% of carbon dioxide emissions annually.[1]

The global buildings sector consumes nearly 30% of total final energy used annually. [2]

Global energy efficiency measures could save an estimated 330 to 483 billion USD annually on energy spending (and the equivalent to almost double the annual electricity consumption of the United States).[3]



[1]"Importance of Green Building." *Green Built Alliance,* n.d. Accessed June 2018.

[2]Cao, Xiadong, et al. "Building Energy-Consumption Status Worldwide and the State-of-the-Art Technologies for Zero-Energy Buildings during the Past Decade." *Energy and Buildings*, vol. 128, 15 September 2016, pp. 198-213. Accessed June 2018.

[3]Molenbroek, Edith, et al. "Savings and Benefits of Global Regulations for Energy Efficient Products." European Commission, September 2015. Accessed June 2018.

Buildings as Energy Drains

Through the use of new materials and equipment, it is possible to reduce our energy consumption considerably.

However, there is “low-hanging fruit” for energy savings (and associated greenhouse gas reduction) available for existing and new buildings.

This is simply the instrumentation of buildings with submetering and energy management solutions to make all stakeholders aware of where and how energy is being used.

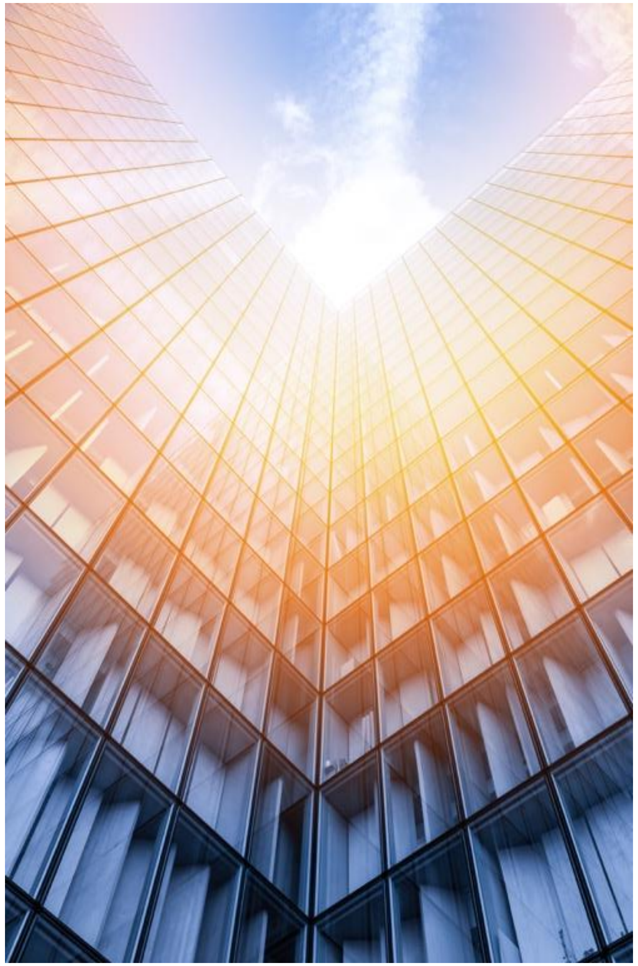
Conventional wisdom shows that actionable awareness can result in substantial energy reductions—up to 15%—even before any modifications are done to a building.

Metering Best Practices: A Guide to Achieving Utility Resource Efficiency. Release 2.0. U.S. Department of Energy, Federal Energy Management Program, August 2011. Accessed June 2018.

What Is Measurement and Verification?

The building industry has recognized the value of building practices that promote green buildings and reduce environmental impact. In fact, such buildings are proven to be attractive to tenants, and ultimately less costly to operate. To give stakeholders a toolset they can use to make informed decisions, multiple green indexes have been developed to score buildings for comparison's sake.

Two of the primary indexes are the LEED® (Leadership in Energy and Environmental Design) green building certification program, developed by the U.S. Green Building Council (USGBC), and the ENERGY STAR ® program, a partnership between the U.S. Environmental Protection Agency (EPA) and businesses and organizations.



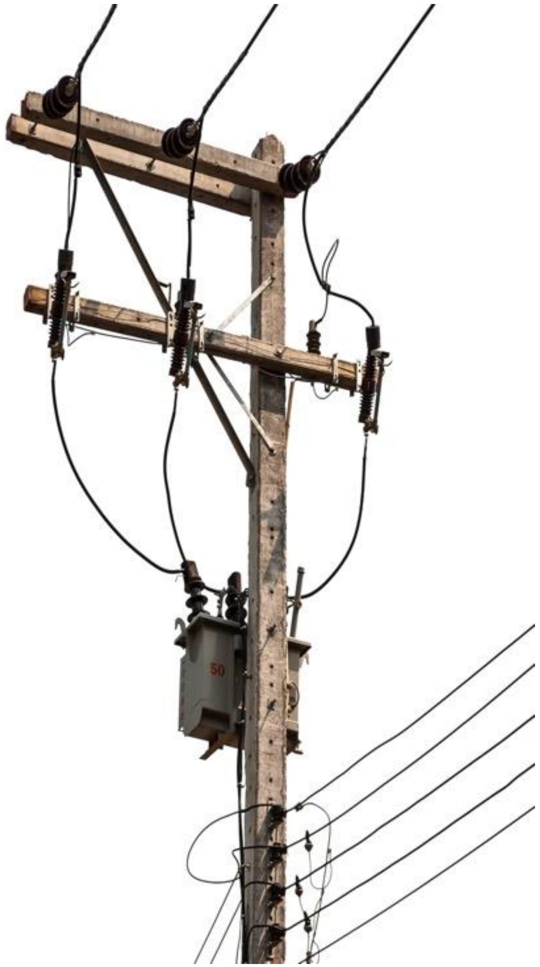
Why Do We Need Measurement and Verification?

In all buildings, one of the fundamental costs, both financially and in terms of environmental damage due to greenhouse gases, is electricity.

USGBC has recognized the fundamental requirement for the measurement of electricity and other resources under its LEED Energy & Atmosphere (EA) category by increasing the allotment of points awarded to implementing a measurement and verification system.

To gauge progress against energy efficiency goals, baseline values and ongoing measurement are required.

It is worth noting that people do not typically take notice of many things until they are accountable for their cost. In multi-tenant/stakeholder buildings, to allocate costs fairly, measurement must take place.



Metering vs. Monitoring

Electricity can be monitored, metered, or metered and monitored at the same time.

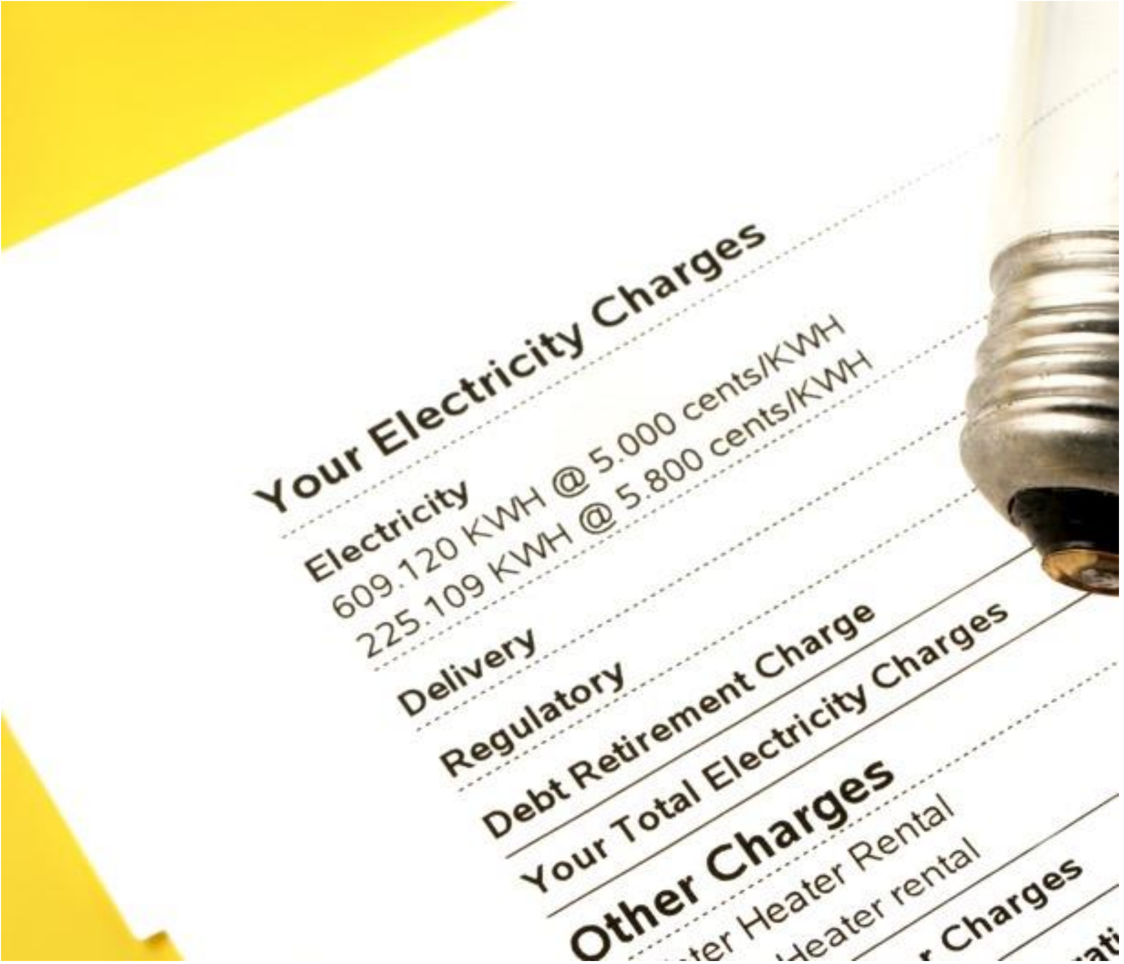
Monitoring is the act of measuring electricity use without charging the user for that use. Actions are taken based on observations of electricity consumption and demand—but third-party tenants are not invoiced.

Using monitoring at critical points in a building infrastructure is extremely useful in informing stakeholders of electricity use for the purposes of energy reduction.

Metering vs. Monitoring

Metering is the act of measuring electricity use for the purposes of charging stakeholders. Monitoring equipment (monitors) can typically be less accurate than metering equipment (meters). Meters are usually regulated by national bodies of standards and measures because they are an essential part of trade.

Metering may also be required for compliance with regulations other than billing. This is a trend. For example, CDFA (California Department of Food and Agriculture) Title 24 is a California Energy Commission mandate that adopts and implements energy efficiency standards for both residential and nonresidential buildings.



