Using wireless monitoring to meet the requirements of Executive Order 13693

A lower cost, simpler means of tracking PUE

Implications of Executive Order 13693 for Federal Data Center Managers

President Obama signed Executive Order (EO) 13693 on February 19, 2015 with the objective of reducing Federal greenhouse gas emissions and increasing the use of renewable energy sources. Priority should first be placed on reducing energy use and cost, then on finding renewable or alternative energy solutions.

Specifics

EO section 3(a)(ii) states that beginning in 2016, Federal agencies shall improve data center energy efficiency at agency facilities by:

> *(A) ensuring the agency chief information officer promotes data center energy optimization, efficiency, and performance;*
>
> *(B) installing and monitoring advanced energy meters in all data centers by fiscal year 2018; and*
>
> *(C) establishing a power usage effectiveness target of 1.2 to 1.4 for new data centers and less than 1.5 for existing data centers.*[i]

Bottom line

All Federal government data centers must have energy monitoring systems and a means to determine PUE by 2018. Existing data centers must have a PUE lower than 1.5 by September 2018. Data Center Infrastructure Management (DCIM) software is also mandatory. Agencies are free to select the solution of their choice until the GSA procurement program is finalized.

Power Usage Effectiveness (PUE)

PUE is a measure of how efficiently a computer data center infrastructure uses energy. It is a ratio that compares a facility's total energy use to the portion of the energy used to support IT equipment. The goal is to minimize the non-IT usage and bring PUE as close to 1.0 as feasible.

Calculating PUE

$$PUE = \frac{Total\ (Data\ Center)\ Facility\ Annual\ Energy\ Use}{IT\ Equipment\ Annual\ Energy\ Use}$$

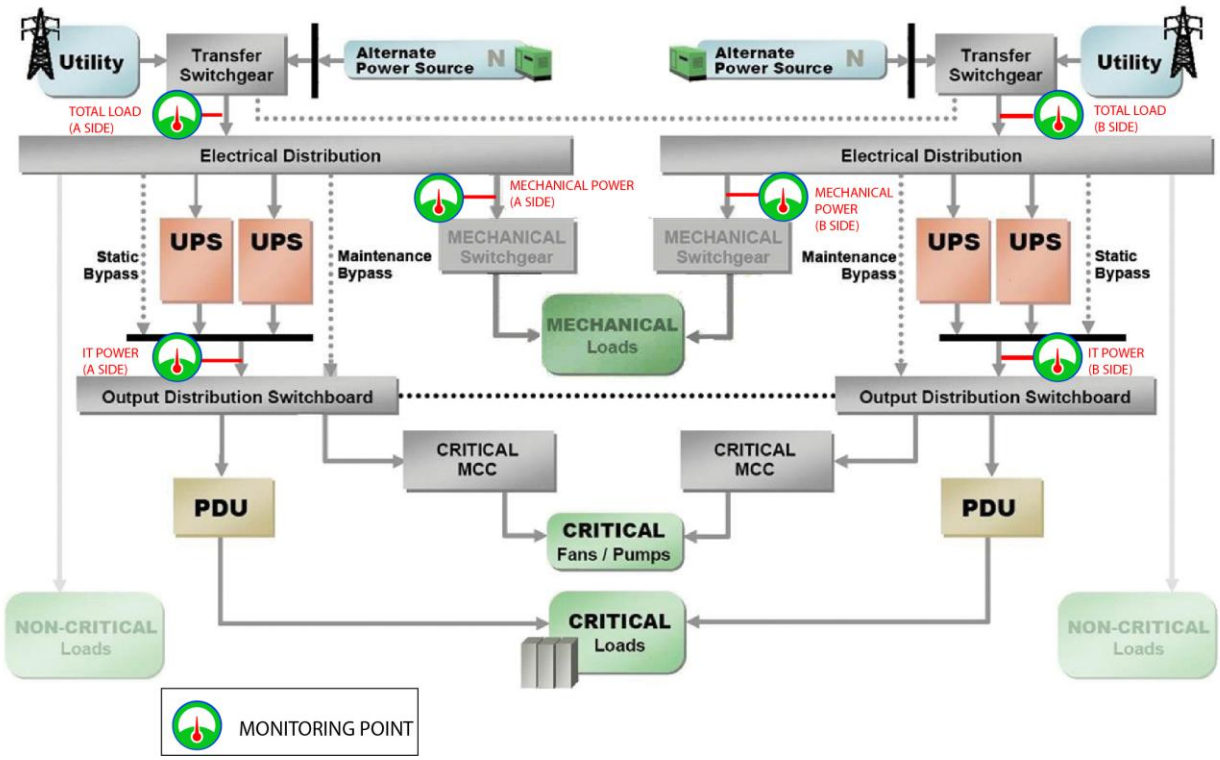
Total (Data Center) Facility Annual Energy Use includes all IT equipment energy, plus power delivery and cooling system components, lighting, and all other energy using devices that support the IT equipment.

