ENERGY EFFICIENCY IN BUILDINGS

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DATA CENTER TIP SHEET

Credits:
This Data Center Energy Efficiency Tip Sheet is adapted from the Quick Start Guide prepared by Lawrence Berkeley National Laboratory for U. S. General Services Administration

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Introduction

There has been rapid growth of the Information Technology (IT) industry in India. Data Centers – the key infrastructure component powering this sector – operate continuously (24x7) throughout the year, and are very energy – intensive. These high- tech facilities generally consume many times the energy of a typical office building as much as a hundred times more on a square-meter basis. These facilities are experiencing significant growth in India, making it one of the fastest growing energy – use sectors and impacting electrical supply and distribution.

In January 2008, USAID ECO-III Project organized a one – day workshop on "Ensuring Global Competitiveness of Indian IT Sector by Improving Energy Efficiency of Indian Data Centers" in Delhi covering the best practices in Data Centers. ECO-III also held a half – day brainstorming meeting with industry experts to identify barriers to energy efficiency in Indian Data Centers, develop possible solutions and strategies to overcome those barriers, and plan next steps. Some of the recommendations made by the group were:

- Create Information/Awareness Framework
- Perform Capacity Building/ Training
- Establish an Industry Forum
- Develop Performance Indicators and Benchmarking Framework
- Create Regulatory, Standards, and Incentives Framework
- Undertake Research Work

USAID ECO-III Project is collaborating with DOE-Lawrence Berkeley National Laboratory (LBNL) and NASSCOM to promote the energy efficiency practices in IT companies in India.

The Bureau of Energy Efficiency (BEE) has initiated an activity to launch a "Data Center Energy Efficiency Design Code" and a "Best Practice Manual" in partnership with the Confederation of Indian Industry (CII) and industry members. USAID ECO-III Project is working with NASSCOM to make Indian IT companies greener under the NASSCOM Green IT Initiative. This best practice tip sheet has been adapted from "A Quick Start to Energy Efficiency" developed by LBNL.

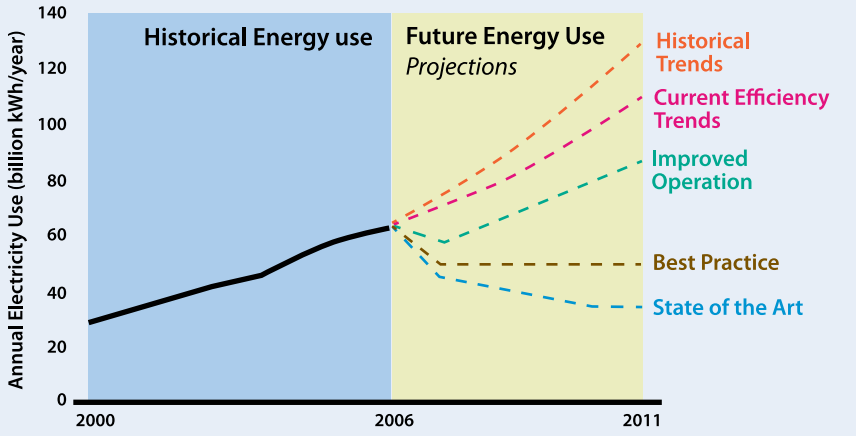
Data Center Energy Efficiency – Taking a Systems Approach

Data Center energy efficiency is derived from addressing both your hardware equipment and your infrastructure.

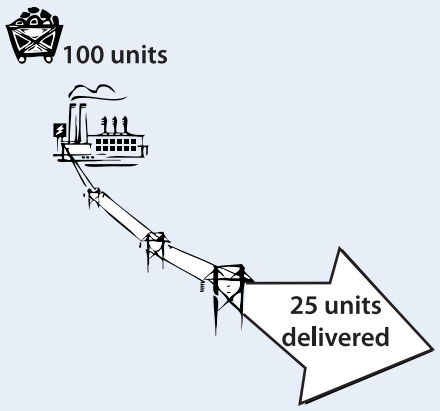
Less than half the power used by a typical Data Center powers its IT equipment. Where does the other half go? It goes to support infrastructure including cooling systems, UPS inefficiencies, power distribution losses and lighting. Why does this matter?

- By 2012, the power costs for the Data Center equipment over its useful life will exceed the cost of the original capital investment.