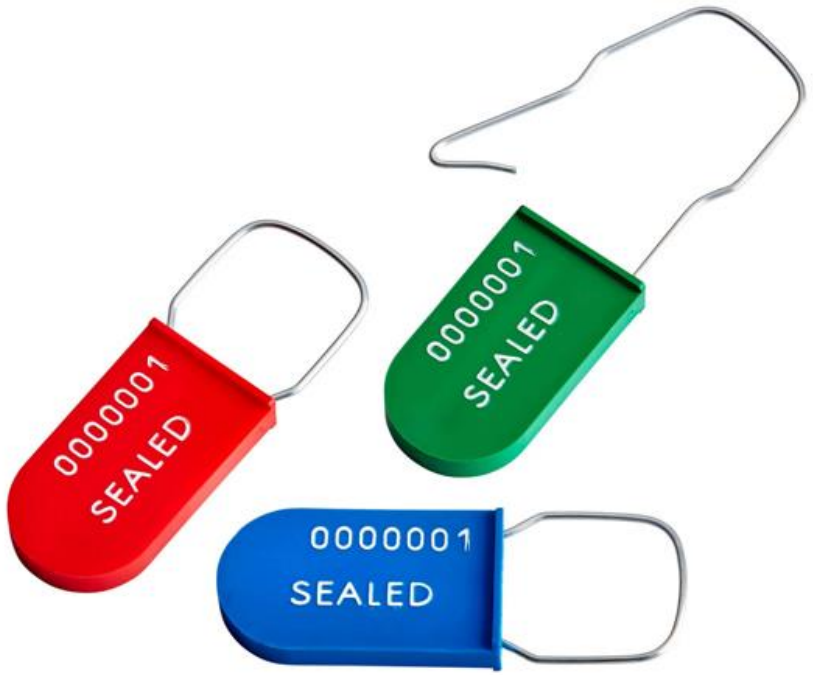
Metering vs. Monitoring

Monitoring accuracy can be as loose as +/-3% but is more typically 1%.

Metering accuracy in many jurisdictions is as tight as 0.5% (ANSI C12.20 Class 0.5, American National Standard for Electricity Meters), and the meters must be sealed by accredited entities (meter shops).

The function performed by monitors can equally be performed by meters.

In many cases, the difference between a monitor and a meter is accuracy, calibration, reliability, the current transformer (CT) used, the act of sealing, and any mechanical requirements that sealing may demand.



Metering Regulations and Building Specifications

A meter is an instrument of weights and measures upon which financial transactions turn. Like a cash register, it needs to be accurate, traceable, and tamper-resistant/evident. As building performance becomes more critical, performance reporting becomes more regulated, and the information used to assess compliance with regulations requires appropriately certified meters.

In jurisdictions where regulations are first being introduced, requirements may be lenient. However, it's better to plan for strict requirements rather than have to retroactively adjust a building's infrastructure to comply later. By using capable equipment, a building is future-proofed at little incremental cost.

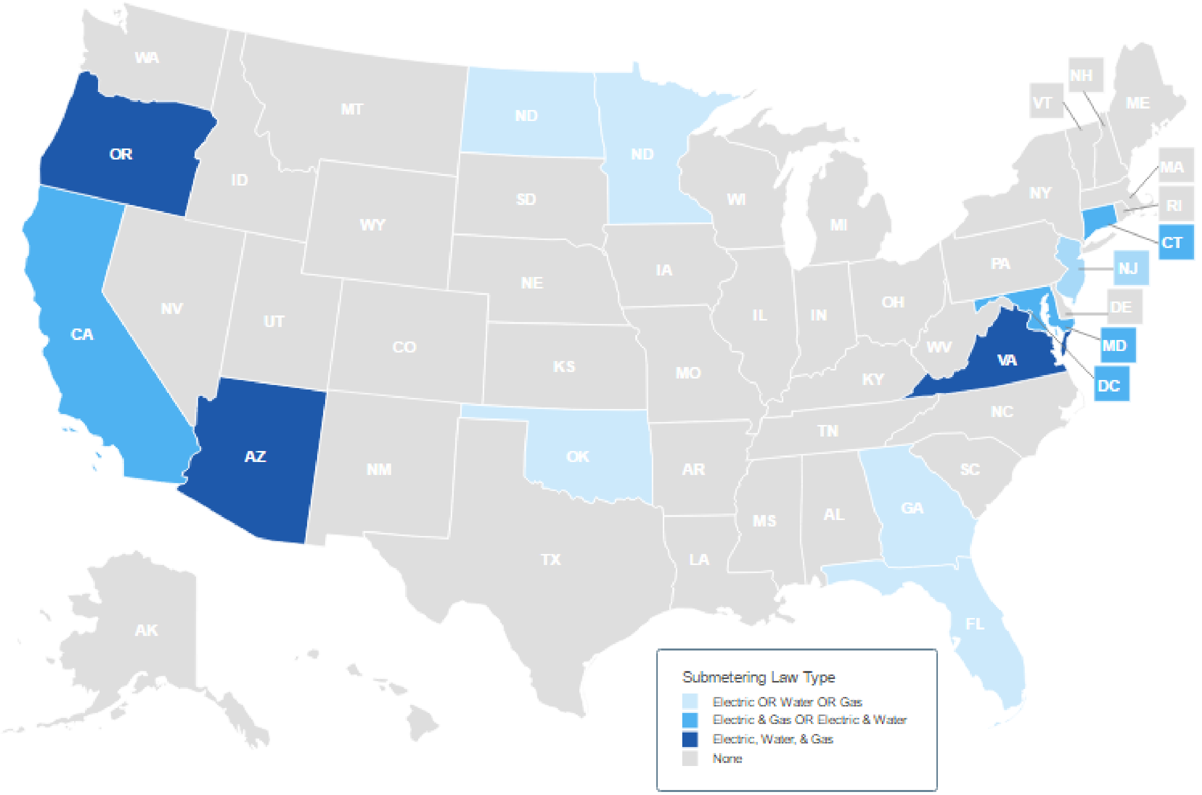
NEMA (National Electrical Manufacturers Association) has formed a submetering group to assist jurisdictions with the introduction of metering regulations.

Submeter Nation

There is a growing wave of regulation throughout the United States focused on the metering of electrical consumption. One after another, cities and states are establishing ever-tightening directives in an effort to reduce energy use and align electricity payment with consumption.

Regulatory bodies are using the tried and tested ANSI C12.20 0.5 accuracy class as the standard meters must meet, and requiring third-party laboratory certification to prove that they do.

These new standards are justified, but they significantly raise the ante for meter vendors.



Source: "Submetering Laws and Regulations: Aquicore's Interactive Map Guides Commercial and Real Estate Professionals to the Latest Information in Every State." *Better Buildings Solution Center*. U.S. Department of Energy, n.d. Accessed June 2018.

The Residential Building Market

Residential buildings are typically made up of tenant suites and common areas. Meters must be used if tenants are to be billed for their electricity use. If meters are owned by the local distribution company versus the building owner, the term used is suite metering. If the building owner pays for electricity on behalf of the tenants and meters their suites and bills them accordingly, this is called submetering.

The same equipment can be used for both cases, and that equipment is usually termed a submeter, in either case. Residential M&V often stops at the suites and common areas, rather than focusing on various building systems, but going the extra mile has positive ramifications for lowering the costs of maintenance, and looking for better green index scoring.




The Commercial Building Market

The commercial market consists of almost all other buildings: industrial, office buildings, data centers, retail, and institutional. The main focus in this market is monitoring to improve performance, but as mentioned earlier, metering at a tenant level in commercial buildings has the benefit of allocating costs fairly and focusing the attention of the stakeholders on costs.

Monitoring is typically applied at the level of building systems such as: HVAC (heating, ventilation, and air conditioning), lighting, elevators, motors, pumps, and other large loads and building sections.




New Builds and Retrofits

New buildings are relatively straightforward when specifying a comprehensive metering strategy—at least from the application of a meter to particular points in the electrical system. However, given the dynamic nature of building management, the networking strategy and the information strategy of a building must be given considerable attention upfront.

Conversely, information and networking strategies in retrofit situations are usually a high priority and relevant to the building's current use. The planning and deployment of a metering/monitoring fabric is much harder, due to the challenge of legacy building design and use scenarios.

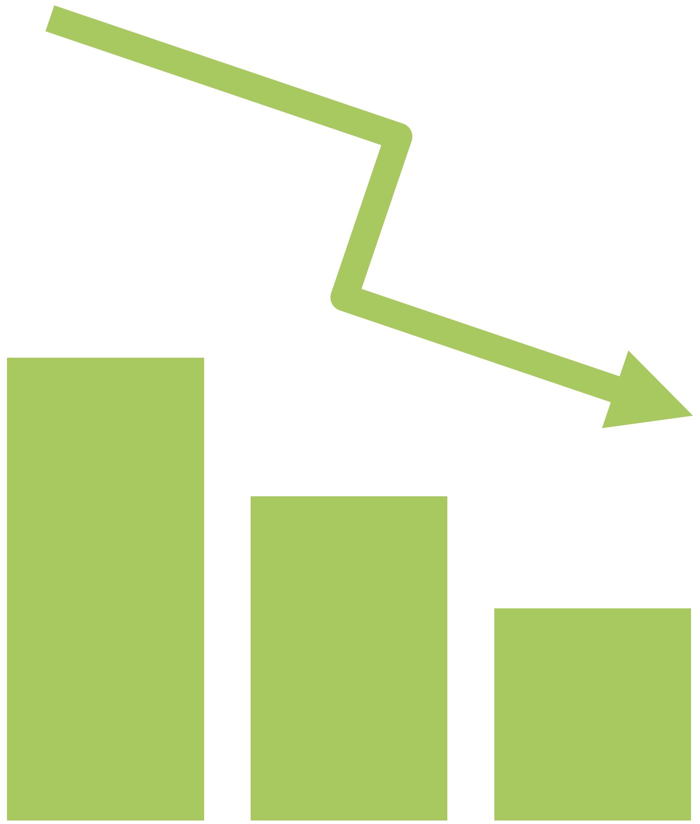
Goals of Measurement and Verification

Goal 1: Energy Savings

Lowering electricity consumption and demand is a direct indication of improved sustainability. Everybody benefits by lowered costs, immediately.

It’s easier to create “negawatts” (reduce consumption) than it is to build power supply. Negawatts are such a big opportunity to lower electricity demand and consumption because current building operations, in the absence of any well-orchestrated conservation program, are incredibly wasteful.

Granular M&V is an effective tool in reducing energy consumption, but it must be coupled with a managed program.



Goal 2: Building Improvements

Simple operations and maintenance improvements can increase energy savings for a building by up to 15% by:

- detecting failing equipment
- finding opportunities for load shifting
- shedding light on poor building processes and procedures
- identifying inappropriate building automation programming, and
- revealing inappropriate building commissioning.

Goal 3: Cost Allocation

Being able to allocate energy costs down to a department or a tenant is a big step. The Federal Energy Management Program (FEMP) estimates that engaging stakeholders by allocating bills to specific accounts will reduce energy consumption by up to 5%.

This measure does not include providing visibility of how energy is consumed, just the simple act of allocating bills.

Combining allocating bills with energy use visibility turbocharges the measure.

Goal 4: Reduced GHG Footprint

Greenhouse gas management (commonly identified with carbon credits or carbon taxes) has the triple upside of:

- managing energy costs
- complying with government regulations, and
- qualifying for credits or reducing tax burdens while promoting to customers and investors the socially responsive pedigree of a company.

