Data Center Energy Efficiency Resource List

Data centers are growing in number, scale and cost in the United States, and this trend is expected to continue. Data centers, or computer rooms, can consume up to 50 times the electricity compared to standard office spaces. The high-energy consumption makes data centers excellent candidates for energy efficient design and retrofit measures to reduce electricity use and save money. Data center loads are critical in nature, which elevates design criteria and creates challenges in defining and implementing measures for savings. Energy efficiency in data centers is addressed with the computer equipment, as well as with the cooling and power infrastructure within a building. Facilities and Information Technology (IT) staff must work together with management to address these challenges. The list below provides a strong foundation of resources for data center energy efficiency solutions.

Documents

Roadmap for Public Interest Research for High-Performance Data Centers – This roadmap identifies many areas in which significant efficiency gains could be achieved through the adoption of current best practices, better application of existing technology, and research into new technological solutions. *http://hightech.lbl.gov/documents/datacenters_roadmap_final.pdf*

Guiding Principles for Energy Efficiency – This report provides recommendations on how to measure and publishing values for Power Usage Effectiveness (PUE) at dedicated data center facilities. It does not address IT efficiency. *http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency*

Self Benchmarking Guide for Data Center Energy Performance – This guide is intended to show data center operators, or their contractors, how to perform a comprehensive measurement, or benchmarking, of their own facilities' energy use. *http://hightech.lbl.gov/documents/DATA_CENTERS/Self_benchmarking_guide-2.pdf*

Best Practices Guide for Energy-Efficient Data Centers – This guide provides an overview of best practices for energy efficient data center design, which spans the categories of IT systems and their environmental conditions, data center air-management, cooling and electrical systems, on-site generation, and heat recovery. *http://www.eere.energy.gov/femp/pdfs/eedatacenterbestpractices.pdf*

High Performance Data Centers – This best practices guide was created to provide viable alternatives to inefficient data center design and operating practices, and address energy efficiency retrofit opportunities. *http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/moneybacksolutions/high_tech/best_practices/data_centers_design_guidelines.pdf*

Impact of Virtualization on Data Center Physical Infrastructure – This document discusses data center virtualization, which reduces overall IT equipment electrical load through consolidation of systems. The resulting energy savings can be further maximized if IT or facilities managers adjust the power and cooling infrastructure to accommodate the reduced loads. *http://www.thegreengrid.org/~/media/WhitePapers/White_Paper_27_Impact_of_Virtualization_Data_On_Center_Physical_Infrastructure_020210.ashx?lang=en*

Opportunities for Clean Heat and Power in Data Centers – This report analyzes the opportunities for combined heat and power (CHP) technologies to assist primary power in making the data center more cost-effective and energy efficient. *http://www1.eere.energy.gov/industry/datacenters/pdfs/chp_data_centers.pdf*

Assessing and Improving Data Center Storage-Related Energy Efficiency – This white paper examines the storage aspects of data center operations and demonstrates how many energy-related indications and assessments can be achieved with existing tools and information. *http://www.emc.com/collateral/software/white-papers/h6021-assessing-improving-data-center-storage-energy-efficiency-wp.pdf*

Resources, Tools & Software

Data Center Energy Practitioner Program – The Department of Energy (DOE) has partnered with industry to develop the Data Center Energy Practitioner Program, which is designed to accelerate energy savings in the dynamic and energy-intensive marketplace of data centers by training Data Center Energy Practitioners, and providing energy efficiency information. *http://www.eere.energy.gov/industry/datacenters/dc_cep.html*

Data Center Energy Profiler/DC Pro – DC Pro is an online software tool provided by DOE to help industries identify how energy is being purchased and consumed by their data center(s), and also identify potential energy and cost savings. *http://www.eere.energy.gov/industry/datacenters/software.html*

Designing an Expansion or New Facility?
Consider CHP which can provide the following benefits:
- Reduced energy-related costs and enhanced economic competitiveness
- Increased power reliability and decreased risk from outages
- Increased ability to meet facility expansion timelines
- Reduced emissions of greenhouse gases and criteria air pollutants

