Data Center Rating Systems

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Various programs acknowledge and encourage best practices

- Environmental Performance Criteria proposed to US Green Building Council
- DOE’s Save Energy Now Data Center Assessments
- EPA’s Energy Star Server Spec
- EPA’s Energy Star Buildings Data Center label
- European Code of Conduct
Federal Energy Management Program
- Best practices showcased at Federal data centers
- Pilot adoption of Best-in-Class guidelines at Federal data centers
- Adoption of to-be-developed industry standard for Best-in-Class at newly constructed Federal data centers

Industrial Technologies Program
- Tool suite & training
- Metrics & energy baselining
- Qualified specialists
- Case studies
- Certification of continual improvement
- Recognition of high energy savers
- Best practice information
- Best-in-Class guidelines
- R&D - technology development

EPA
- Metrics
- Server performance rating & ENERGY STAR label
- Data center performance benchmarking

Industry
- Tools
- Metrics
- Training
- Best practice information
- Best-in-Class guidelines
- IT work productivity standard
Proposed new LEED™ criteria for Data Centers

Sponsored by the California Energy Commission, Lawrence Berkeley National Laboratory in collaboration with ASHRAE and other industry organizations developed a proposed set of criteria for use in rating Data Centers.
Environmental Performance Criteria

• Similar to existing LEED™ rating system for commercial buildings

• Draft criteria for use with data center facilities was developed in collaboration with data center industry associations and formally reviewed by their members

• Criteria emphasizes energy and water issues and de-emphasizes other less important sustainable issues (e.g. bamboo floors, bike rack) since energy and water impacts have more impact
• Points established and weighted as recommended by the industry

• Proposed criteria submitted to the USGBC in January, 2009 for consideration
## Summary of EPC recommendations

<table>
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<th>Category</th>
<th>Current LEED™ Points</th>
<th>Proposed LEED™ Points</th>
<th>Eliminated Points</th>
<th>New Proposed Points</th>
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**DOE Industrial Technologies Program**

**Working to improve the energy efficiency of U.S. industry**

U.S. industry consumes 32 quadrillion Btu per year -- almost 1/3 of all energy used in the nation

Partnerships with energy-intensive industries are key to ITP’s success:
- 5 quads of energy savings, 86 MMTCE reduction

**Save Energy Now** is working to reduce industrial energy intensity 25% by 2017

Data centers are an important and growing “industry”:
- Consumed 1.5% of all electricity in the U.S. in 2006
- Power demand is growing about 12% per year
- Power and cooling systems are “industrial” in scale and complexity
Save Energy Now: Products & Services

**Tools**
- Process Heating
- Steam Systems
- Plant Energy Profiler
- Motors & Pumps
- Fans

**Information**
- Website
- Information Center
- Tip Sheets
- Case studies
- Webcasts

**Training**
- Basic
- Advanced
- Qualified Specialist

**Assessments**
- Energy Savings Assessments
- Industrial Assessment Centers
DOE Save Energy Now Data Center Program

Major Program Elements

1. Develop and test “DC Pro” Software tools

2. Create and publicize Save Energy Now case studies based on pilot energy assessments

3. With ASHRAE, jointly create an awareness training curriculum

4. Develop Qualified Specialists program for Data Centers

5. Create best practice guidelines for “Best-in-Class” data centers and validate with Technology Demonstrations

6. Assist in improving Federal data centers

7. Create and implement a collaborative research program with industry
Rating performance using “DC Pro”

Tools define baseline energy use and identify key energy-saving opportunities

– Determine overall performance
– Benchmark subsystems
– Assess energy savings potential
– Track energy intensity improvement
– Provide quantification of key metrics including cost ($), primary energy (Btu), and carbon
– Encourage continual improvement
DC Pro tool suite

- **Profiling Tool**: profiling and tracking
  - Establish DCIE baseline and efficiency potential
  - Document actions taken
  - Track progress in DCiE over time

- **Assessment tools**: more in-depth site assessments
  - Suite of tools to address major sub-systems
  - Provides savings for efficiency actions
DC Pro tools

**High Level Profiling Tool**
- Overall energy performance (baseline) of data center
- Performance of systems (infrastructure & IT) compared to benchmarks
- Prioritized list of energy efficiency actions and their savings, in terms of energy cost ($), source energy (Btu), and carbon emissions (Mtons)
- Points to more detailed system tools

**IT Module**
- Servers
- Storage & networking
- Software

**HVAC**
- Air handlers/conditioners
- Chillers, pumps, fans
- Free cooling

**Air Management**
- hot cold separation
- environmental conditions

**Power Systems**
- UPS
- Transformers
- Lighting
- Standby gen.

**On-Site Gen**
- Renewables
- use of waste heat
Computing Efficiency (useful work/energy)

**Computing Equipment**
- Computing/Watt
- DC Pro
- IT Module
  - Computers, Storage, & networking hardware
  - Software
  - Power Supplies

**Power Distribution**
- UPS
- PDUs
- Transformers
- Power Supplies

**Infrastructure**
- DCiE/PUE

**Air Management**
- Hot/cold isolation
- Bypass
- Recirculation

**HVAC**
- Chilled water plant
- Air handlers
- CRAC/CRAH units
- Humidification
- Free cooling
- Environmental conditions