GHG credits (or carbon credits) are often associated with electricity:

- GHG reduction = electricity reduction x carbon content of electricity
- GHG credits are attributed for direct actions taken
- A baseline is required
- Certified measurement is required

Subjects of Measurement and Verification

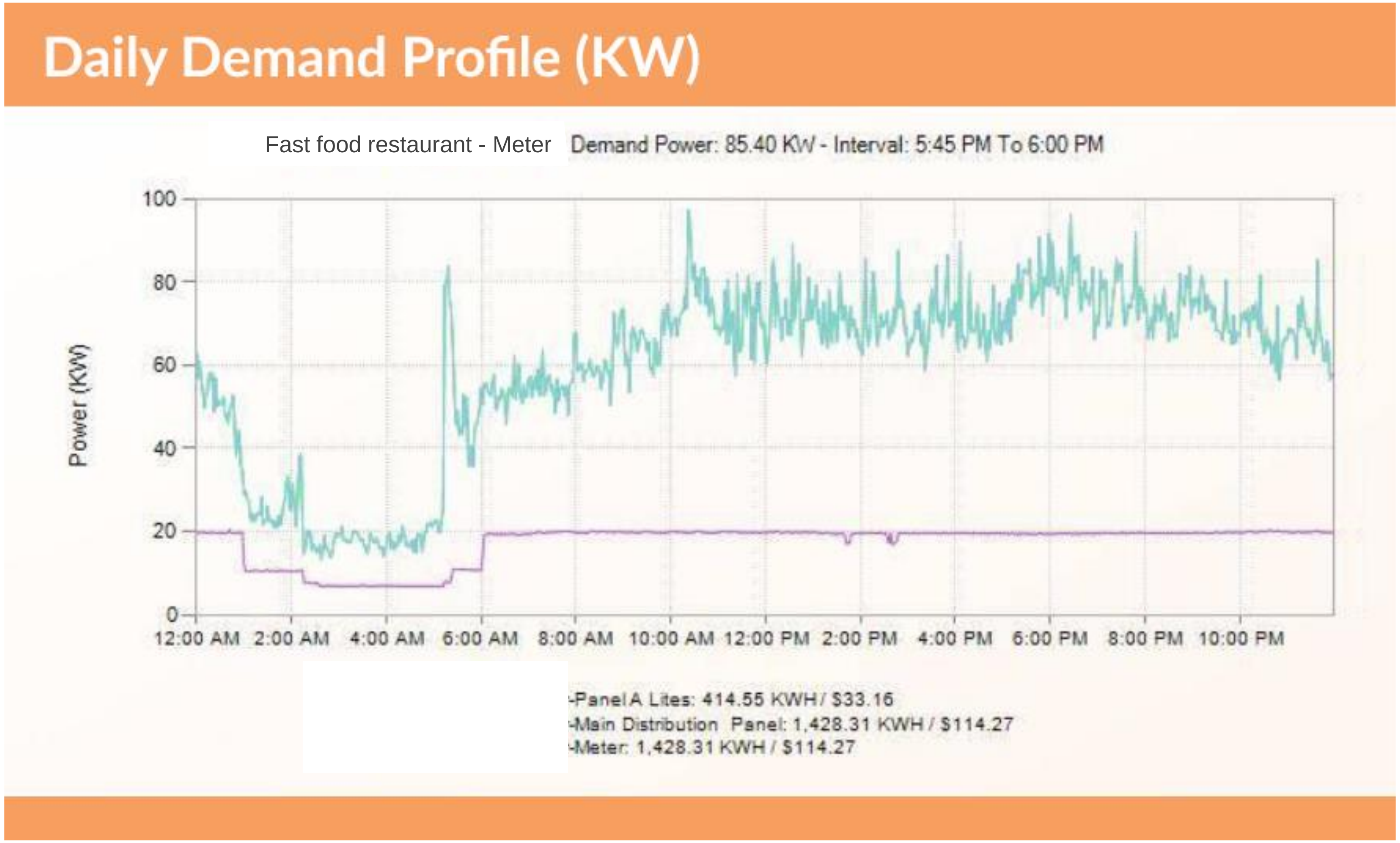
Demand Reduction

Negawatts (demand reduction) is much more cost-effective than creating new generation to meet demand. Granular measurement and verification is an effective tool in reducing energy consumption, but it must be coupled with a managed program.

Granular measurement means measuring energy use at as many points as possible in a building vs. measuring only at the bulk bill level. The higher the coverage, the better the visibility of what may be going wrong or what might be changed—from faulty equipment to inefficient building processes, forgotten loads to wasteful practices.

Example: Lights Left On

When outdoor lighting is not controlled by a timer, its on/off times are subject to human error. If the outdoor lights are on all day, the total load is increased by 10 kW x $11.53/kW. The extra kWh required to run the outdoor lights is $11.00 per day. Lighting control errors may happen five to ten times per month.



Optimized Time-of-Use

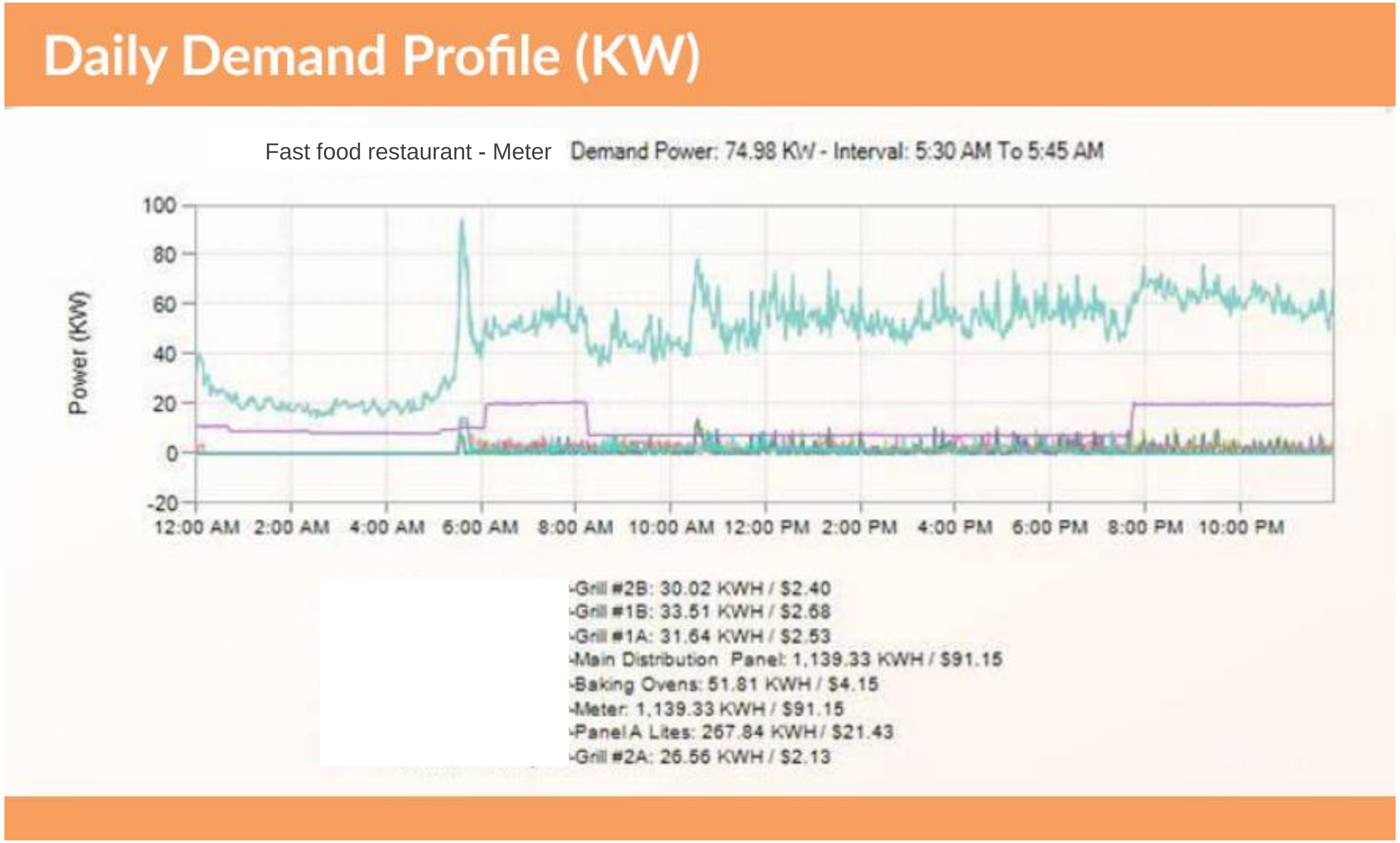
The electrical grid needs to supply capacity to meet all demand put on it. This demand varies during the day, but the grid must be built to supply to the peak demands, since peak periods can have much greater demands than other times.

To discourage power consumption at peak periods, utility electricity rates are higher during these times. Building operations cannot be aligned with these pricing periods to take advantage of lower rates unless they are monitored as part of a comprehensive metering plan and then analyzed against the commissioning requirements of the building.

Example: Process Control

This graph illustrates how the building start-up sequence also determines billable demand charge. Four grill circuits and the ovens combine to produce the spike in demand at 5:30 a.m. Software tools were used to simulate corrective action.

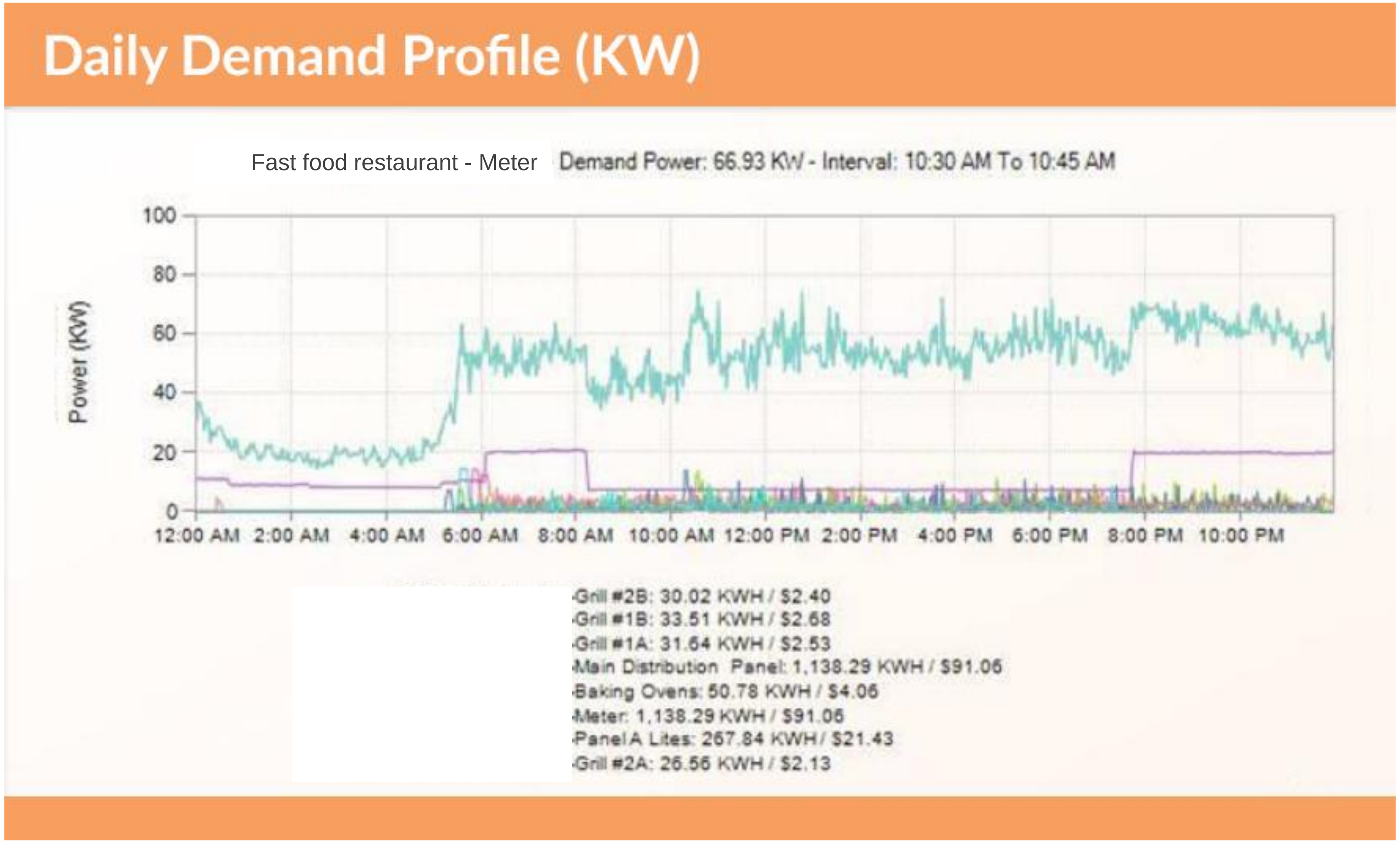
The solution: stagger the start-up of the grills and ovens to smooth out the demand curve—with big savings.



