ENVIRONMENTAL ENERGY TECHNOLOGIES DIVISION

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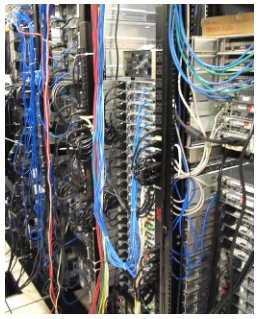
Improving Energy Efficiency for Server Rooms and Closets

Top 14 Measures to Save Energy in Your Server Room or Closet

Introduction

Is there a ghost in your IT closet? If your building has one or more IT rooms or closets containing between 5 and 50 servers, chances are that they account for a significant share of the building's energy use (in some cases, over half!). Servers, data storage arrays, networking equipment, and the cooling and power conditioning that support them tend to draw large amounts of energy 24/7, in many cases using more energy annually than traditional building loads such as HVAC and lighting.

The good news is that there are many cost-effective actions, ranging from simple to advanced, that can dramatically reduce that energy use, helping you to save money and reduce pollution.



A. Simplest, No-Cost, Or Very-Low-Cost Measures

1 Determine computational functions/Turn off any unused servers

An Uptime Institute survey suggests that close to 30% of servers in data centers are consuming power but not doing any useful work. To better manage server usage and utilization, create and regularly update a server hardware and application inventory that will help you track the number of applications running on each server. Mapping applications to the physical servers on which they are running helps identify unused servers and opportunities for consolidation. Just make sure to migrate any remaining data or workloads before shutting down.

2 Increase temperature setpoints to the high end of ASHRAE's recommended limit

ASHRAE temperature guidelines allow much broader operating ranges than those commonly used, allowing the air temperature at the IT equipment inlet to be raised—up to 80°F or higher—which considerably reduces cooling energy usage.

3 Examine power backup requirements (do you really need UPS equipment, and if so, how much is enough?)

Many IT applications are not so critical that they cannot be shut down if there is a power disturbance and restarted without adverse effects. Analyzing your power backup requirements can help you eliminate capital costs for unnecessary or oversized redundant power supplies or Uninterruptible Power Supply (UPS) equipment. It can also help you save energy lost in power conversion in those devices as well as energy to cool them. Anything that needs high reliability should be a candidate for moving to a true data center or cloud solution.

4 Airflow management: Install blanking panels and block holes between servers in racks

Airflow management is conceptually simple and surprisingly easy to implement. Your challenge: ensuring that the cool air from your cooling equipment gets to the inlet of your IT gear, without getting mixed with the hot air coming from the back; and ensuring that hot air going back to the cooling equipment does not mix with the cold air. This can be done by clearing clutter from the airflow path, blanking within and between the racks and the openings in the floor if the gear sits on a raised floor. Containment of cold or hot aisles is a more effective approach. When good airflow management is in place, further savings can be realized through additional measures, such as raising temperature setpoints.

B. A little More Work, But Still Fairly Simple

5 Refresh the oldest equipment with high-efficiency models

Establish server refresh policies that account for increases in generation-on-generation computational ability, energy-efficiency, and power manageability improvements. The savings in energy and software costs will often justify a faster refresh than expected. Consider Energy Star, Climate Savers Computing Initiative Server Catalog (see urls on back page), high-temperature tolerant servers, and high-efficiency power supplies (80 PLUS®). When purchasing new equipment, servers with solid-state drives (SSD), rather than hard disk drives, may be considered, as they feature faster speeds, are generally considered to be more reliable, and consume less power.

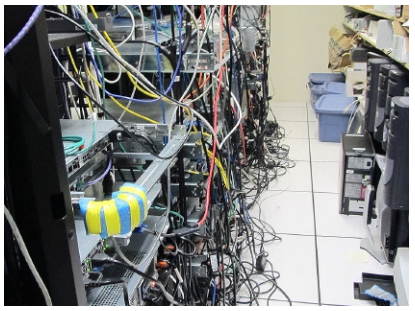
6 Move to a more energy-efficient internal or external data center space, or to cloud solutions

Distributed server rooms are typically not very energy efficient. If a central data center is available, you may be able to save energy and reduce your utility bill, by moving your servers to that location. When a data center is not available, many organizations are moving their equipment to co-location or cloud facilities (public or private cloud facilities both typically provide much better efficiencies than on-premise server rooms). Data centers, colocation and cloud facilities typically offer better security, redundancy, and efficiency than is usually available in server rooms.

