Workspace
Technology Limited

Technology Paper 004

Metrics for Data Centre Efficiency

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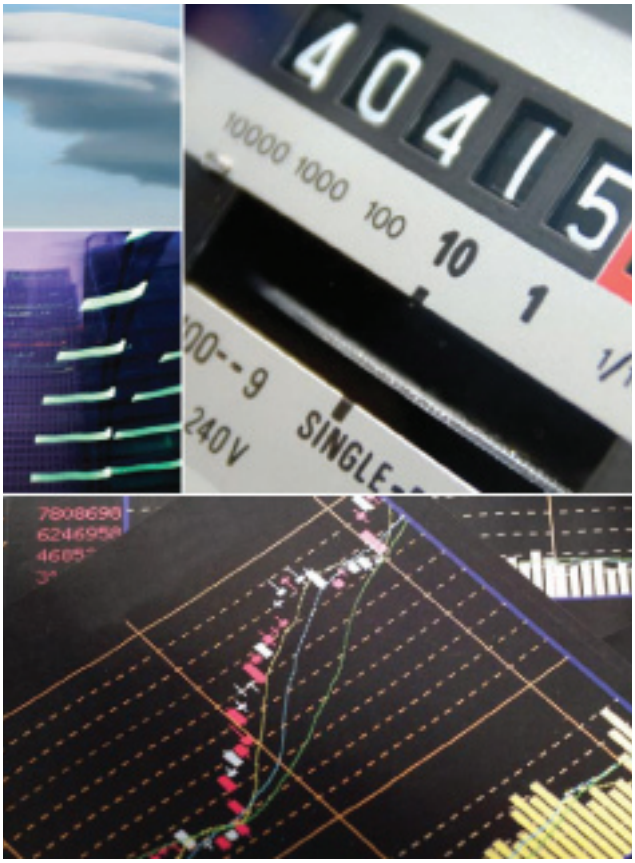
Introduction

Energy efficiency is imperative to environmental and IT economic productivity and can no longer be ignored. Slowing the growth rate of electric power use for servers and data centres is necessary to reduce the rate of growth of greenhouse gas emissions. The current level of consumption makes IT hardware and data centres a leading contributor to carbon emissions. Technology Paper 002 Server Room & Data Centre Energy Efficiency provides further details on this subject.

Metering the total energy used at a site is important, but it does not show how energy consumption is being used across an area, or for specific applications such as a data centre. Therefore, it can be hard to understand why and where energy performance is poor and how to improve it. The Carbon Trust recommends the implementation of the sub metering of key energy consumption elements.

This Technology Paper provides a high level overview of the measurement strategy which has been formulated by The Green Grid, an association of I.T professionals seeking to dramatically raise the energy efficiency of data centres.



Server Room Efficiency Measurement & Metrics

As part of any energy reduction strategy it is imperative to recognise the importance of establishing metrics to specifically measure data centre efficiency. Metrics can show how systems are currently performing and help drive the "tune up" process.

There are two related metrics that have been recently introduced to the industry, Power Usage Effectiveness (PUE) and Data Centre Efficiency (DCE).

The PUE is defined as follows:

$$\textbf{Power Usage Effectiveness (PUE)} = \frac{\textbf{Total Facility Power}}{\textbf{I.T Equipment Power}}$$

and its reciprocal, the DCE is defined as:

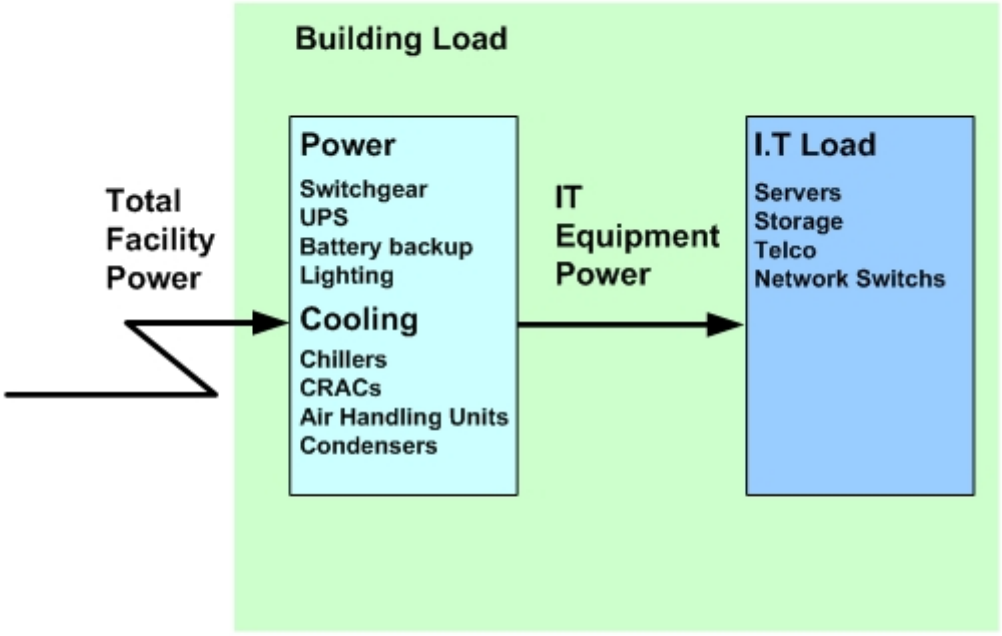
$$\textbf{Data Centre Efficiency (DCE)} = \frac{\textbf{I.T Equipment Power}}{\textbf{Total Facility Power}}$$

1. **I.T Equipment Power.** This includes the load associated with all of the I.T equipment, such as compute, storage, and network equipment, along with supplemental equipment such as KVM switches, monitors, and workstations/laptops used to monitor or control the Data Centre.
2. **Total Facility Power.** This includes everything that supports the I.T equipment load such as:-
   - Total I.T Equipment Power
   - Power delivery components such as UPS, switch gear, generators, PDU's batteries, and distribution losses external to I.T equipment.
   - Cooling systems components such as chillers, computer room air conditioning units, direct expansion air handler (DX) units, pumps, and cooling towers.
   - Other misc. loads including lighting, BMS panels etc.

The use of ‘PUE’ and ‘DCE’

PUE: Power Usage Effectiveness

PCE: Data Centre Efficiency



$$PUE = \frac{\text{Total Facility Power}}{\text{I.T Equipment Power}}$$

$$DCE = \frac{1}{PUE} = \frac{\text{I.T Equipment Power}}{\text{Total Facility Power}}$$

The use of the ‘PUE’ and ‘DCE’ provides a way to determine :-

- Opportunities to improve a Server Room or Data Centres operational efficiency
- How a Server Room or Data Centre compares to other competitive facilities
- A method of ongoing monitoring of the Server Room or Data Centre efficiency.

The best position to measure the “Total Facility Power” is at the input power feeds to the server room. This should represent the total power entering the data centre (for which the utility supplier will charge).

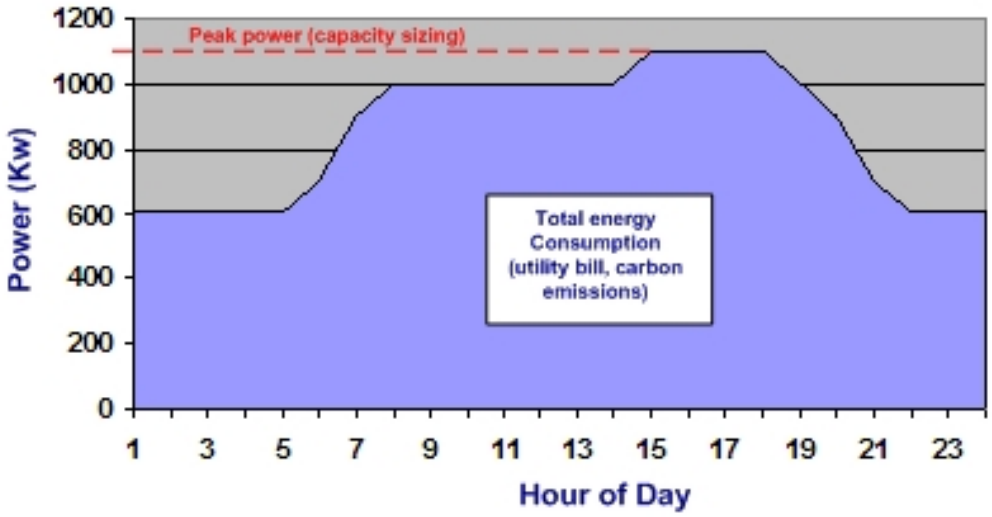
Typically the practical measurement point for “I.T Equipment Power” is the output of the UPS or UPS bypass switch, which in turn feeds critical distribution power boards and hence the critical I.T equipment load.