Example: Process Control

Staggering the start-up of the kitchen equipment reduces the billable demand by an additional 8.5 kW. No reduction in usage is required, just process control.

The change produced a total demand reduction of 18.5 kW x $11.53 = $214.00/month.



Failing Equipment

Motor-based electrical loads run less efficiently before they fail. This can only be seen by instrumenting the load.

Understanding motor efficiency losses matters because less efficient units lead to much higher operating costs over the life of the equipment—a large power sink in many commercial and residential buildings.

Example: HVAC and Rooftop Units (RTUs)

HVAC systems account for 22% of energy consumption.

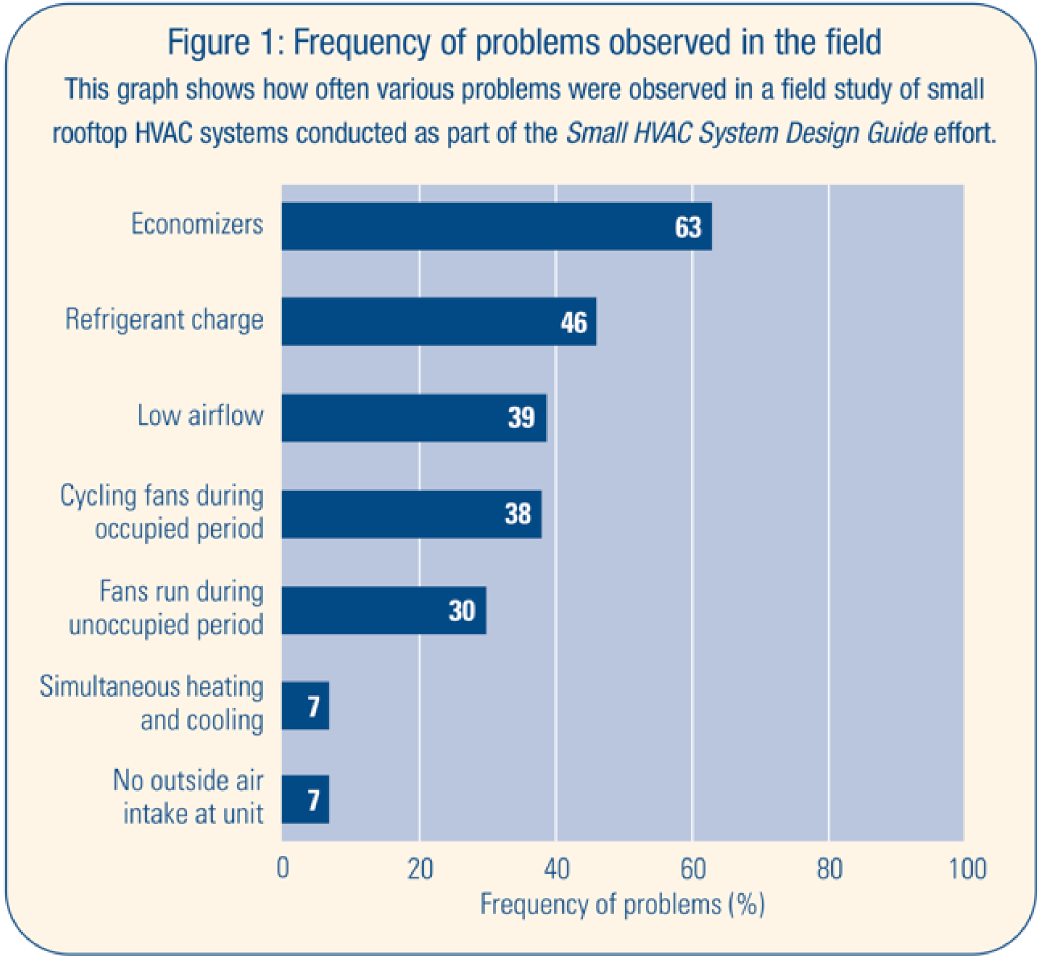
Inefficient HVAC systems require 25–35% more energy.

Savings opportunity:

- Keep HVAC systems running properly.
- Monitor electrical consumption per unit.
- Identify units not operating properly.

Savings gained are between 6.25% and 8.75% of all electricity costs.

“Design Guide: Big Savings on Small HVAC Systems.” Technical Brief. Public Interest Energy Research Program, 2005. Accessed June 2018.



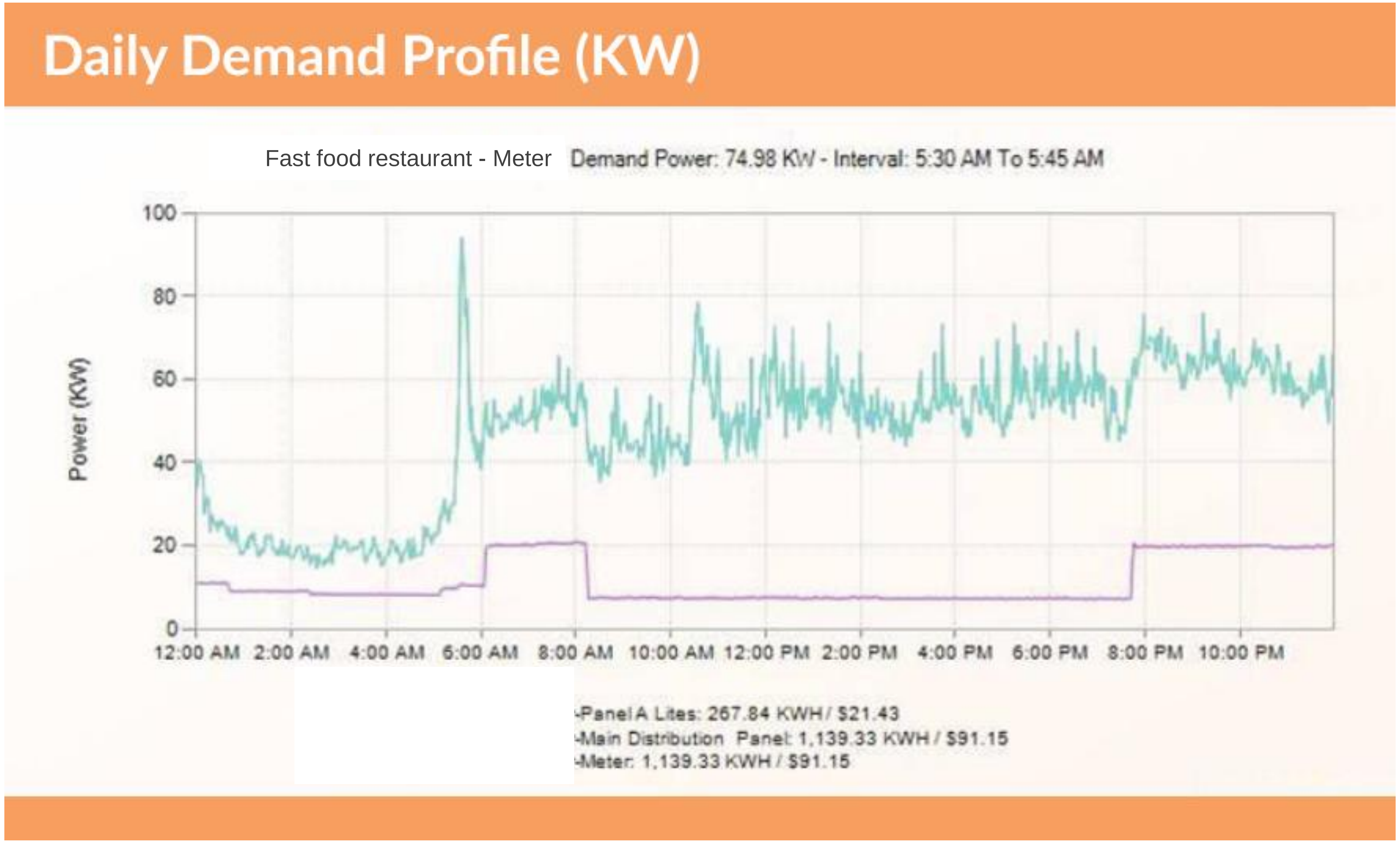
Forgotten Loads

In every building, systems that do not need to be on/powered up are left on.

Whether it's lighting left on after it's needed or air conditioning or heating units being used when it's not necessary, these forgotten loads can add significantly to overall energy use and peak costs.

Example: Forgotten Loads

This graph shows the normal pattern for the indoor and outdoor light load; we know they turn the outdoor lights and signs on in the morning for a couple of hours and then again at dusk. 75 kW is the typical demand charge for this time of year.

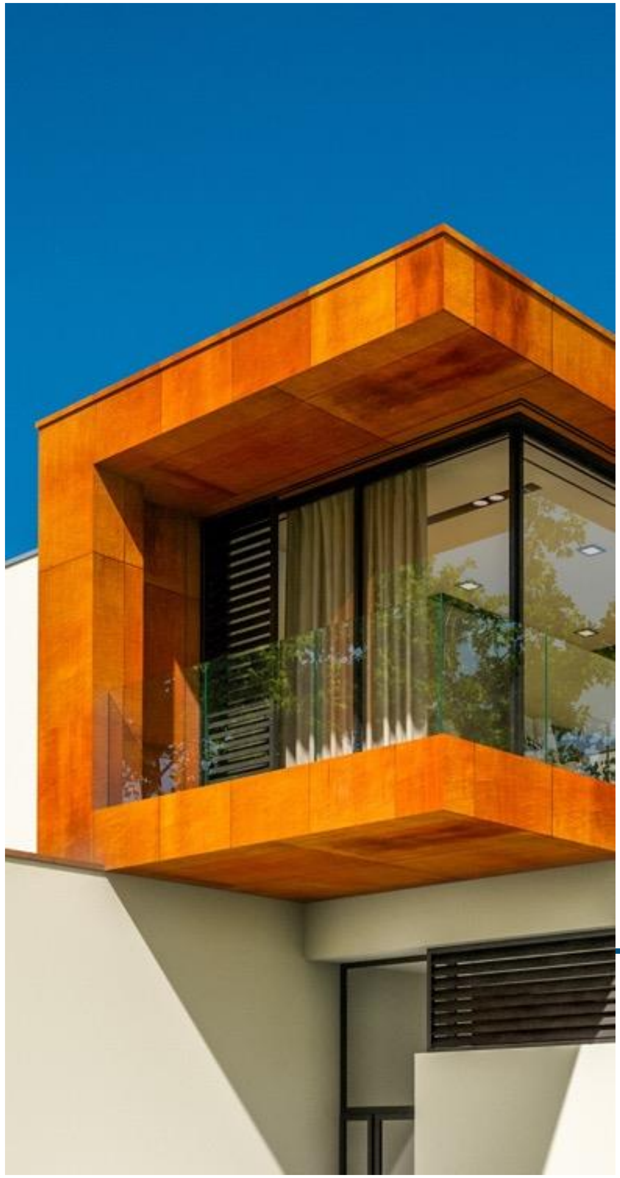


Attribute Usage

Understanding the costs associated with each building component is key to effective property management.

When utility costs are properly attributed, steps can be taken to decrease costs either through energy efficiency programs or decreased usage. Costs can also be passed on to tenants or departments, thus providing incentive for further energy reduction.

