



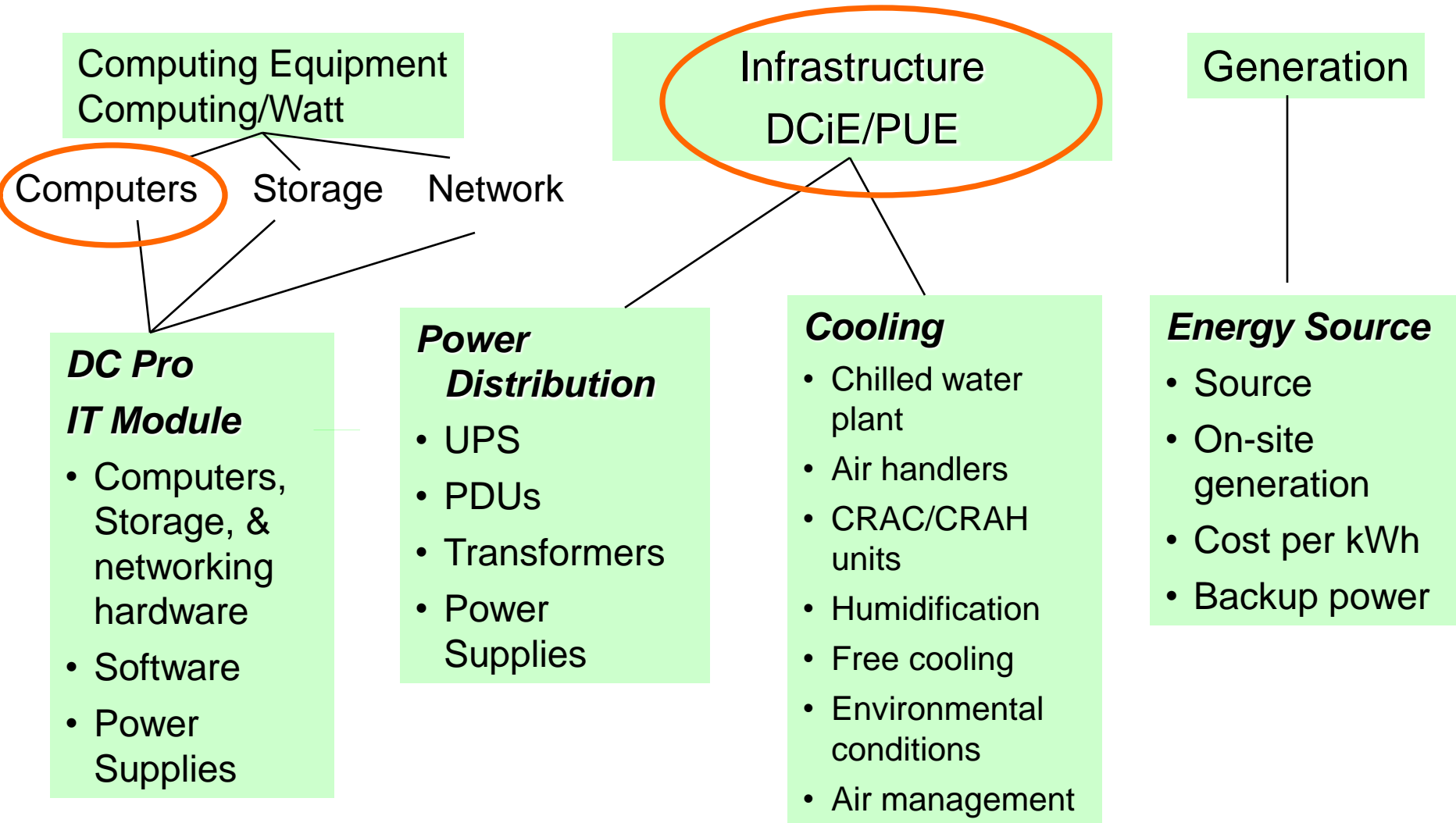
Data Center Energy Efficiency Metrics

**Intel Great Debates
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Computing Efficiency (Useful work/Energy)





DOE Save Energy Now “DC Pro” key elements

Data Center Performance

- Overall energy performance (baseline) of data center
- Performance of IT & infrastructure subsystems compared to benchmarks
- Potential areas for efficiency improvement
- Energy cost (\$), source energy (Btu), and carbon emissions (Mtons)



IT

- Computers, Storage, & networking hardware
- Software
- Power Supplies



Cooling

- Chillers, Pumps, Fans
- CRAC/CRAH units
- Humidification
- Free cooling



Electrical Dist.