Source: **U.S. Environmental Protection Agency**
http://www.epa.gov/chp/documents/datacenter_fs.pdf

Building Energy Software Tools Directory – This directory provides information on 392 building software tools for evaluating energy efficiency, renewable energy and sustainability in buildings. The energy tools listed in this directory include databases, spreadsheets, component and systems analyses, and whole-building energy performance simulation programs.
http://www.eere.energy.gov/buildings/tools_directory/

Data Center Energy Efficiency Savings Calculator – 42U's Data Center Efficiency Savings Calculator helps IT Professionals and C-level management understand the short and long-term savings that can be achieved by improving the energy efficiency of their data center infrastructure.
http://www.eere.energy.gov/buildings/tools_directory/software.cfm/ID=584/pagename=alpha_list_sub

Data Center Energy Management Tools – A host of computer-based tools are available to help evaluate energy efficiency options for data centers, spanning engineering and economic analysis. Some of the tools described below focus on evaluating specific technologies (e.g. uninterruptible power supplies), while others help to organize information or guide the user through cross-cutting processes such as benchmarking. *http://hightech.lbl.gov/DCTraining/tools.html*

Portfolio Manager – Portfolio Manager is an interactive energy management tool that allows tracking and assessing energy and water consumption across an entire portfolio of buildings in a secure online environment. *http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager*

Target Finder – Target Finder helps users establish an energy performance target for design projects and major building renovations. By entering a project's estimated energy consumption, users can generate an energy performance rating based on the same rating system applied to existing buildings. Outstanding projects may be designated as "Designed to Earn the Energy Star."
http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

Case Studies

Energy Efficient Data Center Demonstration Project – A case study by the Silicon Valley Leadership Group of an approach to improving energy efficiency in a chilled water and cooling system.
http://www.coolcentric.com/marcom/click_counter.php?CID=CS2

Sun Microsystems Energy – Efficient Modular Cooling Systems – Comparison of the efficiency of the modular approach to conventional cooling systems.
https://microsite.accenture.com/svlgreport/Documents/pdf/case%20study_sun_modularv2.pdf

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Where Does the Energy Go?
In existing facilities, up to 75 percent of the energy used in a server room feeds the servers and other IT equipment. The remainder is used primarily by the operation of mechanical and electrical systems – largely cooling and air handling equipment. A comprehensive energy conservation program will seek to reduce the load of the IT equipment, while cooling the remaining load efficiently.

Source: *http://www.energyexperts.org*

Data Center Efficiency Summit – Presentations and case studies from this industry event. *http://dcee.svlg.org/case-studies/*

Energy Efficient Data Center Retrofit - Wireless Sensor Network – Lawrence Berkeley National Laboratory EETD News story about a data center retrofit at the Lab, including reconfiguring the HVAC and installing wireless sensors. *http://eetd.lbl.gov/newsletter/nl34/eetd-nl34-4-datacenter.html*

Google's Data Center Efficiency Overview – Describes Google's efforts to reduce energy use at their energy-intensive facilities. *http://www.google.com/corporate/datacenter/index.html*

U.S. Department of Energy Data Center Assessment Studies – Summaries of studies at Verizon, Lucasfilm, and Sybase Inc. *http://www.eere.energy.gov/industry/datacenters/case_studies.html*

Rebates & Incentives

Your best source of information is your local utility company. You can also check the **Database of State Incentives for Renewables and Efficiency**: *http://www.dsireusa.org/* At this point, only a few states offer rebates or incentives for energy efficiency in Data Centers.

Ask a Technical Question

U.S. Department of Energy
EERE Information Center
https://www1.eere.energy.gov/information center/
1-877-337-3463

Northwest Clean Energy
Application Center
http://www.Northwestcleanenergy.org/ContactUs.aspx
The U.S. Department of Energy Clean Energy Application Center provides resources and assistance about CHP, district energy, and waste heat recovery, to industries in Alaska, Washington, Oregon, Idaho and Montana.

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