By allocating bills to specific accounts, FEMP estimates up to a 5% savings in energy consumption.



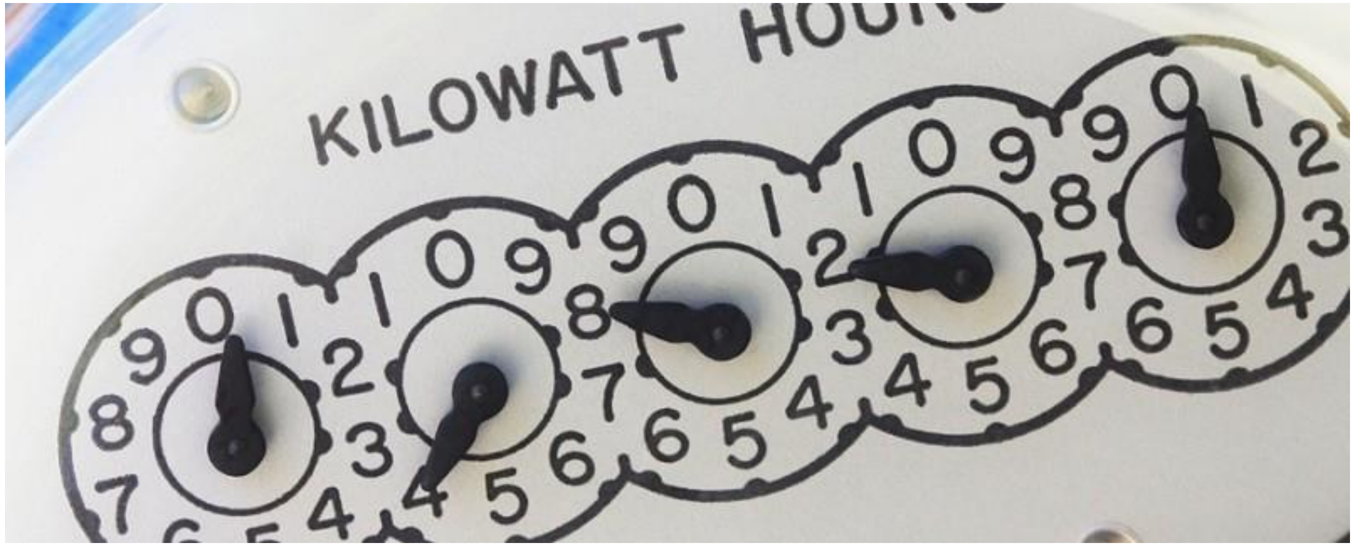
Submetering for Sustainability

What Is Submetering?

In addition to the main load meter used by utilities to monitor overall building consumption, submetering utilizes individual submeters that allow visibility into energy use at the tenant and individual equipment level, creating opportunities for both energy and capital expenditure savings.

Submeters are divided into two main groups:

- single-circuit or single-point meters (SPM)
- multi-circuit or multi-point meters (MPM)



Single-Point Meters

Single-point meters allow metering of one single- or three-phase electrical circuit, and are very useful for measuring specific points of interest in a building. They are also a viable option when the desired meter load is not local to a panel but is significant to the overall building usage.

Typically, single-point meters have higher per meter point deployment, integration, and maintenance costs than multi-point meters.

Commercial markets have not traditionally worried about billing; therefore, single-point meters are usually designed at monitoring accuracy (<1%). This is looser than the 0.5% accuracy normally required of revenue-grade meters.

Multi-Point Meters

Multi-point meters allow for the metering of six or more circuits depending on the model and need.

They are useful when measuring a large concentration of circuits and a viable option for multi-load, granular data requirements.

Multi-point meters have a much smaller footprint than multiple single-point meters, and lower per meter point deployment, integration, and maintenance costs than single-point meters.

The Role of Current Transformers (CTs)

Current transformers (CTs) are an essential part of an electrical meter, acting as a current sensor that can then be used to extrapolate power consumption. The type of transformer used is important as it is a trade-off between flexibility, cost, and accuracy.

Solid core CTs (typically 100 mA or 5A) are more compact and accurate. Their disadvantage is that the electrical service must be disconnected from the breaker for them to be connected. Revenue-grade meters usually require solid core CTs.

Split core CTs usually have a 333 mV output. They are less accurate but can be clamped onto an electrical service via a detachable side—avoiding having to disconnect the service from the panel. The downside is they are more expensive and bulky.

Solid core CT

Split core CT

The Evolution of Multi-Point Meters

Electrical metering in multi-tenant residential and commercial buildings has evolved significantly over the past 40 years. Initially the purview of single-point analog meters, high-density buildings typically saw multiple single-point meters grouped together in significantly sized cabinets where they were manually read by utility personnel. Approximately 30 years ago, systems that grouped multiple meter points into a single unit began to emerge.

One multi-point meter replaces multiple single-point meters.

First-Generation Multi-Point Meters

The goal was a smaller footprint in the building, but a secondary benefit was that digital interfaces became a necessity, thereby enabling collection of data from all meters in a building via one central collector local to the building. These were designed to be stand-alone systems, so proprietary protocols were acceptable.

From these humble space-saving beginnings, new generations of multi-point electrical meters have risen in profile and are now accepted as cornerstone devices for modern building information management and cost-reduction programs.

First-generation multi-point meters: local, proprietary

Second-Generation Multi-Point Meters

Generation 1 multi-point meters were the norm for more than a decade until a newer class of meter was introduced, equipped with a new type of interface: ethernet. Using open Internet Protocols (IP), these meters pushed their information to a centralized collector, which could be on premise, but more likely would be off-premise in the cloud.

This new generation of multi-point meter was suitable for integration with both building automation systems (through MODBUS TCP/IP) and energy management systems through IP.

Second-generation multi-point meters: web-centric, open systems

Second-Generation Multi-Point Meters

In addition to measuring electrical current, some second generation multi-point meters added pulse inputs that could collect information from external meters, such as water or gas meters. The later stage second generation multi-point meters added BACnet (communications protocol for building automation and control networks) compatibility. We will discuss BACnet in more detail further in the course.

This addition lay the groundwork for expanding the role of the electrical multi-point meter from simple electrical measurement to building systems information management.

Later stage second-generation multi-point meter with added BACnet compatibility

Third-Generation Multi-Point Meters

The emergence of generation 3 multi-point meters around 2014 is coincident with the rise of more billing regulations, and a growing desire to use submetering as an energy management tool.

Entries from various companies are characterized by a higher number of CT inputs, increased pulse input capacity, and the incorporation of more stringent meter security and accuracy features.

Generation 3 meters have not evolved greatly in terms of communications capabilities and increased functionality. The prevailing paradigm is still a meter that is a slave to a building automation style collector (connected via MODBUS TCP/IP or BACnet IP, or serial busses).

Third-generation multi-point meters: more inputs, more regulation

Fourth-Generation Multi-Point Meters

The evolution from generation 3 to generation 4 meters will primarily be in the information networking nature of the device—evolving with the move to a more cloud-based emphasis for building management.

Improvements in network interface capabilities (such as application programming interfaces (API) and interaction and tagging or object modelling for big data), will favor a flattening of the traditional building IT architecture.

In addition, added embedded computing will unlock more functionality in a fourth-generation meter, enabling it to take advantage of its reserved footprint in a building’s electrical closet and pave the way to play a critical role in the emerging Building Internet of Things (BIoT), where components of a building (heating, HVAC, security, communications, etc.) are connected to the Internet to create operational efficiencies, achieve energy management goals, improve building security, and much more.

Fourth-generation multi-point meters: advanced networking, built-in logic, web-centric services

Measurement and Verification Strategies

Measurement and Verification: A No-Brainer

According to the U.S. Federal Energy Management Program, businesses without proactive energy management programs are spending 10% to 45% more on energy per year than they need to be.[1]

With energy expenditures accounting for a significant portion of a business's annual operating costs, the upfront savings alone make pursuing an energy management program a no-brainer.

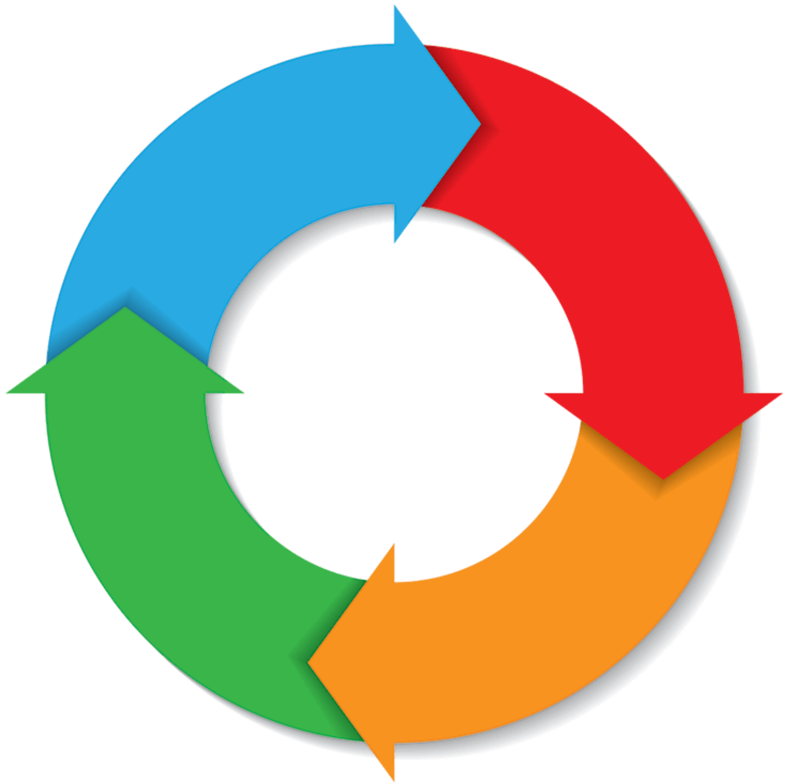
From a risk mitigation perspective, the movement towards real-time, time-of-use pricing and the potential for much greater energy costs in the near future demand action.

[1]*Metering Best Practices: A Guide to Achieving Utility Resource Efficiency.* Release 2.0. U.S. Department of Energy, Federal Energy Management Program, August 2011. Accessed June 2018.

A Four-Step Energy Management Program

Energy management is a simple process that, once implemented, quickly gains its own momentum from the inevitable cost savings realized.

1. Measure energy use (meter)
2. Fix the basics
3. Monitor and improve
4. Continuous commissioning



Step One: Measure Energy Use

The old adage “you can’t fix what you don’t measure” holds true for energy usage. Without a clear understanding of where energy consumption is taking place, it’s impossible to manage it.

However, once identified, areas of consumption can be investigated to uncover opportunities for savings. Often those opportunities amount to simple equipment fixes or changes in process that can have a large impact on energy conservation, which in turn makes a huge difference to an organization’s bottom line.

Step One: Measure Energy Use

Measuring energy use is a simple process with today's readily available smart metering products. IP-based metering systems can be easily plugged into new or existing buildings' electrical infrastructure with no rewiring costs.

And once installed, energy consumption information can be transmitted over existing wireless, phone, or high-speed Internet connections—keeping building owners and property managers up-to-date with the latest energy consumption data at their fingertips.

Step Two: Fix the Basics

Often the most costly wastes of energy are the easiest ones to identify once a metering infrastructure is in place.

A metering system allows building managers to identify energy use by equipment and/or building area over time.

With such a system installed, it's easy to see where energy resources are being consumed.