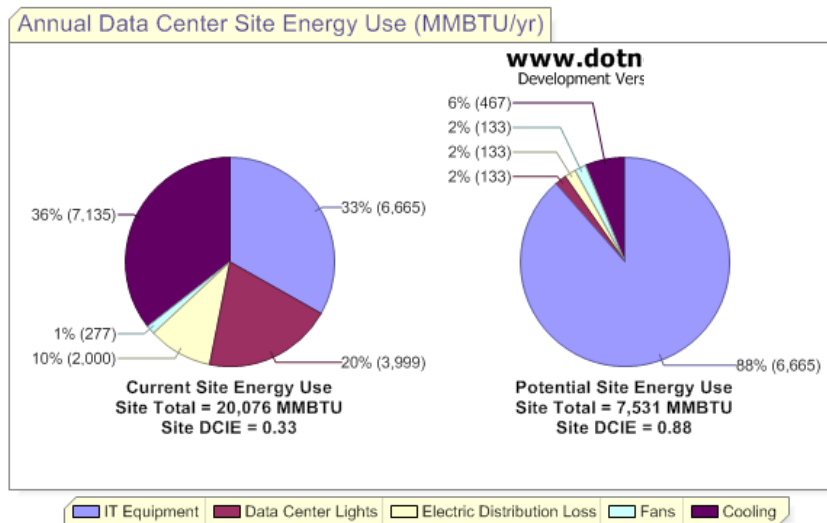
- UPS
- PDUs
- Transformers
- Power Supplies



Energy Source

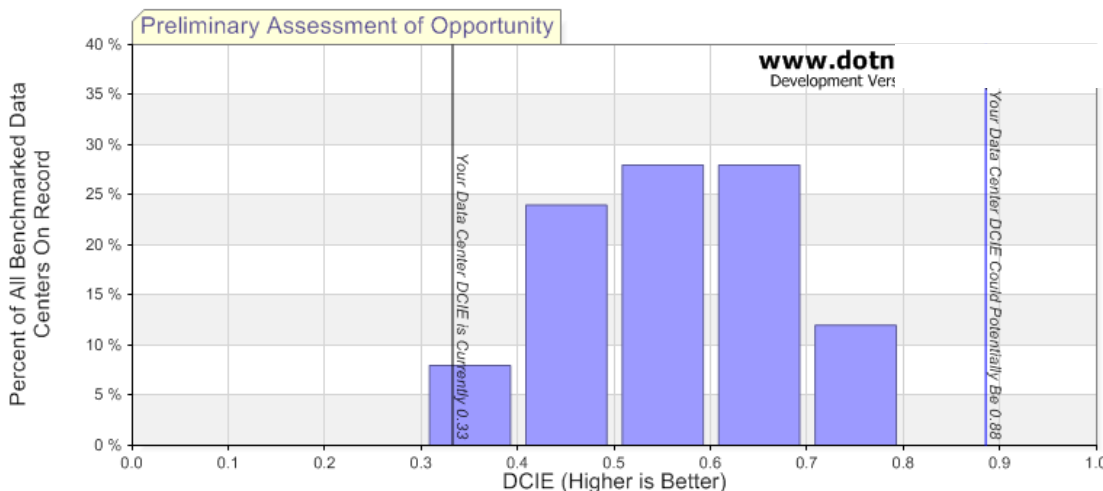
- Source of power
- On-site generation
- Cost per kWh
- Backup power

DCiE - (rating the infrastructure)

