



# A Quick Start to Energy Efficiency

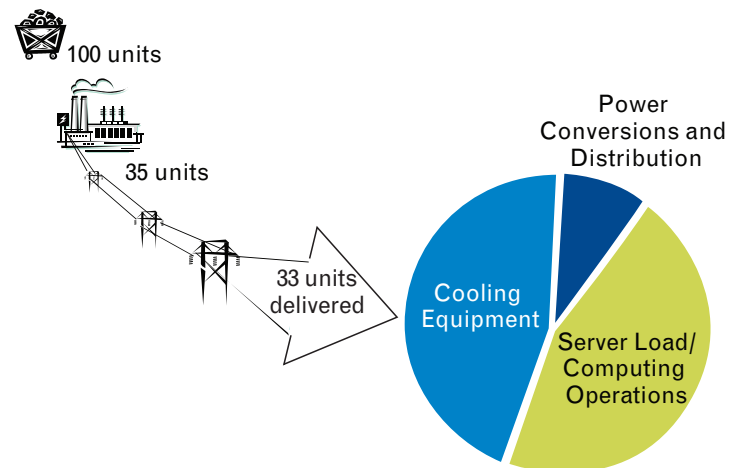
Data Center Energy Efficiency  
Increase Your Data Center Energy Efficiency • Increase Your Data

## Energy Usage in Data Centers

## Meter, Measure, Manage

## Environment and Airflow

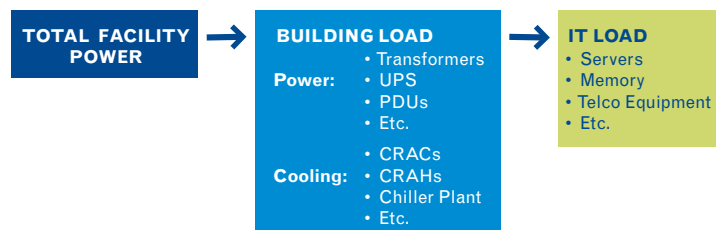
### How Energy Gets to Your Servers



Power plant inefficiencies and transmission line losses mean that just 15% 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 presents substantial savings opportunities:

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

### High Level Facility Metrics



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

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

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 \$800,000 annual savings at \$0.08/kilowatt hour.

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

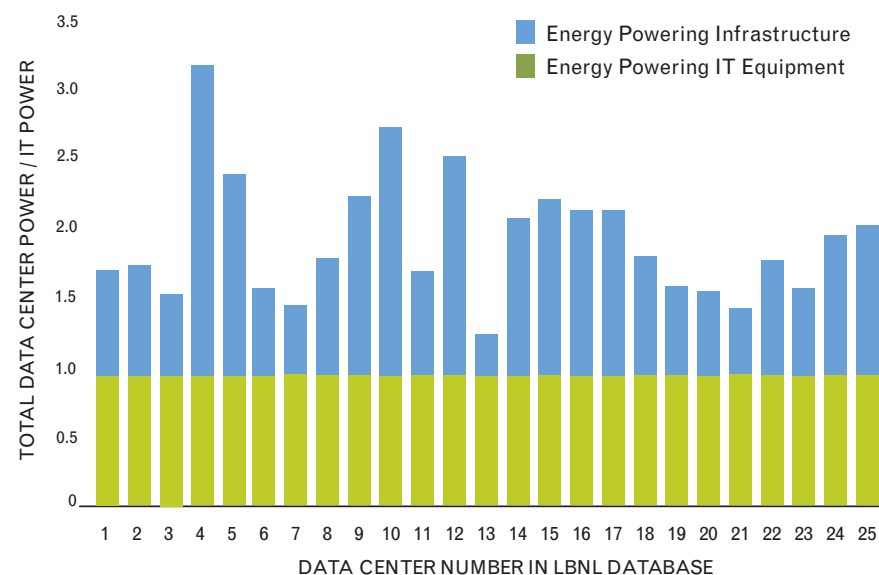
### Energy Benchmarking and Continuous Monitoring

Energy benchmarking can be effective in helping to determine the efficiency of your current data center and to identify better-performing designs and strategies. As new strategies are implemented, energy benchmarking will enable comparisons 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.

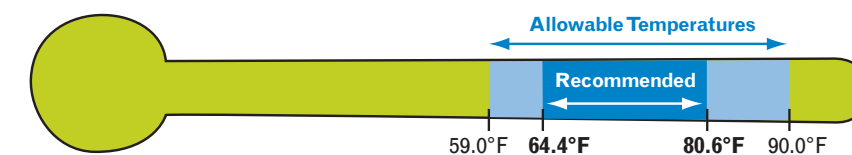
### Lowering PUE (Total Facility Energy/IT Equipment Energy)

In a study of 25 data centers studied by Lawrence Berkeley National Laboratory (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 PUE, the more efficient is your data center infrastructure (power distribution and cooling).



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".

### Temperature Guidelines at the Inlet to IT Equipment



### 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 70s Fahrenheit and your hot air return could be as high as 90–100 degrees Fahrenheit. That is why you want to keep them separate.
- Consider using air handlers (CRAHs) rather than 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.

### Cold and Hot Aisle Layout