IT Equipment Annual Energy Use includes the energy associated with all of the IT equipment (e.g., computers, storage, and network equipment).

Capturing PUE data

Obtaining accurate PUE data requires installing energy meters at key points in the power distribution system to segregate energy use between IT and mechanical loads.

Advance energy meters installed by agencies shall be meters that enable the active tracking of power usage effectiveness (PUE) as well as promote implementation of DCIM. Agencies shall adopt a cloud-first or cloud-by-default policy when developing or purchasing new systems. [ii]



Reporting PUE

PUE is an energy-based metric. Energy is measured in kilowatt hours (kWh), so PUE is calculated and reported over some interval of time. There is no formal requirement for what that time period should be. As facility performance (and PUE) can often be influenced by weather, baseline PUE measures should cover at least a month, and reporting systems should make it easy to see PUE trends over time. Comparing a daily PUE reading to the baseline can help put current facility performance in context. Some IT operations also benefit from real-time PUE calculations (usually based on power measured in kW rather than energy in kWh).

Finding the right metering system to track PUE

Adding the monitoring systems needed to measure and analyze PUE can be costly and time-consuming. As such, it is important to find the simplest, least disruptive and most cost-effective means of gaining accurate information. Secure wireless monitoring systems meet the needs at a fraction of the cost of traditional wired meters.

Easy to install

Installation costs can represent a substantial portion of the costs of a metering deployment. They fall into three broad categories:

- **Physical installation** of the meter, including installing the meter on the circuit to be monitored, configuring the meter for the size and type of circuit, and installing any data communications wiring the meter requires.
- **Configuring the meter** to meet data network addressing and security requirements and to allow data to be interpreted correctly by an existing a monitoring system.
- **Adding a new monitoring application**. Since a full-blown DCIM implementation can take months and costs tens of thousands of dollars, EO 13693 strongly encourages the use of a cloud-based monitoring system to minimize this cost. To start, favor systems that require minimal customization in order to track PUE.

Wireless systems minimize physical installation costs by eliminating the need for most data communications wiring. By using split-core current sensors, the meters can often be installed without disrupting power. More advanced meters eliminate the need for on-site configuration to make installation quick and simple. And most systems using mesh network protocols avoid having to specify to each meter the "gateway" device it must communicate with and greatly simplify network configuration.

Easy to manage

Monitoring devices need ongoing management like any other "smart" device. To minimize the time required for ongoing management, ensure that it is easy to see the status of a meter and that firmware upgrades can be applied remotely and without disrupting normal meter operation.

Advanced wireless meters support delivery of firmware upgrades over the wireless network, avoiding the need to directly interact with each meter each time an upgrade is required. Firmware upgrades can be pushed out in the background, enabling the upgrade to take place with little to no disruption to normal metering function. The systems will also indicate how often readings are being received from each meter and automatically

Secure

Security is paramount in data centers, and metering systems are often deployed on the most highly secure control networks. And while PUE can usually be determined from a fairly small number of metering points, facilities that use metering for circuit load monitoring, cooling optimization, or cost allocation can have hundreds or thousands of monitoring points. So a metering system must not only be able to meet strict network security requirements but also limit its potential use as a back door to the main data networks.

Wireless metering systems are available that use network protocols that are purpose-built for monitoring and cannot be used for other purposes. Some systems can even be isolated entirely from the core data networks. Some systems can encrypt the data transmissions over the wireless network. And systems that use radio frequencies that are different than those typically used for IT systems may be less likely to be spotted by potential intruders.

Open

Adding metering systems to an existing site can be a challenge and may involve monitoring equipment from a variety of manufacturers. The type of meter used should also not limit the data center operator's ability to use the monitoring application of their choice. Meters should:

- Be able to be installed on any manufacturer's equipment
- Work with a wide range of current sensors to meet needs for circuit size (expressed as the rated amperage of the CT, e.g. 800 amps), the type and diameter of the conductors (expressed as the inside diameter of the CT), and the available space in the panelboard.
- Support industry standard data formats such as SNMP, Modbus or BacNet to make it possible to feed data to most monitoring applications.

Accurate

Because PUE is based on kWh, the meters used must be able to measure energy. In addition to reporting energy, modern meters will also track current (amps), voltage (volts), power (watts), real power (volt-amps reactive), power factor, frequency, and in some cases measures of power quality such as total harmonic distortion. Most meters will track these attributes by phase on multi-phase circuits and in total for the circuit overall. While only energy is needed to determine PUE, most facility operators have many uses for these other attributes, and any new metering deployment should utilize hardware that supports many or all of them.