**Generation**
- Energy Source
  - Source
  - On-site generation
  - Cost per kWh
  - Backup power

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Data center infrastructure efficiency - DCiE

IT Power to Total Data Center Power

Average .57

Higher is better

Source: LBNL Benchmarking
Other Data Center Metrics:

- **Power Distribution**: Power conversion and distribution losses
- **HVAC**
  - IT total/HVAC total
  - Fan watts/cfm
  - Pump watts/gpm
  - Chiller plant (chiller or overall HVAC system) kW/ton
- **Air Management metrics**:
  - Rack cooling index (fraction of IT within ASHRAE recommended temperature range)
  - Return temperature index (RAT-SAT)/ITΔT (a measure of mixing of air in the data center)
- **Lighting watts/square foot**
EPA Energy Star Programs

- Energy Star for Servers
- Energy Star for Buildings
- Top quartile eligible for Energy Star label
ENERGY STAR for servers

- Server energy demand drives data center power & cooling needs
- Goal: Identify energy efficient servers in the market place and standardize measurement and reporting of key power and performance metrics
- Technical specification will have several key elements:
  - Definitions of product types eligible for ENERGY STAR
  - Standard test procedures for power supply energy efficiency & Idle power measurement
  - Proposed levels to set the bar:
    - Near Term: Tier 1 to include power supply efficiency and Idle power;
    - Longer Term: Tier 2 will develop a more holistic metric (power used per work delivered)
- Initial focus on volume servers and mid-range servers
- Tier 1 considerations
  - Power supply efficiency
  - Idle power
  - Standard reporting requirements (standardized data sheet)
  - Ability to measure power and temperature with reporting
- Tier 2 to utilize industry developed energy performance benchmarks
Performance Data Sheet

- System characteristics
- Thermal information (Air flow rate and delta T)
- Available power management features
- Power and temperature measurement and reporting
- Power and performance data (min, typical, max configuration)
- Link to savings calculator
Timeline

• Goal – First phase specification finalized in early 2009

• More Information
  – www.energystar.gov/productdevelopment (click on New Specs in Development)
  – Andrew Fanara, EPA, fanara.andrew@epa.gov
ENERGY STAR buildings

- U.S. Government energy management program to help building owners and managers reduce their energy consumption.
- Over 1,700 Partners operating more than 11 billion square feet of space (nearly 20% of space in the U.S.).
- More than 62,000 buildings measure and track their energy performance using ENERGY STAR’s Portfolio Manager on-line tool.
- ENERGY STAR labeled buildings use about 40 percent less energy than average buildings.
- More than 4,000 buildings have earned the ENERGY STAR label for energy efficiency.
Energy Star performance rating system

• Allows for peer group comparison
  – Compares a building’s energy performance to its national peer group.
  – Allows owners with multiple facilities to compare performance across a portfolio of buildings.

• Based on actual as-billed energy data.

• Serves as a whole building indicator
  – Captures the interactions of building systems not individual equipment efficiency.
EPA’s Data Center 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 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
Goals for ENERGY STAR data center rating

- Build on existing ENERGY STAR methods and platforms. Methodology similar to existing ENERGY STAR ratings (1-100 scale).
- Usable for both stand-alone data centers, as well as data centers housed within office or other buildings.
- Assess performance at the building level to explain how a building performs, not why it performs a certain way.
- Offer the ENERGY STAR label to data centers with a rating of 75 or higher (performance in the top quartile).
- Rating to be based on Data Center Infrastructure Efficiency (DCiE). Data collected will be ranked from 1 to 100.
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”
Development plan

• Gather monthly data from at least 100 data centers for a 12-month period (over 200 have signed up)

• To develop a statistically valid rating model the following will be collected:
  - Climate zone (zip code)
  - Type of data center (function)
  - Reliability (Tier Level)
  - Total IT energy use (12 months of data)
  - Total facility energy use (12 months of data for all fuels)

• Data collected from a wide variety of facilities (large/small, stand-alone/within larger bldg, etc.)

• Data will be analyzed to develop rating models.

• Launch ENERGY STAR Data Center Infrastructure Rating in Portfolio Manager.
European Code of Conduct

• Voluntary program where participants annually propose to adopt measures, and report results
• A list of expected and optional best practices is provided. Participants select from this list but can also suggest other measures.
• Performance is tracked over time. Continuous improvement is the goal
• Many areas are addressed: operations and management, cooling, IT equipment, geographic location, use of waste heat, etc.
Code of Conduct – best practices

Selected best practices:

- Use of ASHRAE recommended ranges and moving to allowable ranges in 2012
- Many IT measures – e.g. efficient software
- Extensive air management measures
- Free cooling – air and water side
- Monitoring
- Central plant efficiency
Harmonizing the rating systems

- Use of DCiE and other common metrics
- DOE DC Pro and EPA Energy Profiler similar inputs and benchmarks
- Green Grid and ASHRAE MOU
- Harmonizing metrics and measurement protocols
- Opportunity for alignment world-wide
Questions?