- ✓ Improperly programmed building automation (lights, HVAC)
- ✓ Forgotten equipment loads
- ✓ Lighting systems not needed
- ✓ Poor work processes
- ✓ Non staggered AC motors
- ✓ Failing AC motors
- ✓ Failing HVAC equipment
- ✓ Time-of-use for heavy loads
- ✓ Opportunities to sequence loads

Step Three: Monitor and Improve

It is clear that one-time process and equipment fixes alone are not enough to sustain energy cost savings over time. Without continuous monitoring, short-term gains are quickly lost.

According to an industry leader, the lack of regular monitoring and maintenance of identified energy savings opportunities causes companies to lose ground at a rate of up to 8% per year in energy consumption. That number increases to 12% when regulation and control systems are not put in place.

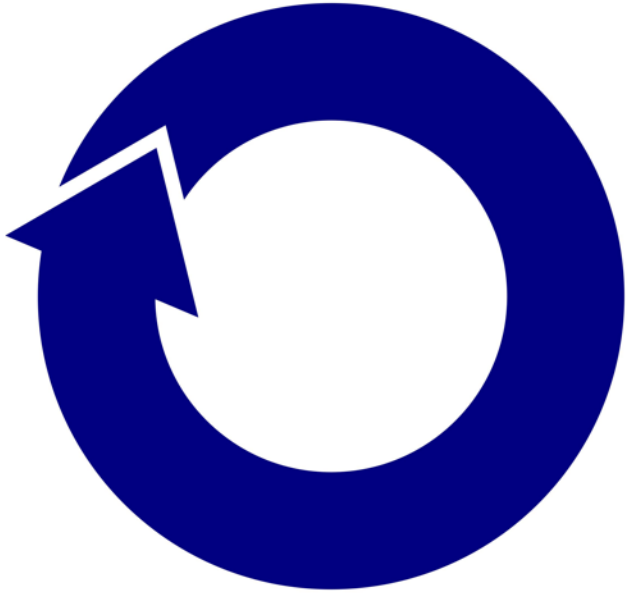
“Energy Efficiency Solutions for Buildings: Leading the Way to Energy Savings.” Schneider Electric, August 2009. Accessed July 2018.

Step Four: Continuous Commissioning

Building use and therefore electrical systems have traditionally been optimized for the building’s first commissioning, in which case they may be tuned appropriately.

However, building use changes over time and drifts to suboptimal implementation. Building systems must be constantly tuned in order to optimize their use and keep costs down.

Continuous commissioning utilizes existing building management systems (BMS) and metering platforms as the first line of defense in keeping energy management initiatives on track.



Step Four: Continuous Commissioning

Continuous commissioning is best approached in a systematic way.

Constant monitoring of the dynamics of energy use results in:

- the optimization of energy resources
- improved operations and maintenance, and
- visibility, education, and accountability at the stakeholder level.

By tuning the commissioning of a building, FEMP estimates up to a 45% reduction in energy use.

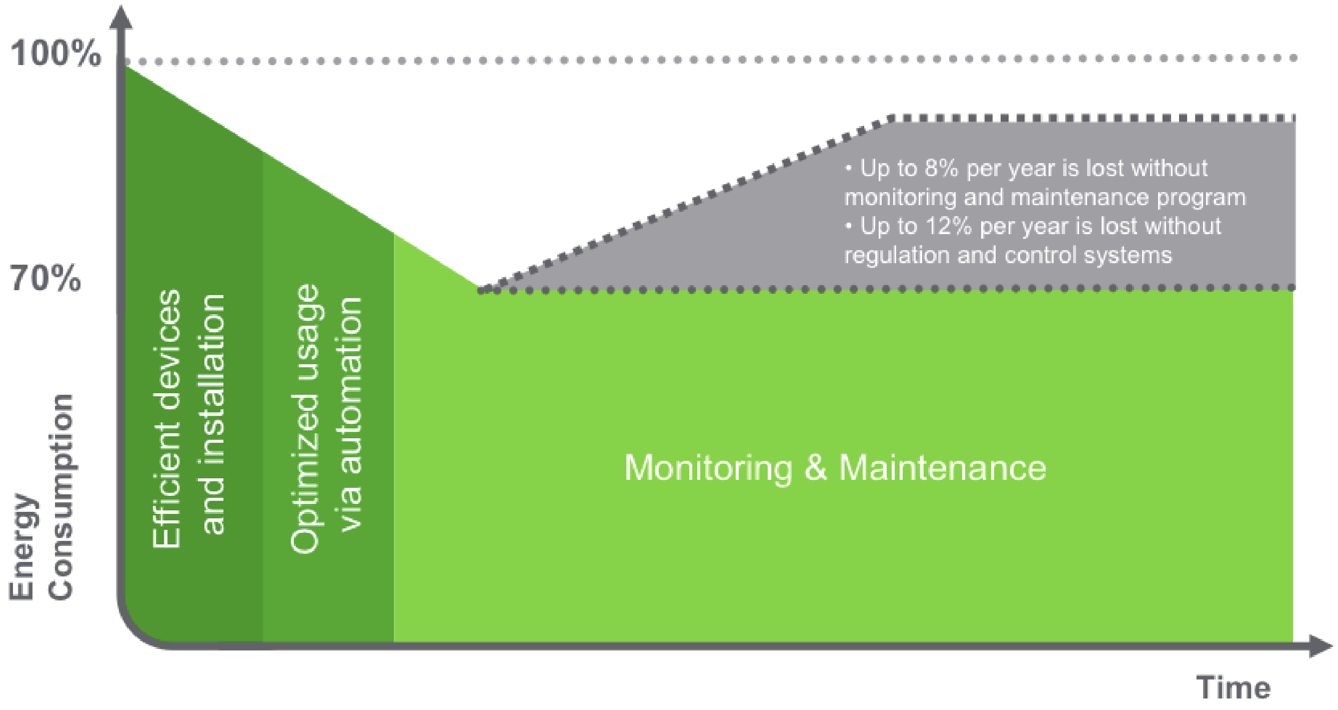


Image courtesy of Schneider Electric

A Note About Stakeholder Visibility

The term *Hawthorne effect* is used to describe the tendency for subjects to improve or modify their behavior simply in response to the fact that they are being studied.

A common theme emerging from the building industry is that resource consumption information should be made visible to a broad audience (on display in elevators, halls, cafeterias, etc.) showing actual vs. target usage. This visibility cultivates ownership among all the stakeholders and promotes energy conservation.

This response is documented by FEMP—showing up to 2% reduction in energy consumption due to the Hawthorne effect.

Experiments on worker productivity by the Western Electric Company at its Hawthorne plant in Chicago

The Goals of Measurement and Verification

1. Lower energy consumption
   - It’s easier to create negawatts (reduce consumption) than it is to build supply.
2. Identify areas for building improvement
   - Simple operations and maintenance improvements can increase energy savings by up to 15%.
3. Allocate costs fairly (and legally)
   - Simply allocating bills to specific accounts can result in up to a 5% savings in energy consumption.
4. Reduce greenhouse gases
   - GHG credits (or carbon credits) are often associated with electricity reduction strategies.

Measurement and Verification Targets

- **Demand reduction**
  - Granular M&V is an effective tool in reducing energy consumption, but it must be coupled with a managed program.
- **Optimize time-of-use**
  - To discourage power consumption at peak periods, utility electricity rates are higher during these times.
- **Identify faulty equipment**
  - Old or improperly functioning equipment is a significant power sink.
- **Identify forgotten loads**
  - In every building, systems that do not need to be on or powered up are often left on.
- **Attribute usage**
  - Allocating costs motivates users to reduce.

Gauging M&V Program Effectiveness

How much energy can be saved through M&V initiatives?

FEMP, part of the U.S. Department of Energy (DOE), has created a framework for estimating the amount of energy consumption that might be reduced based on several levels of M&V application and program engagement.

As shown in this table, savings can be anywhere from 2% to 45%, depending on the measures taken.

Metering Savings Ranges

Action	Observed Savings
Installation of meters	0% to 2% (the Hawthorne effect)
Bill allocation only	2½% to 5% (improved awareness)
Building tune-up	5% to 15% (improved awareness and identification of simple operating and maintenance improvements)
Continuous commissioning	15% to 45% (improved awareness, ID simple operating and maintenance improvements, project accomplishment, and continuing management attention)

Metering Best Practices: A Guide to Achieving Utility Resource Efficiency. Release 2.0. U.S. Department of Energy, Federal Energy Management Program, August 2011. Accessed June 2018.

Meter Data: Invaluable, Not Always Available

It’s clear that the information meters provide is invaluable to the creation of sustainable buildings through M&V and energy management initiatives.

It’s a common mistake to not give enough attention to how this information is going to get accessed when designing building systems. As a result, much of that information can be trapped within localized applications due to poor meter or networking choices.

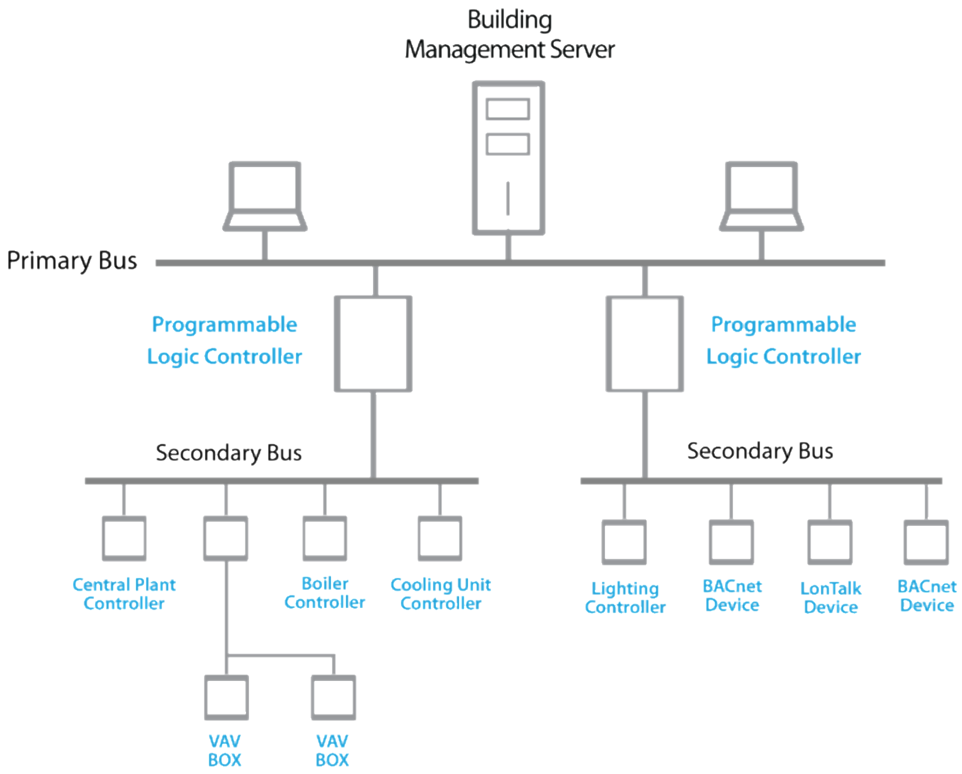
These problems are being solved through the flexible, open, web-centric nature of the rapidly emerging Building Internet of Things (BIoT) model—making data more fluid, and opening up a whole new set of energy management and sustainability initiatives that leverage multiple stakeholders and fulfil the promise of big data.

The Building Internet of Things (BIoT): An Open and Flexible Future

Traditional BAS

Not long ago, the only path for achieving comprehensive building management was to buy into a proprietary building automation system (BAS) from one vendor.

This type of system is composed of simple actuators and sensors at the lowest layer for control and alarm purposes, a middle tier of programmable logic controllers (PLC) and collectors to gather the data, and the “head end” (database, application) as a central (mostly closed) data repository.



