

Gaining Energy Transparency and Efficiency in the Data Center

Introduction

Because of the proliferation of the Internet and information age in the mid 1990s, there has been a rapid expansion of data centers. To address the extremely rapid growth of applications and IT services, more and more data centers have been built, expanded, and utilized over the last decade and a half. With this growth in data centers, energy consumption has also soared to unheard-of levels and shows no signs of slowing.

According to [The White House Office of Management and Budget, July 2011](#): "The need for backup power supplies, environmental controls (air conditioning, fire suppression, etc.) and special security devices mean that data centers can consume 200 times as much electricity as standard office spaces."

[Information Week, May 2011](#) shared that "More than a third (36%) of data center facilities will run out of space, power, or cooling, or all the above in 2011 or 2012, according to the Uptime Institute, which recently surveyed 525 data center operators and owners, with 71% situated in North America. Of those that will run out of one or more data center lifelines, 40% plan to build a new data center, 62% plan to consolidate servers, and 29% plan to lease collocation space."

According to the same Information Week article, "IT is looking to meet growing demands for more computing power through consolidation, virtualization, and hardware upgrades." This evolution in the industry has brought the need to be able to measure energy use and effectiveness to the forefront.

Energy Measurement Challenges

While the need for accurate energy measurement has long been acknowledged by industry leaders, the tools available have been both costly and inadequate. Energy assessments and measurement of electrical loads have typically been measured through traditional power meters, measuring actual plug loads. The process of deploying meters and measuring individual devices is a very time-consuming and expensive endeavor. According to many data center operators, this can even be an extremely risky endeavor since many meters have to be in line to the devices they are monitoring and require infrastructure to be taken offline for installation.

Because of the inability to realistically measure energy on individual data center assets in an efficient way, data centers have been unable to measure energy reduction and carbon emissions reductions related to data center consolidation, virtualization, and capital equipment upgrade projects. With no way for data centers to measure and report the effectiveness of these projects, their success can only be approximated.

Until now, to read energy on each IT and facilities asset has been a challenge. Only if the asset was instrumented for energy or connected to a device that was instrumented for energy could that data be retrieved. Table 1 provides some examples of ways to actively measure energy on IT assets and the challenges associated with them.

Table 1. Challenges for Measuring Energy in the Data Center

Active Energy Instrumentation	Challenges for Successful Measurement
Floor PDU branch circuit monitoring	<ul style="list-style-type: none">• Lack of granularity• Not device specific• Could have 30 to 40 devices per branch circuit
Intelligent rack PDUs	<ul style="list-style-type: none">• Lack of granularity• Not device specific• Could have 30 to 40 devices per rack PDU
System and switch monitoring	<ul style="list-style-type: none">• Only the newest servers and switches are instrumented for energy measurement• Leaves out all legacy devices over a couple of years old
Industry APIs (for example, Cisco EnergyWise™)	<ul style="list-style-type: none">• Only the newest servers and switches are instrumented for energy measurement• Leaves out all legacy devices over a couple of years old

Energy Management Solutions for the Data Center

Based on feedback from data center owners and operators around the world, we have already identified a comprehensive best practices list that should be implemented by any energy management solution hoping to serve the needs of the data center industry.

Deployment

- No effect on the current network configuration
- Fast and inexpensive deployment
- Automated device discovery
- Device independent: must work with every device in the data center, including legacy equipment

Reporting

- Comprehensive visibility by data center, row, rack, slot, virtual machine (VM), or physical device
- Fully customizable reporting on energy consumption, utilization, costs, savings, and carbon emissions by device, location, cost center, division, and time of day

Business Implications

- Quick time to benefit
- Three- to 6-month ROI
- Assist data center consolidation, virtualization, and cloud projects
- Assist data center energy capacity planning
- Support corporate sustainability initiatives for energy and carbon reduction
- Reduce energy consumption and costs in the data center, while meeting service-level agreements (SLAs), without impeding performance

Cisco EnergyWise Management for Data Centers

[Cisco® EnergyWise™ Management for Data Centers](#) has been designed to these best practices specifications in order to best serve the energy challenges faced by data centers today.

Features of Cisco EnergyWise Management for Data Centers

Using our network-based approach means that EnergyWise Management for Data Centers does not require installation of device-side software, network reconfiguration, or hardware meters. This means quicker time to benefit; significantly lower deployment time; and no hassles with maintenance, configuration, or patches.

Cisco EnergyWise Management for Data Centers uses standard network protocols to retrieve and control energy, acting as a virtual smart meter. With EnergyWise Management for Data Centers, you can query energy information without the need for physical instrumentation from:

- Legacy data center IT assets such as servers, network appliances, switches, and routers
- Facilities devices such as power distribution units (PDUs), computer room air conditioning (CRAC) units, and more

EnergyWise Management for Data Centers conducts the virtual smart metering through an agentless discovery of all IT and facilities assets connected to the network. Through this discovery process, EnergyWise Management is able to utilize asset information, system utilization, and performance details to dynamically calculate energy consumption on a per-device basis. The agentless process:

- Minimizes deployment costs:
 - Human resources
 - Disruption of service
 - Change management processes
- Minimizes capital costs
 - Physical metering
- Reduces time to value from weeks/months to hours/days

By implementing EnergyWise Management for Data Centers, organizations gain the ability to quickly, easily, and inexpensively measure the success of virtualization, as well as the efficiencies gained through data center.