7 Energy-efficiency awareness training for IT custodial and facility staff

Have your IT and facilities staff attend server room energy-efficiency awareness classes offered by utility companies, ASHRAE, and other efficiency advocates, to take full advantage of best practices in that area.

C. Higher Investment, But Very Cost Effective



8 Implement server power management

Check for power management options that come with your server models and enable power management if possible. Power management saves energy, especially for applications that do not run continuously or are accessed infrequently. Power cycling can also be implemented to put servers that are unused for long periods of time in a light sleep mode. Lastly, consider built-in or add-in cards that enable servers to be powered on or off remotely when they are not in use.

9 Consolidate and virtualize applications

Typical servers in server rooms and closets run at very low utilization levels (5-15% on average), while drawing 60-90% of their peak power. Consolidating multiple applications on a smaller number of servers accomplishes the same amount of computational work, with the same level of performance, with much lower energy consumption. Virtualization is a proven method for consolidating applications, allowing multiple applications to run in their own environments on shared servers. By increasing server utilization, this reduces both the number of servers required to run a given number of applications and overall server energy use.

10 Implement rack/infrastructure power monitoring

Power monitoring identifies the energy use and efficiencies of the various components in an electrical distribution system. Power meters can be installed at the panels serving the cooling units, or directly on IT and HVAC equipment. Another alternative is to read IT power from UPS display, and to estimate cooling power from the nameplate, taking into account unit efficiency and operating hours. Often power distribution products will have built-in monitoring capability. A key metric is the Power Usage Effectiveness (PUE), which is the ratio of total power to IT input power (with the "overhead" being electrical distribution losses plus cooling power usage). Monitor and strive to lower your PUE: over 2 shows significant room for improvement; 1.5 is good; 1.1 is excellent.

11 Install variable frequency drives on cooling units

If your server room is cooled with a Computer-Room Air Handler (CRAH) or Computer-Room Air Conditioner (CRAC) unit, then it is highly likely that the unit has a single-speed fan, and that it provides more airflow than your IT equipment needs. Units with variable frequency drives (VFDs) have the capability of providing only the amount of air that is required by the IT equipment. To maximize potential energy savings, coordinate the implementation of airflow management measures and airflow isolation systems with the installation of a VFD on the cooling unit fan. See item 4 for air management suggestions. Ideally the fan speed should be dynamically controlled to maintain IT inlet temperature within the recommended range.

12 Install rack- and row-level cooling

If you are installing a new server room or buying new racks, consider local cooling; in-rack and in-row cooling refer to a cooling system located in that rack or row. Another highly efficient option is a Rear Door Heat Exchanger (RDHX), in which a coil is installed directly on the rear (exhaust) section of the server rack. Condenser (Tower) water, chilled water, or refrigerant is run through the coils to passively absorb the exhaust heat and provide the needed cooling. Air circulation through the cooling coil is provided by the internal server fans.

13 Use air-side economizers

An economizer simply draws in outside air for cooling when conditions are suitable. For a server closet with exterior walls or roof, there is a good possibility that an air-side economizer could be installed. This could be in the form of an exhaust fan removing heat in one portion of the room and an opening in another location allowing cool, outside air to enter; or it could be in the form of a fan coil or CRAC/H with air-side economizer capability. Depending on the climate zone in which the server closet is located, this strategy can save a significant amount of energy by reducing compressor cooling energy use.

14 Install dedicated cooling for the room, rather than depending on building cooling

Install cooling equipment solely for the use of the room, so that the building system does not have to operate around the clock. If a retrofit is in order, installing dedicated cooling equipment (like a packaged air conditioning unit) for your server room(s) can result in significant energy savings. Specify a high-efficiency unit with a high SEER rating.

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Energy Star:
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DC

Climate Savers Computing Initiative Server Catalog:
http://www.climatesaverscomputing.org/csci-certification-output/product-catalog

BERKELEY LAB

For information on how to implement each of these actions, refer to:
http://hightech.lbl.gov/documents/data_centers/fact-sheet-ee-server-rooms.pdf

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