A typical building automation system: with closed, on-premise access

Traditional BAS

Access to these systems has been mostly on premise and local—with limited communication capabilities between the head end and the plethora of powerful, cloud-based energy management and building control applications that are starting to emerge. In many ways, these systems fit the old model of local facility management “owning” the operations of a building.

A growing pressure to get access to and share building management information has resulted in some rudimentary cloud-based integration for these systems, but even so, information access is often slow, limited in scope, and confined to proprietary formats and schemas.

The Emergence of the BACnet

This decade has heralded a new approach. The emergence of the BACnet communication protocol has provided a standardized object model for building automation components, normalizing vendor products to an equipment type (e.g., thermostat versus a brand name thermostat) with generic attributes, parameters, and arguments.

In this model, BACnet compliant controllers talk to all instrumentation in a building using the same control language, and it’s the responsibility of the instrument to understand and respond.

Moving to a Cloud-Based Model

As the power and capabilities of micro-electronics increase (and costs plummet), the instrumentation layer is becoming more and more powerful, removing the need to lock-in to any particular building automation vendor and freeing property managers and building owners to buy the best equipment for the job. As a result, the BACnet standard is becoming widely adopted.

At the same time, a corresponding reduction in cost and increase in performance in communications technologies has enabled higher bandwidth communications right to the instrumentation layer.

With smarter and more powerful end-points and less reliance on intermediate grooming, the door has been opened for buildings to move to a cloud-based application model rather than on-premise, isolated servers.

The Internet of Things and the Promise of Big Data

Today, local devices (desktop computers, mobile phones, home appliances, security systems, etc.) have become information and data grooming instruments connected to a constellation of ready-to-consume applications via a ubiquitous, standardized, and intentionally transparent network.

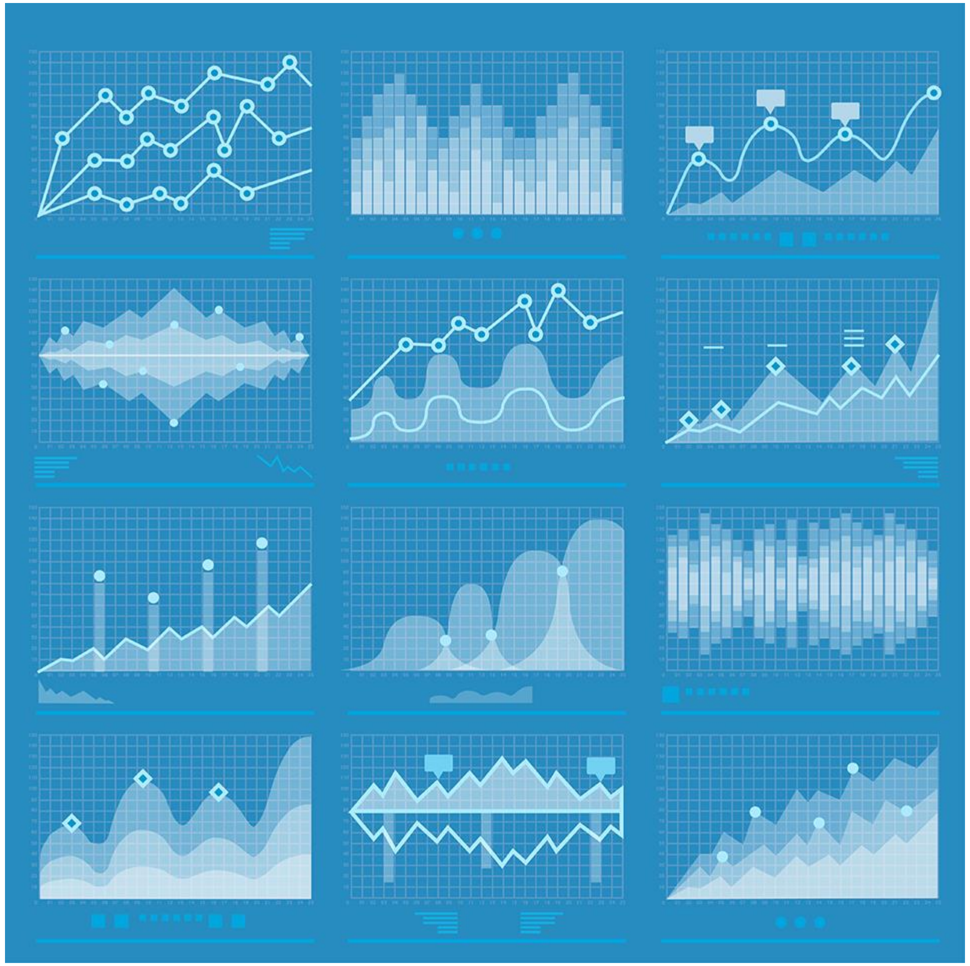
Through web services interoperability, this Internet of Things (IoT) can now share information to form greater functionality—superseding the old, locked-in, single-vendor models with greater capability and better visibility of data for all stakeholders. This is the promise of big data, where the whole is greater than the sum of its parts.

The Internet of Things and the Promise of Big Data

The benefits for building management networks to follow this same multi-vendor path are clear: more energy management and building control functionality that is easier and cheaper to deploy.

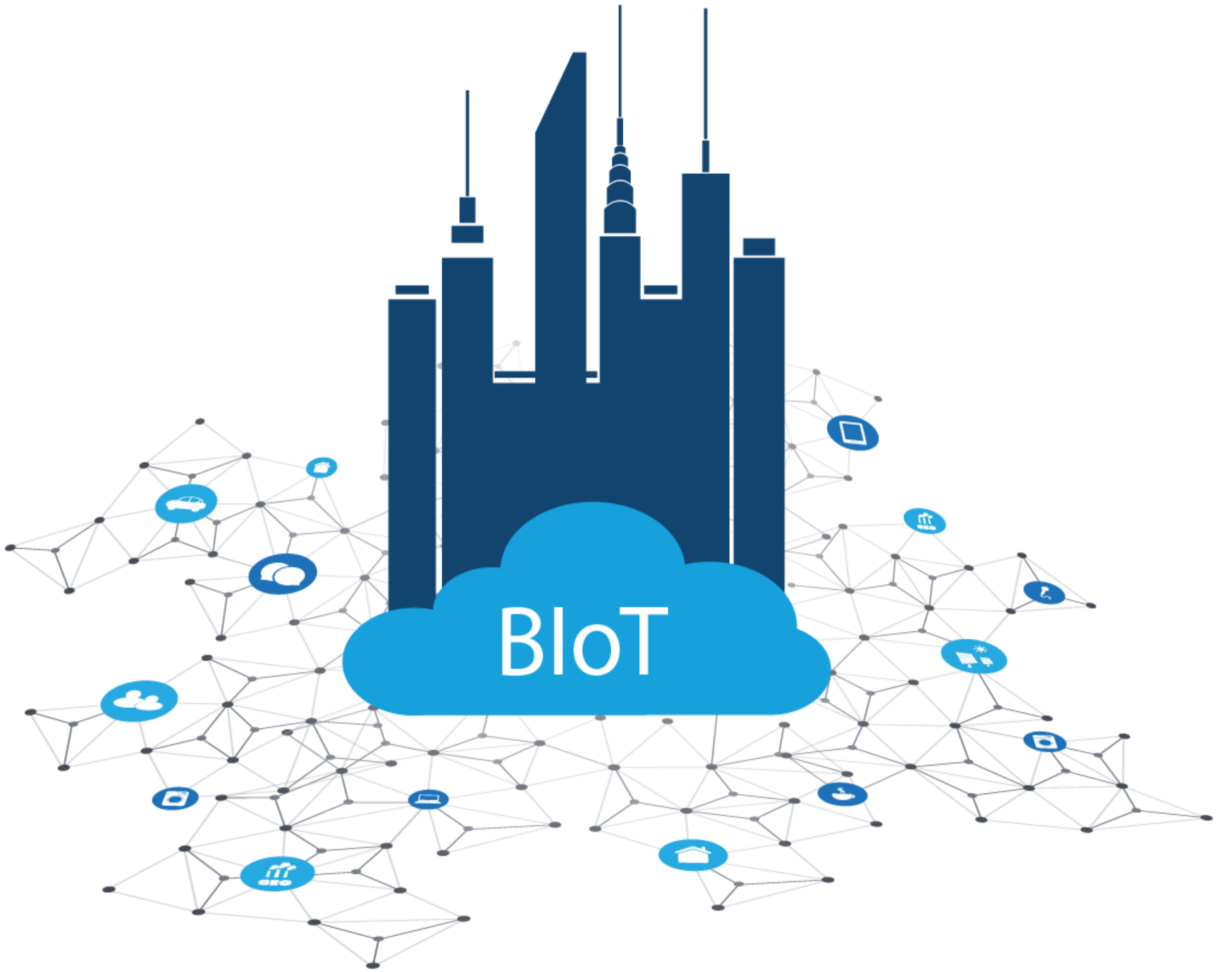
But while IP-attached building sensors and actuators communicating directly to web-based applications via a transparent IP fabric would seem to be the next evolution for building automation, this vision is only viable for simplistic buildings, such as single-family dwellings. Larger buildings need to manage multiple and sometimes competing entities.

Critical building systems, tenant systems, security concerns, multiple stakeholders, and the sheer volume of instrumentation necessitates some form of building systems access, edge computing (to streamline the flow of information from IoT devices and provide real-time local data analysis), and usage control.



The Building Internet of Things

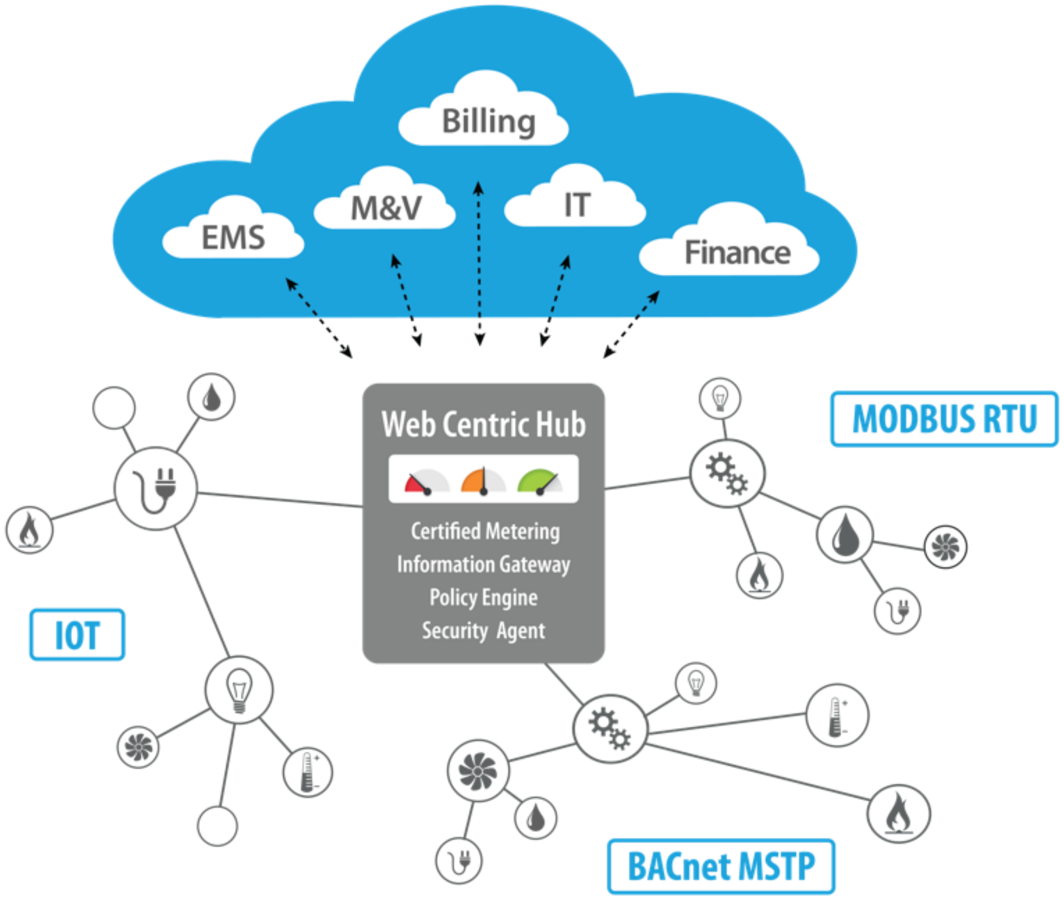
Coined by Realcomm in 2014, the term Building Internet of Things (BIoT) focuses on the components of a building (heating, HVAC, security, communications, etc.) that can be connected to the Internet to create operational efficiencies, achieve energy management goals, improve building security, and much more.