Other Primary Benefits of Cisco EnergyWise Management

- Powerful analytics help quantify, justify, and prioritize energy savings and carbon reduction savings of data center consolidation, virtualization, server retirement, and equipment refresh/upgrade projects.
- Alerting capabilities set thresholds to alert on power, utilization, and temperature conditions.
- Policy engine provides advanced control capabilities such as power capping servers (regulating the amount of energy drawn by a server) and managing power profiles to optimize performance and energy.
- Extensible platform manages, analyzes, and controls energy from any distributed office device or system connected to the network, including those where software agents cannot be installed, such as virtual servers, virtual desktops, desktop monitors, VoIP phones, and printers.

Figure 1 shows how EnergyWise Management unifies IT energy management.

Figure 1. EnergyWise Management Architecture

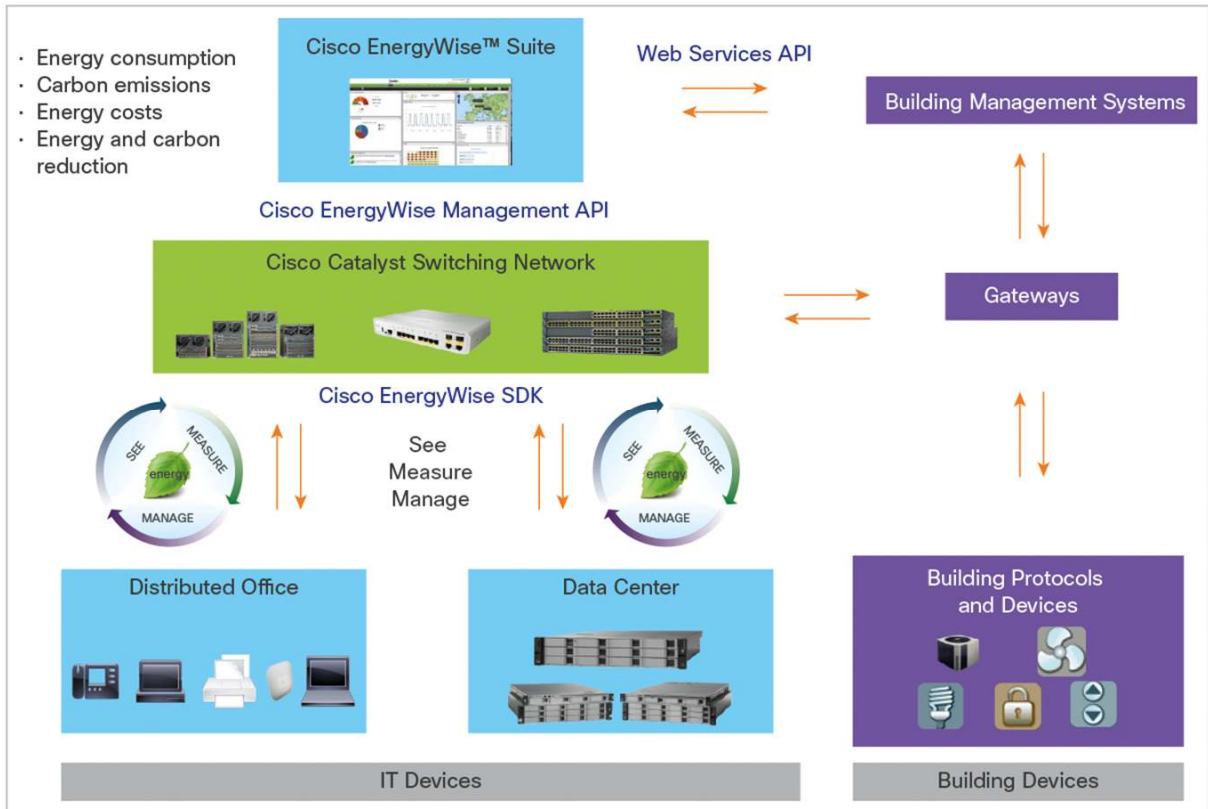
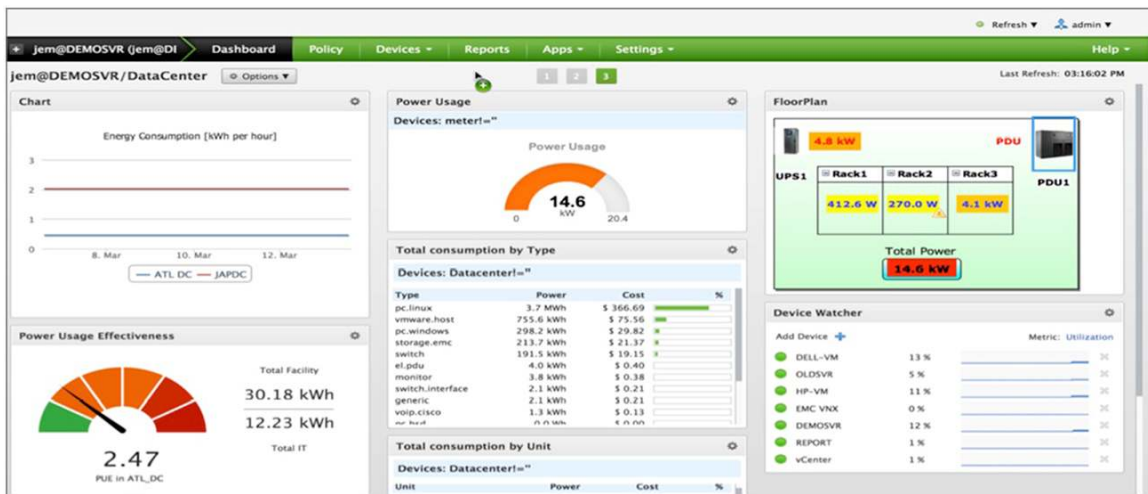