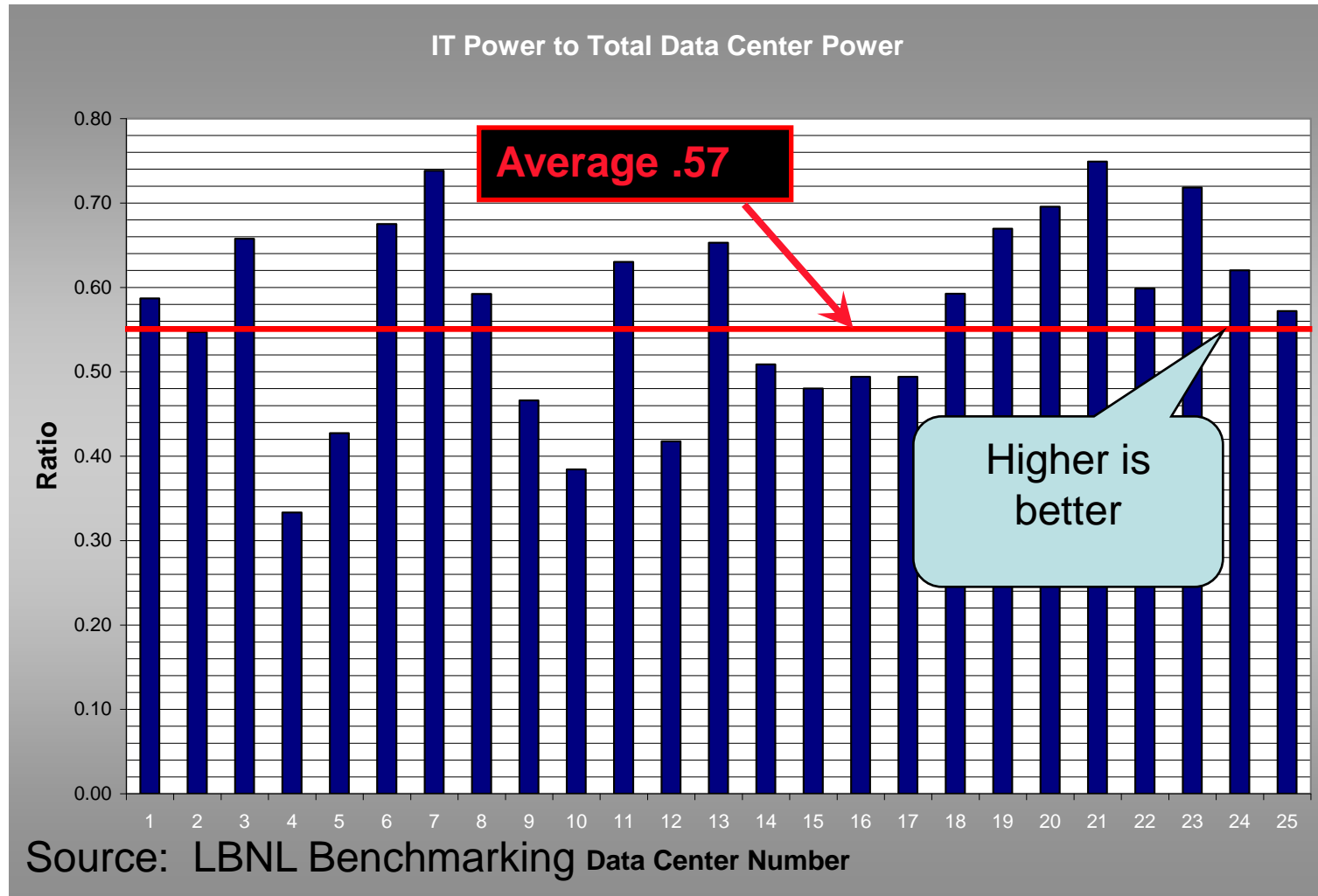


DCiE = IT Energy/Total Data Center Energy

For more information visit <http://www.dotnetcharting.com>

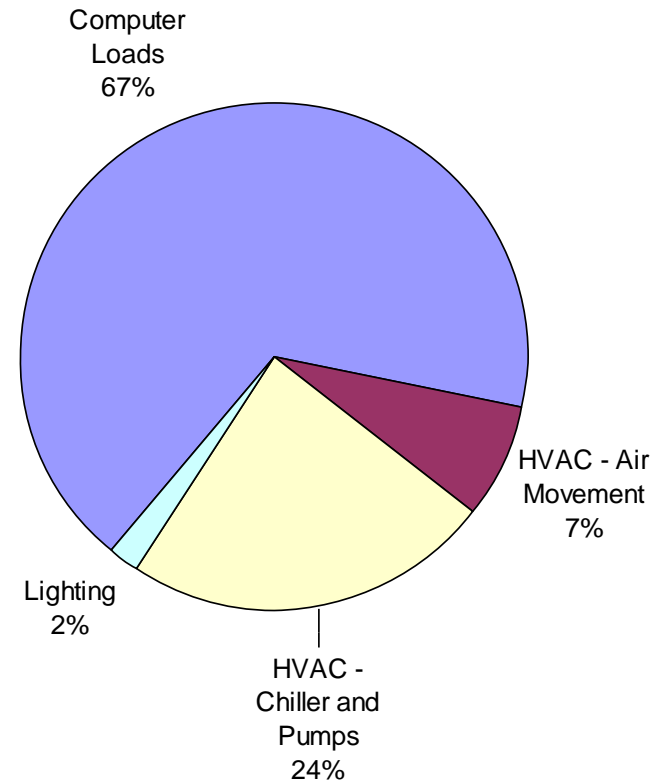
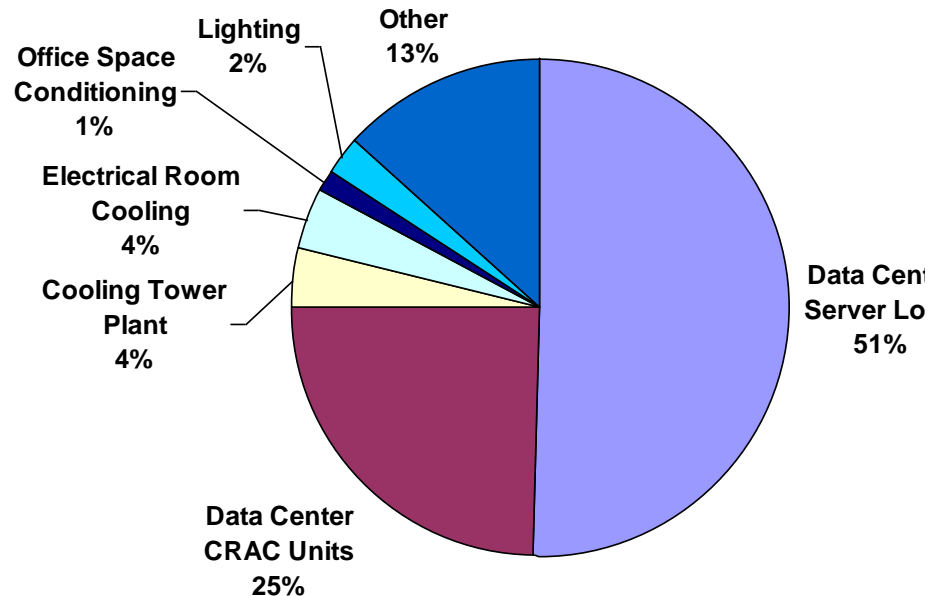


Benchmarking DCiE



LBNL Benchmarking - Energy End Use

The relative percentages of the energy actually doing computing vary considerably.





Other Data Center Metrics:

- Power distribution: UPS efficiency, IT power supply efficiency (ratio of output to input)
- HVAC
 - IT total/HVAC total
 - Fan watts/cfm
 - Pump watts/gpm
 - Chiller plant (chiller or overall HVAC system) kW/ton
- Lighting watts/square foot
- Rack cooling index (fraction of IT inlet conditions within ASHRAE recommended temperature range)
- Return temperature index $(RAT - SAT) / IT\Delta T$ (a measure of mixing of air in the data center)

ENERGY STAR for BUILDINGS



AEGON Center
Louisville, KY



Shriners' Hospital for Children
Houston, TX



500 Boylston St.
Boston, MA



Westin San Francisco
Airport
Millbrae, CA



Twin Peaks Charter Academy
Longmont, CO



Blue Earth County Courthouse
Mankato, MN

EPA's Energy Performance Rating System

- Obtaining data on IT energy use and total data center energy use for large sample of data centers (voluntary effort) over 12-month period
- Collecting data to analyze key variables. Adjustments may be made to account for factors such as climate or tier level
- Rank performance on scale of 1-to-100 where one point represents one percentile of the sample
- Top quartile eligible for Energy Star label
- Usable for both stand-alone data centers and data centers housed within office or other buildings
- Data must be measured in a consistent way
- To date over 100 organizations with over 200 centers are participating

Data Needed to Build Rating

- Required data
 - Climate zone (zip code)
 - Type of data center (function)
 - Reliability (Tier Level)
 - Total IT plug energy (12 months of data)
 - Total facility energy usage (12 months of data for all fuels)
- Data needed from a wide variety of facilities (large/small, stand-alone/within larger bldg, etc.)
- EPA estimates that good data from at least 100 data centers is needed in order to develop the rating

ENERGY STAR

Data Center Rating Goals

- Ideal high level metric: kBtu / useful work
- Challenge: how to measure “useful work”?
- Next Steps
 - Agree on “useful work” – challenge industry to reach consensus
 - Implement working metrics for end users while industry determines definition of “useful work”



DC Pro tool:

www.eere.energy.gov/datacenters

Energy Star Buildings Program

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DOE Data Center program

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