A Web-Centric Hub

The difference between the Internet of Things (IoT) and the Building Internet of Things is that BIoT requires an aggregation and computing component that can groom information from building instrumentation into database-level repositories.

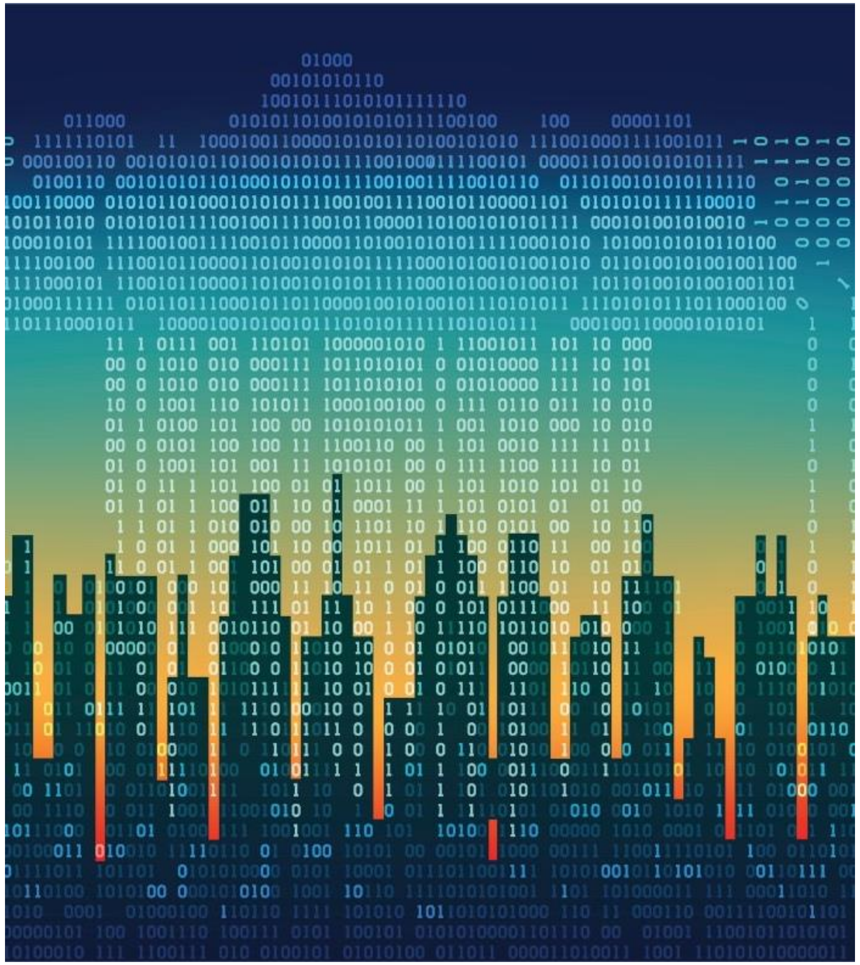
Additionally, BIoT systems will require a level of edge computing to handle low latency policy/control decisions and fail-safe operations of complex building systems—a middle tier or gateway that can enforce rules and uphold system integrity and security at the building level.



A Web-Centric Hub

Combining building information model (BIM) style abstractions (data semantics and tagging) with system and instrument permission controls creates a control point where any stakeholder and any cloud-based system can be given access to building system data sets.

These data sets can then be accessed from cloud applications over rich web service APIs (e.g., a JSON RESTful API with a Project Haystack or ASHRAE 223P tag model) or any other building semantic/communication models and cloud-based applications.



Unlocking Building Services Data

This form of cloud-centric data management unlocks building data for building owners, property managers, and other stakeholders…or at least it should.

One of the most enduring and frustrating experiences a property owner or facility manager can have is the simple act of trying to use the data generated by their building management or metering systems.

Inadequate system interfaces, locked-in data management models, and poor data mobility can cause loss of control of data, with potentially disastrous results.

Unlocking Building Services Data

Lack of data visibility, poor service, and inescapable costly contracts can plague property owners for years if they are not careful.

To ensure this never happens, care must be taken when specifying and implementing these systems and any ongoing services attached to them.

★ Please remember the **exam password DATA**. You will be required to enter it in order to proceed with the online examination.

A Web-Centric Information Path

Today, it’s widely accepted that combining system information flows into larger big data pools provides more opportunity for insights that lead to better decisions with long-term strategic business benefits.

The pressure on building management and metering platforms to play ball is increasing, meaning a web-centric information path is a fundamental and mandatory design feature for any building going forward.

Make Service Agreements Mutually Beneficial

Service agreements typically associated with the provisioning and maintenance of building systems and the ongoing analysis of derived data are a common point of peril for building owners and property managers.

There are a lot of companies that offer building services with the technology infrastructure costs hidden in the price of the service itself (no money up front). It’s an enticing and potentially mutually beneficial scenario, but it’s all too easy to inadvertently give away the data rights in the process.

Remain Open to Take Advantage of Web Services

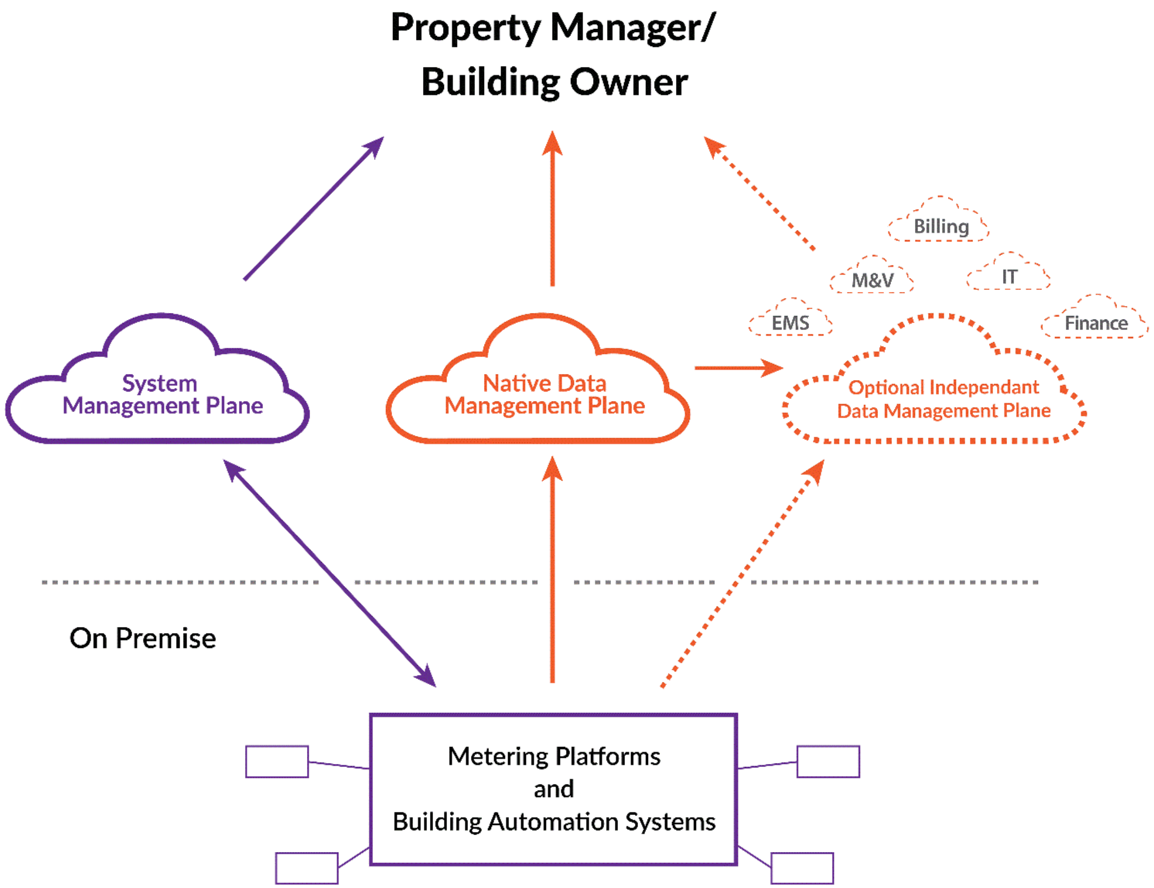
Once a provider has a signed service agreement, their goal is to keep building owners as customers for as long as possible. Unfortunately, retention isn't always based on the quality of service, but rather on onerous movement fees or the ability to hold historical data hostage—making it difficult to move to another provider.

With today's open communication protocols, there's no reason that property managers and building owners shouldn't be able to take full advantage of as many web services as they like without restriction or having to choose a single provider.

The Free Flow of Building Information

It's not uncommon for building owners or other stakeholders to be underwhelmed by their existing service provider and their data packages. Having the opportunity to evaluate another vendor while maintaining an existing service is key to making wise decisions, both today and tomorrow.

Equally important is the ability for all stakeholders to be able to have information presented easily for consumption—on any platform or device. To accomplish this, it's critical that data generated by any system be available in its raw original form, with low to no latency, so it can be processed by multiple platforms at the same time.



Where Do Meters Play in BIoT ?

Generation 4 meters need to know how to play in the BIoT world, not only as data sources, but also as active components that help make the BIoT vision happen.

Installing metering solutions that use standard compliant APIs and open meta tagging ensures a platform that can form the backbone for energy management initiatives today and tomorrow, a cost-effective choice for property managers and owners.

Benefits All Around

The benefits to property managers and building owners of delivering the IoT model via a standards-based BIoT metering gateway are significant, including:

1. Making the right information available to the right people, at the right time.
2. Gaining unobstructed access to new and emerging energy management and building control applications.
3. Vendor independence and consumer choice (with no lock-in).
4. Plug and play replacement of components (at any level).
5. Future-proof durable systems with software that can be remotely upgraded.

Summary

Summary

- Measurement and verification (M&V) is essential to understanding the use of energy within a building.
- Submetering, the backbone of M&V, is an essential part of sustainability programs and intelligent building design.
- Submetering can affect positive energy and cost reductions of up to 45%, when combined with proactive corrective action measures.
- Submetering systems are used in commercial, residential, and institutional applications.
- Multi-point meters are cost-effective, high-density devices.
- Facility management-oriented BAS is giving way to networks that expose building information to IT networks and business applications.
- It’s widely accepted that combining system information flows into larger big data pools provides more opportunity for insights that lead to better decisions with long-term strategic business benefits.
- With their place reserved in a building’s infrastructure, metering platforms that employ open system communications are well-positioned in the BIoT to act as a central hub for measurement, policy, security, and information flow.

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Conclusion

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