Employ PUE to Better Manage Your Data Center

To be good stewards of their resources and to remain competitive, all industries must use their energy effectively, and data centers are no exception. By their nature, data centers are huge consumers of electrical energy, estimated to account for between 1% and 3% of the world's energy consumption. When so much energy is being consumed, and paid for, the efficient use of that energy is extremely important.

Power usage effectiveness (PUE) is a measure of the efficiency of energy usage in a data center. PUE helps data center operators ensure that the energy used to generate income is greater than the energy used to maintain the data center facility. The term originated in 2007 in a book published by the Green Grid, called "PUE: A Comprehensive Examination of the Metric."[i] PUE is a ratio of the total amount of energy used by a data center divided by the amount of energy used to power its IT equipment. Basically, it is a determination of the amount of energy being used to generate income versus the amount of energy used for non-income generating tasks, such as chillers and UPS. "PUE is expressed as a ratio, with overall efficiency improving as the quotient decreases toward 1.0."[ii] As an example use case, if a data center used 50,000 kWh in a month and 40,000 of that was used by the IT equipment, the ratio would be 50000/40000 for a PUE of 1.25. If the next month they used 50,000 kWh again, but 45,000 of that was used by the IT equipment, the ratio would be 50000/45000 for a PUE of 1.11.

Since the introduction of PUE, data centers have used this metric to drive a reduction in energy consumption. The energy used by IT equipment is determined mostly by the number of servers and equipment needed to run them. But by decreasing the amount of energy used for non-income generating tasks, data centers can increase their profitability, as shown in an improvement in their PUE as it gets closer to the goal of 1. Another advantage to improved PUE is a more positive impact on the environment, which results from lowering a data center's carbon footprint. This is extremely important to all of us, since data centers are such large consumers of energy, much of it still from fossil energy sources.

Due to their energy consumption and environmental impact, governments are now beginning to draft regulations requiring data centers to be more efficient, as indicated by their achieving a minimum PUE. As reported in an article by Uptime Institute, "The new Energy Efficiency Act in Germany, which came into force in September 2023, mandates data centers in Germany to achieve a PUE of 1.5 from July 1, 2027 and a PUE of 1.3 from July 1, 2030. New data centers opening from July 1, 2026 are required to have a PUE of 1.2, or less..."[iii]

While achieving an ideal PUE of 1.0 may not be possible yet, some data centers have been able to come close to this number. For example, LinkedIn has a new data center outside of Portland, Oregon, which has shown a PUE of 1.06. Part of its design involves innovative cooling methods.[iv] Cooling is one of the major contributors to data center costs, so any improvement in that area should improve energy efficiency and lower PUE.

What are the steps a data center must take to determine and improve their PUE? An energy management system that can measure and record readings from power and energy meters throughout the data center and then calculate the PUE automatically for the facility, is one of the best ways for a data center to measure its PUE. Locating the source of energy usage and costs allows operators to take steps to improve efficiency in specific areas, for example updating older network devices. If the PUE indicates that energy efficiency is worsening, the facility operator

can use other metrics and power quality analysis from the energy management system to locate the source of increased non-income generating energy and make changes to improve that energy usage. For example, if there is a problem with cooling equipment or the UPS, fixing that issue should impact efficiency and improve the PUE. The effectiveness of their actions will be evident in the improved PUE.

An energy management system that supports limit alarms on power quality problems - poor power factor, power quality events, frequency variations, etc., lets data center facility operators be proactive in addressing problems before they escalate. A system with machine learning that can predict increased usage and demand of non-IT related energy can also enable the facility operator to manage non-essential energy usage and avoid demand penalties or other increases in cost. In this way, energy management systems consisting of power, energy, and power quality monitoring and related data management and analysis software can assist data center operators to ensure that the energy being consumed by their facility is used efficiently. And the ability to monitor voltage and current levels as well as power factor helps determine the reliability of the energy being supplied by the utility.

EIG offers a full line of power and energy meters and advanced power quality analyzers. When these are integrated into the EnergyPQA.com® AI driven energy management system, the data center operator gains the ability to monitor energy usage throughout the facility. The EnergyPQA.com® system automatically calculates PUE for the facility. The operator can view browser-based Dashboard displays of current, voltage, power factor, and waveform events to understand how the system is using energy. They can set and receive alarms of out of limit and power quality events to respond in a timely manner. And they can generate reports of energy efficiency per circuit in the facility to determine where excess energy is being used.

To learn more about the EnergyPQA.com AI driven energy management system and all the EIG advanced power, energy, and power quality meters visit EIG's website at:

https://www.electroind.com/products/energypqa-com-energy-management-system/

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[i] "What Is Data Center PUE? Defining Power Usage Effectiveness," Antonella Gina Fleitas, accessed from What Is Data Center PUE (Power Usage Effectiveness)? (datacenterknowledge.com) on 8/28/2024.
[ii] "Power Usage Effectiveness," Alexander S. Gillis, accessed from What is PUE (Power Usage Effectiveness)? - TechTarget.com on 8/28/24.
[iii] "Large Data Centers Are Mostly More Efficient, Analysis Confirms," Jaqueline Davis, accessed from Large data centers are mostly more efficient, analysis confirms - Uptime Institute Blog on 9/6/2024.
[iv] "Inside LinkedIn's Cutting-Edge Portland Data Center," Rich Miller, accessed from Inside LinkedIn’s Cutting-Edge Portland Data Center | Data Center Frontier on 9/6/2024.