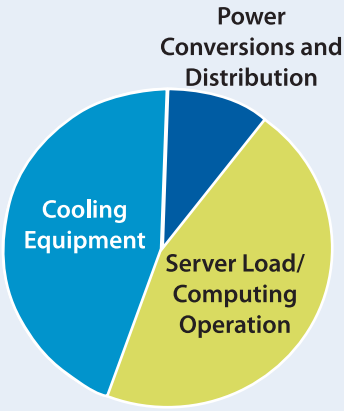




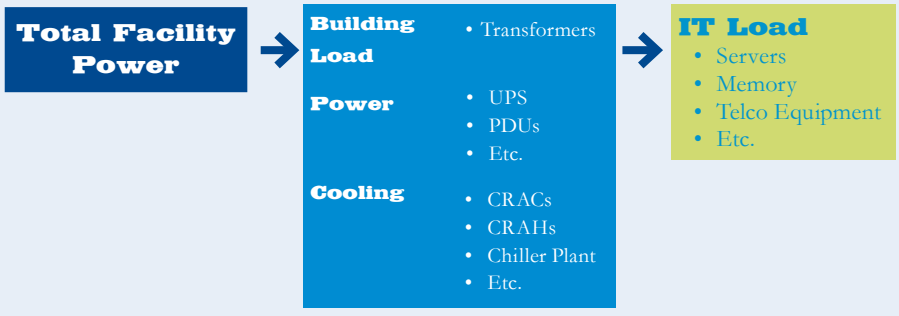
Source: Report to Congress on Server and Data Center Energy Efficiency Public law 109-431, US EPA,August 2, 2007



Percentage of useful energy avilable at site after accounting for generation, transmission and distribution losses



Breakout of Electricity Consumption in a typical Data Center



$$\text{Power Usage Effectiveness (PUE)} = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

$$\text{Data Center Infrastructure Efficiency (DCiE)} = \frac{1}{\text{PUE}} = \frac{\text{IT Equipment Power}}{\text{Total Facility Power}}$$

NOTE: Improving PUE from 2.0 to 1.6 for a Data Center with a 2.5 MW IT load yields a 20% energy savings or over INR 50 lakhs annual savings at INR 5 /kWh.

- By 2020, the carbon footprint of Data Centers will exceed the airline industry.
- With today's best practices, 20-50% energy savings are possible, extending the life and capacity of existing Data Center infrastructure, avoiding millions of metric tons of carbon emissions.

Source: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431, US EPA, August 2, 2007.

The energy used by a 10MW Data Center each year is equivalent to the energy consumed by 73,000 typical urban Indian houses or equivalent to energy consumed by 17,520 typical Indian cars.

Source: Equivalent matrix prepared by ECO-III Project. (www.eco3.org/downloads/equivalentmatrix.pdf)

Energy Usage in Data Centers

How Energy Gets to Your Servers

Power plant inefficiencies and transmission line losses mean that just 15% or less of source energy is typically available to your servers. Because support infrastructure typically consumes approximately half of site energy, improvements in IT efficiency (e.g. server virtualization, consolidation, storage and network gear) yield a 2:1 ratio in total energy savings. Additionally, the following key changes to the on – site power chain present substantial savings opportunities:

- Increase distribution voltage
- Incorprate DC distribution where possible
- Improve equipment power supplies
- Improve uninterruptible power supplies and transformer efficiency
- Monitor energy at all levels

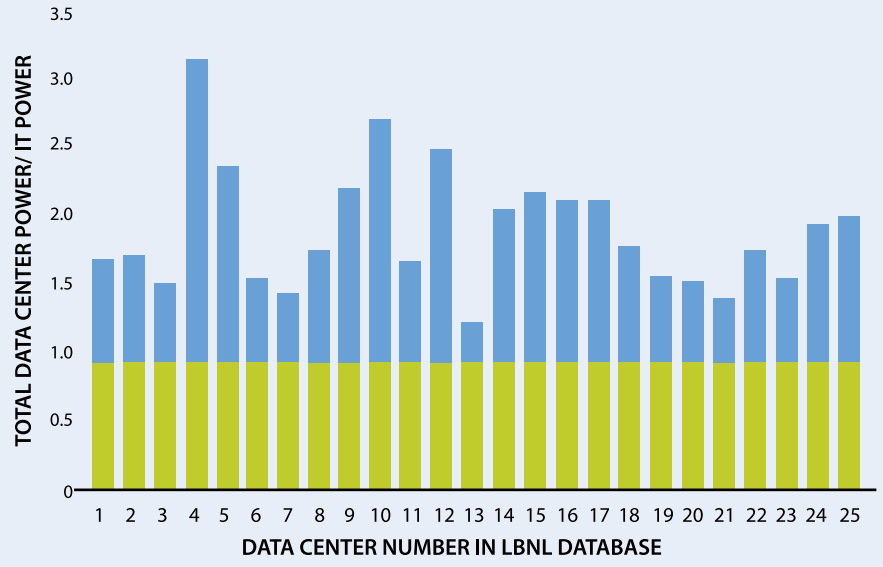
Meter, Measure, Manage

Measuring where you are now is a good place to start.