In an ideal Server Room, 100% of the electricity draw is delivered to the servers, i.e. there are no overheads required for distribution or cooling. This would lead to a PUE / DCE = 1. With current technology, it is not possible to achieve this scenario.

A typical example of an old style data centre, is one with the total facility power at 40Kw and the critical load at 10Kw, resulting in a PUE of 4.0. Preliminary work indicates that many Data Centres may have a PUE of 3.0 or greater.

Workspace Technology's goal is to ensure that all of its ecodesign solutions are 2.0 or less, with the goal of achieving ratios of 1.5, by using the latest energy efficiency technology and through design.

Overall energy consumption



^ **The relationship between power and energy**

The DCE and PUE figures are relative and prove the overall effectiveness of the server room infrastructure design and efficiency. They do not in themselves measure the actual total energy consumption.

Difference between Power and Energy

In a Data Centre, peak power demand determines how big the UPS, Cooling systems and utility power feeds need to be. Reducing the peak power demands through server virtualisation tends to reduce the Capex Investment for new data centres and allows for deferment of expensive capacity expansions to existing data centres.

Enterprise sustainability initiatives are typically more interested in energy because energy consumption determines the quantity of fuel which must be burned at a power plant, with its requisite emissions of carbon dioxide.

Power - spot measurement at a point in time

Energy - is consumed over a period of time.

Power is measured in Kilowatts (Kw) while energy is measured in Kilowatt hours (Kwh).

The distinctions are important because it is possible for systems to draw a lot of power without using much energy and vice versa. For example a 1500W hairdryer used 5 minutes each day uses 15x more instantaneous power than a 100W light bulb left on all year but the hair dry only uses about 1/20 as much energy.

If a Data Centre really draws the same amount of power every hour of the year, then the energy use in Kwh is just the same as power in Kw x 8,760 hours. However, in a green data centre, annual energy use will not be the peak power times 8,760 hours, because:-

- Idle servers and storage can be set to hibernate at off peak times, at night, or on weekends.
- Free cooling can be used during some hours of the day and year depending on external ambient temperature.
- Future generations of I.T equipment might be designed to draw less than their peak power when they are only running at partial computer load.

Conclusions

Conclusion

You cannot manage what you do not know, therefore the measurement of energy efficiency is crucial to ensure that the any data centre or server room delivers effective power distribution and cooling. The use of the Power Usage Effectiveness (PUE) and Data Centre Efficiency (DCE) ratios are simple tools which clearly demonstrate the efficiency of any size, shape or form of server room facility. In time, it is anticipated the server room infrastructure can be graded in a similar fashion to energy labels used on consumer products.

For a complete picture of server room and data centre efficiency, the comparative energy figures must also be identified. The implementation of any future server virtualisation and server room infrastructure fine tuning and technology investments must be clearly measurable.

The implementation of products such as Workspace Technology's EcoMeasure are an excellent way for data centre managers to accurately track and benchmark improvements as changes, additional equipment and technology are deployed.

About Workspace Technology

Workspace Technology provides a range of services for Network Critical Physical Infrastructure (NCPI) facilities which include communications, server and data centre facilities.

The design and implementation of ecodesign* energy efficient solutions forms part of Workspace Technology's overall strategy for providing clients with a complete turnkey approach to the design and build of server room and data centre solutions.

Workspace Technology's expertise and services incorporates consultancy, upgrades, expansion, re-locations, turnkey design & build, planned maintenance and support and remote monitoring services.

A copy of Workspace Technology's "Environment" Server Room Solutions and Services can be downloaded from www.workspace-technology.com.

Workspace Technology are approved Integration Partners for a number of leading manufacturers for UPS and critical cooling systems and are APC InfrastruXure Partners.

*ecodesign represents Workspace Technology's commitment to help clients reduce their carbon footprint through the deployment of energy efficient technology and designs

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IBDN InfraStruXure CSV Certified System Vendor APC Silver Solutions Partner denco Systems Integrator