Figure 2 shows the home screen of the Cisco EnergyWise Management console. This management console is completely configurable for each user's needs. Display power by location or even organizational unit. This level of energy visibility provides unique insights as to where the energy is going and how it is being used.

Figure 2. Cisco Energywise Management Dashboard



The EnergyWise Management console allows users to view the power draw of individual devices, reported on and discovered automatically with the software. (See Figure 3)

Figure 3. Energy Consumption by Individual Device

Power	URI	Hostname	Device Type	Model	Location
258.8 W	192.168.3.85	OLDSVR	pc.windows	Dell//PowerEdge 2650	Atlanta//Lab/...
83.5 W	192.168.3.1	ATL-RTR	switch	Linksys//RV016	Atlanta
72.3 W	192.168.3.2	ATL-WAP	switch	Cisco//WRVS440N	Atlanta
45.4 W	192.168.3.116	virtual-aci4nsw	pc.windows		Atlanta//Office
44.3 W	192.168.3.254	CB-ATL-RTR	router	Cisco//2901	東京 Tokyo
21.4 W	192.168.3.126	WINVISTA-PC	pc.windows	VMware//VMware Vir...	Atlanta//Office
2.3 W	192.168.3.22...	LAB-VOIP	generic	Cisco//SPA504G	東京 Tokyo

Furthermore, users can measure the success of power savings of virtualized devices. Figure 4 is an example of the savings measure by virtualizing 25 hardware hosts and consolidating them on a single platform.

Figure 4. Savings Example

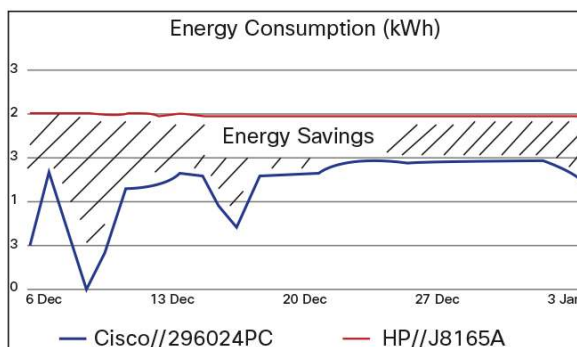
Energy Cost (\$0.10/KWh):	Month	Year	3 Years
Dell//PowerEdge 2650	\$463.65	\$5641.11	\$16.92k
Dell//PowerEdge C1100	\$19.66	\$239.15	\$717.44
» old vs. new	-\$444.00	-\$5401.96	-\$16.21k
CO2 Emissions:	Month	Year	3 Years
Dell//PowerEdge 2650	2.78 tons	33.85 tons	101.54 tons
Dell//PowerEdge C1100	117.94 kg	1.43 tons	4.30 tons
» old vs. new	-2.66 tons	-32.41 tons	-97.24 tons

An Example

One Cisco client, an auto manufacturer, is working to currently consolidate and virtualize its server infrastructure. This client is challenged to measure energy and carbon reduction goals as part of its overall sustainability plan, which is reported annually to the company's shareholders. In the past, IT has not been able to measure or report energy reduction or carbon emission reduction on IT projects because of limitations of legacy IT equipment. With Cisco EnergyWise Management for Data Centers, the company was able to identify, measure, and report carbon and energy reductions for this project within one week of deployment.

In Figure 5, you can see the energy reduction of the old device compared to the new device. The new device has the added benefit of making sure of lower power states and power reduction using Cisco EnergyWise Management. Note that energy is accurately measured without meters but at the device itself.

Figure 5. Comparing the Energy Consumption between an Old and New Device.



Conclusion

With the innovative Cisco EnergyWise Management software and its virtual smart meter, Cisco is empowering data center professionals by putting a previously unheard of amount of reporting and control at their fingertips. For the first time, IT can quickly, efficiently, and inexpensively measure and report actual energy and emissions reduction of virtualization, consolidation, and infrastructure upgrades. With our agentless approach, all of this is being achieved with little effect to IT or facilities operational staff or service levels.




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