Energy Benchmarking and Continuous Monitoring

Energy benchmarking can be effective in helping to determine the efficiency of your current Data Center and to identify better-performing designs

High Level Facility Metrics



and strategies. As new strategies are implemented, energy benchmarking will enable tracking of performance.

The benefits of measuring, monitoring, and taking steps to optimize your energy efficiency also will enable you to extend the life and capacity of your existing Data Center infrastructure, as well as avoid millions of metric tons of carbon emissions that would result from expansion.

Lowering PUE (Total Facility Energy/IT Equipment Energy)

In a study of 25 Data Centers conducted by LBNL, roughly 87% of the site energy reaches the IT equipment in the best case, while in the worst case only 33% makes it to the IT equipment. The lower your Power Usage Effectiveness (PUE), the more efficient is your Data Center infrastructure (power distribution and cooling).

Environment and Airflow

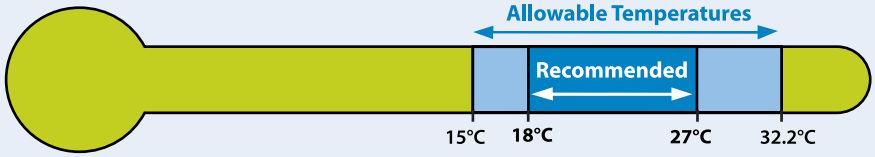
You want to maintain your Data Centers at a comfortable temperature for your servers (not your staff). Recommended and allowable airflow, filtration, humidity, and temperature limits are all described in ASHRAE publications such as "Thermal Guidelines for Data Center Environments".

Air Management Opportunities

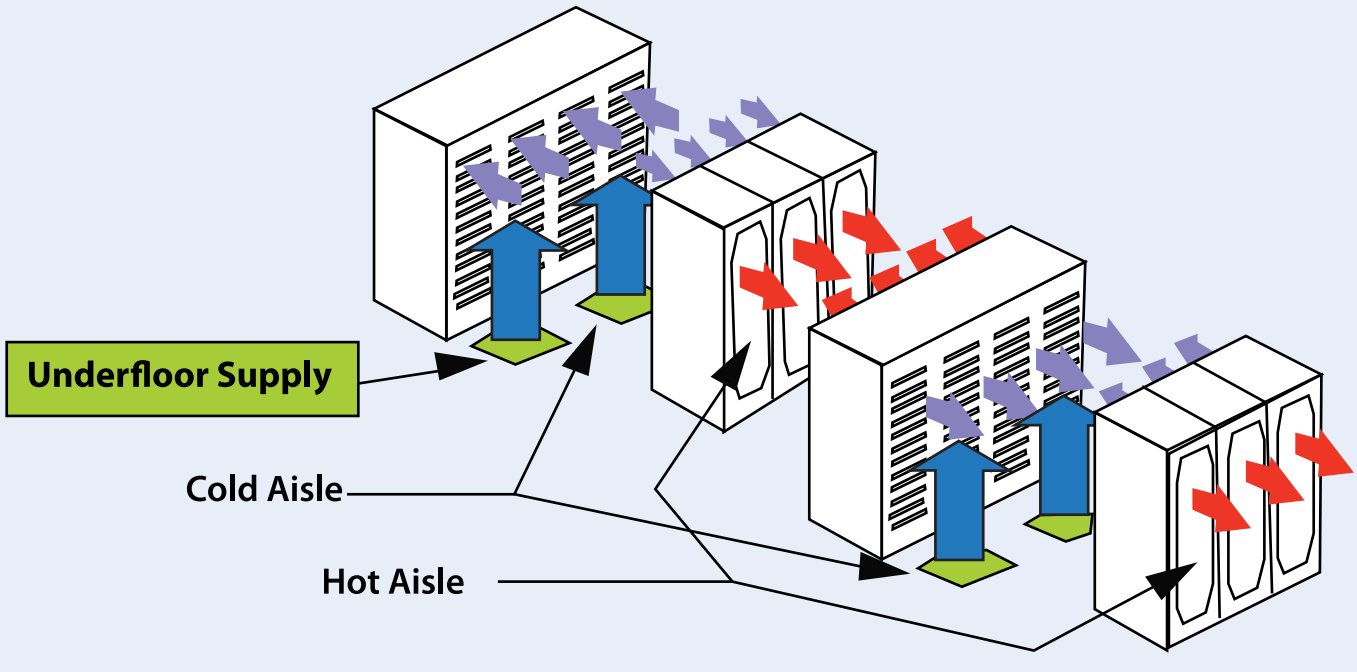
If you feel cold in your Data Center, you have an opportunity!