There is no stated requirement for how accurate a metering system must be to determine PUE. In the recent past, systems that could track energy at +/- 5% were considered adequate. More recently, the norm has become +/- 1% and some systems seek to achieve accuracy of 0.5 or even 0.2 percent. For PUE purposes, +/- 1 % is suitable.

The rate at which data is made available can also vary across metering systems. Older systems reported energy only and did so once a day. Modern systems report many power attributes and may do so many times per minute. While not strictly required for PUE, systems that report more often can support other uses such as alerting that many data centers find valuable.

Most modern meters, whether wired or wireless, measure and report a wide range of power information quickly and accurately. Limited function meters that measure current only or report kWh only through older means such as pulse metering may be available for a lower cost, but they offer much less value to the data center operator than a more real-time metering system.

Cost effective

The most cost-effective overall solution is the one that meets accuracy, openness and security requirements and minimizes the following costs:

- Purchase price of the metering units and current sensors
- Physical installation
- Hardware configuration (of the meter and network)
- Monitoring application acquisition, installation and customization
- Ongoing operations, warranty and support

Wireless metering systems offer lower purchase prices, eliminate the need for most wiring and meter configuration, minimize expensive electrician time, and minimize the amount of IT resources needed to

operate the system across time. And they meet or exceed the accuracy, reliability and security of wired monitoring solutions.

Benefits of monitoring beyond PUE

Beyond meeting the requirements of EO 13693 to track PUE, wireless monitoring systems offer many other benefits to data center operators and can play a critical role in providing the information needed to improve PUE over time. These include:

- Improving availability by avoiding tripped breakers due to overloading circuits and receiving alerts when problems occur.
- Increasing efficiency by improving load balancing by phase and uncovering equipment with poor power factors.
- Extending facility life by identifying under-utilized circuits and safely increasing the power density of racks
- Allocating operating costs to motivate end users to reduce energy usage.
- Reducing energy usage by providing the information needed to identify hot spots, safely increase ambient air temperatures, and dynamically optimize advanced cooling systems.
- Tracking the performance of efficiency initiatives such as containment systems and server virtualization.

The type and extent of power and environmental monitoring required can vary a great deal based on which type of benefit is desired. In choosing your PUE monitoring solution, give consideration to whether the monitoring system you select can scale to support these more extensive requirements should you need to meet them in the future.

PUE Metering Checklist

Meter accuracy

- ☐ Less precise than +/- 1 %
- ☐ Precision equal to or better than +/- 1%

Data provided

- ☐ Energy (kWh, by phase and total)
- ☐ Power (W, by phase and total)
- ☐ Voltage (V, by phase)
- ☐ Current (A, by phase and total)
- ☐ Frequency (Hz)
- ☐ Reactive power (VAr)
- ☐ Power factor
- ☐ THD – Amperage
- ☐ THD – Voltage

Monitoring data reporting interval

- ☐ Real-time
- ☐ 5-minute
- ☐ 15-minute
- ☐ Hourly
- ☐ Daily

Data output formats

- ☐ SNMP V2
- ☐ SNMP V3
- ☐ Modbus
- ☐ Bacnet

Monitoring application

- ☐ Available as cloud service
- ☐ Standard PUE calculation available
- ☐ Easy to build custom reports
- ☐ Supports real-time data access
- ☐ Alerts

Installation and customization time for full deployment

- ☐ Under 5 hours
- ☐ 5 to 20 hours
- ☐ 20 or more hours

Full range split-core CT support

- ☐ 3000A+
- ☐ 2000A
- ☐ 1000A
- ☐ 800A
- ☐ 600A
- ☐ 400A
- ☐ 300A
- ☐ 200A
- ☐ 100A
- ☐ 50A
- ☐ 30A
- ☐ Bus bar format
- ☐ Rogowski coil support

Security

- ☐ Encryption
- ☐ Purpose-built monitoring protocol
- ☐ Isolation from core networks

Ease of deployment and management

- ☐ Mesh network protocol
- ☐ Gateway to monitor ratio
- ☐ Self-configuring network
- ☐ Continuously optimizes performance
- ☐ Wireless firmware upgrades
- ☐ Easy to add more monitoring units

Flexible reporting

- ☐ Prebuilt reports delivering essential data
- ☐ Customizable reports
- ☐ Data easily accessible

Total cost of ownership

Hardware purchase price _____

Installation costs

Electrical _____

IT _____

Ongoing maintenance costs _____

TOTAL total cost loaded here

Long term solution

- ☐ Grows to hundreds/thousands of monitoring points
- ☐ Supports power and environmental monitoring
- ☐ Supports metering at device, rack, busway, panelboard and switch gear levels
- ☐ Works with any hardware and software

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[i] Executive Order – Planning for Federal Sustainability in the Next Decade Press Release
https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade

[ii] https://www.whitehouse.gov/sites/default/files/docs/eo_13693_implementing_instructions_june_10_2015.pdf