PUE: Building a Greener Data Center

What is Power Usage Effectiveness (PUE)?

The Power Usage Effectiveness (PUE) rating of a data center is the ratio between all power used and that which is delivered to the server equipment. The rating was devised by The Green Grid, a non-profit organization with input

from major data center hardware and software developers. This group is part of the Information Technology Industry Council (ITI) which handles global information and communications technology. Beyond PUE, there is also the Water Usage Effectiveness (WUE) ratio as water utilization is becoming a serious environmental issue.

PUE acts as a method of measuring or benchmarking a data center's efficiency along with the related Data Center Infrastructure Efficiency (DCIE) standard. A primary "Green" goal is to have data centers hit and maintain a PUE of 1.3 or less. Therefore, data centers can monitor their PUE as a Key Progress Indicator (KPI) with a stated goal in mind. PUE is standardized internationally by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IOC) under 30134-2:2016. It is further a European Standard (EN) under 50600-4-2:2016.

Power Usage Sources

It's important to know what types of power usage fall under what category in order to derive an accurate PUE. All Information Technology (IT) equipment, that is anything required for the servers to operate, is separate from auxiliary power requirements. As data centers usually exist to provide information at high bandwidth, IT equipment would include routers, switches, and things of that nature required to maintain a high-speed connection. However, most IT power usage will be coming from the server hardware itself, including the CPUs and storage.

Power sources that would count towards the total side of the PUE ratio include lights, utility plugs, and any emergency standby generators. Servers in data centers tend to run hot, to the point that cooling is crucial to maintain performance uptime. This includes pumps for filtering and water loops, including those used to circulate water through fan walls, fan coils, and air units. HVAC as a whole also falls into this category for ventilation and air conditioning. As data centers contain expensive equipment and data, there are also added costs for supervision and security to make sure everything stays running safely.

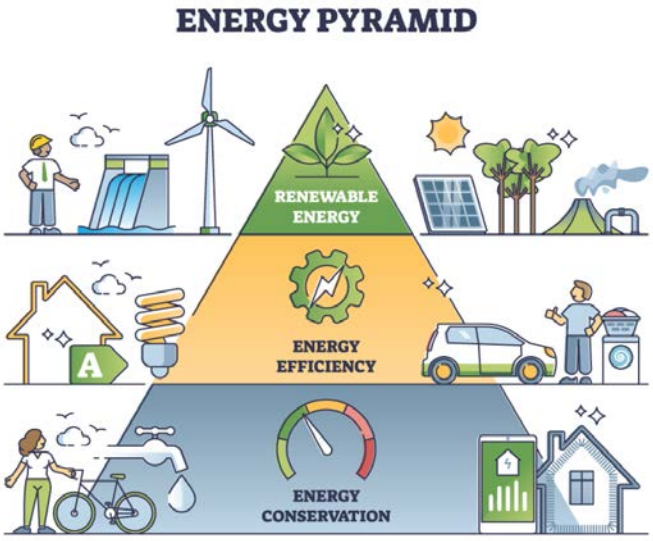
PUE Shortcomings

When PUE was introduced, a common value was 1.8 while the ideal was closer to 1.2. This level of variance

encouraged some businesses to “fudge” the data, particularly as PUE became a marketing opportunity (“PUE abuse”). However, more commonly errors were derived from human mistakes or misunderstandings. For example, the power used for a heat generator should focus on the data center portion of the building rather than the entire building if the generator is shared. Many devices may also be run constantly which calls utilization into question – that is, a data center with higher utilization but a higher PUE might actually be more efficient than the contrary.

Other potential issues involve location, due both to climate and annual temperature. Hotter locations would necessarily require more cooling. Likewise, sunny and flat locations could run solar panels or utilize wind generators respectively; this generation of power could alter the efficiency equation. PUE, after all, exists ultimately as an efficiency metric with the goal of making data centers more environmentally friendly. Therefore, a one-size-fits-all ratio needs to consider not only calculation but actual overall impact. As it stands, the value must be taken within context.

PUE Improvements



If a data center is trying to improve its PUE there are many avenues available. The most obvious is to upgrade and replace equipment with more efficient models. This includes newer hardware, lighting, and other devices, preferably with recycling of the old. Improving cooling systems, and this means all aspects of said systems, is also a good approach, especially in hotter climates. Lastly, data centers can move to virtualization in order to increase utilization, and in fact, this is commonly occurring with improvements coming all the time.

Conclusion

PUE is a valuable, if limited, ratio intended to determine a data center's efficiency and impact on the environment. There are practical reasons to improve PUE because, obviously, energy isn't free, but additionally power is getting more expensive all the time. Moreover, the extra power "wasted" to achieve the same amount of output can have a compounding effect as the data center will, for example, have more equipment to cool. Data centers also benefit from being in relative proximity to population centers so climate and power costs are always a concern.

While like many Green initiatives PUE can be harnessed for marketing reasons, its standardization and industry support demonstrate that companies do take it seriously. It provides a convenient way to measure progress in the data center over time, giving a big-picture metric that reflects smaller changes. Adding energy-efficient hardware, for example moving from HDDs to SATA SSDs to NVMe™ SSDs, can have real effects. Data centers have always looked to improve cooling, but now there are additional considerations because many are powered, at least partially, by renewable energy.

Nevertheless, it is important that those running the data center, especially those managing it and making decisions, are aware of how PUE specifically works. An accurate measurement allows competitive comparison and paves the way for internal improvements. Since the standardization of PUE in 2016 the environment has only become a bigger focus politically, and on a global scale. This is especially true as data center growth has been unprecedented since 2020. Investing in a more efficient data center now is therefore bound to pay big dividends.

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