- Arrange racks in a hot aisle/cold aisle configuration and isolate the two. Your cold air supply could be in the mid-20s°C and your hot air return could be as high as 32-38°C. That is why you want to keep them separate.
- Consider using computer room air handlers (CRAHs) rather than

Temperature Guidelines at the Inlet to IT Equipment



Cold and Hot Aisle Layout



computer room air conditioners (CRACs) for improved performance. Get variable speed fans to match server flow requirements.
- Optimally configure floor tile perforations, plug floor leaks, and install blanking plates in every unfilled rack.
- Continuously monitor temperature, humidity, and underfloor pressure.

Key Best Practices

Optimize the Central Plant

Typically, a central cooling plant and air handlers are more efficient than distributed air conditioning units. Begin with an efficient water – cooled variable speed chiller, add high efficiency air handlers, low-pressure drop components, and finish with an integrated control system that minimizes unnecessary dehumidification and simultaneous heating and cooling.

Use temperature resets to allow use of medium-temperature chilled water (12.8°C or higher). Warmer chilled water improves chiller plant efficiency and eliminates the need for the chiller during many hours of operation (tower cooling).

Free Cooling

Can you design your Data Center for free cooling? Can you retrofit the outside air supply? Can you retrofit a water side economizer (use cooling tower to pre-cool return "chilled" water)? It is all about humidity and temperature.

Right Sizing

When the ultimate load is uncertain, Data Center cooling systems are often oversized and operate at inefficient part loads. Therefore, it makes sense to pre-install fixed elements such as ducts and pipes, but design for modular growth of the mechanical equipment. Include variable speed fans, pumps and compressors. Right size all your plant equipment; overbuilding in advance of actual needs makes many subsystems operate inefficiently.

Use Liquid Cooling of Racks and Computers

Water is 3,500 times more effective than air on a volume basis; so it cools servers and appliances more efficiently than air conditioning! Today, you can purchase liquid cooled racks. Manufacturers are prototyping liquid-cooled computers as well.

People are Key

Facilities and IT staff bring different perspectives to create better solutions when it comes to Data Center energy efficiency. Try inviting your counterpart to an informal meeting so you can begin to learn about their challenges and explain your own.

How To Start

Commit to Improved Design and Operations

- Benchmark existing facilities
- Document design intent
- Introduce energy optimization early in the design process
- Use life-cycle total cost of ownership analysis
- Continuously monitor energy and environmental conditions
- Re-commission as a regular part of maintenance
- Empower IT and facilities staff to work together

Learn More

You can get more information about Data Center Energy Efficiency Initiative in India at the following websites:

1. *USAID ECO-III Project:* www.eco3.org
2. *Bureau of Energy Efficiency:* www.bee-india.nic.in
3. *NASSCOM:* http://www.nasscom.in/nasscom/templates/LandingNS.aspx?id=55759
4. *Confederation of Indian Industry:* www.greenbusinesscentre.com

The following topics need to be discussed as a part of an overall Data Center energy efficiency strategy because each of them — separately as well as part of an integrated plan — help in improving energy efficiency in Data Centers.

- Air management
- Right-sizing
- Central plant optimization
- Efficient air handling
- Free cooling
- Humidity control
- Server efficiency
- Liquid cooling
- Improving power chain
- UPSs and equipment power supplies
- On-site generation
- Designing, measuring & optimizing processes

You can get more information about the above topics at the websites listed below:

1. *ASHRAE Data Center Technical Guidebooks:* http://tc99.ashraetcs.org
2. *DOE Save Energy Now Tools and Resources:* www.eere.energy.gov/datacenters
3. *Lawrence Berkeley National Laboratory (LBNL):* http://hightech.lbl.gov/datacenters
4. *Energy Star® Program:* http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency

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