



ENERGY STAR® Data Center Infrastructure Rating Development

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CEE Industry Partners Meeting

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Learn more at energystar.gov

What is ENERGY STAR for Buildings?

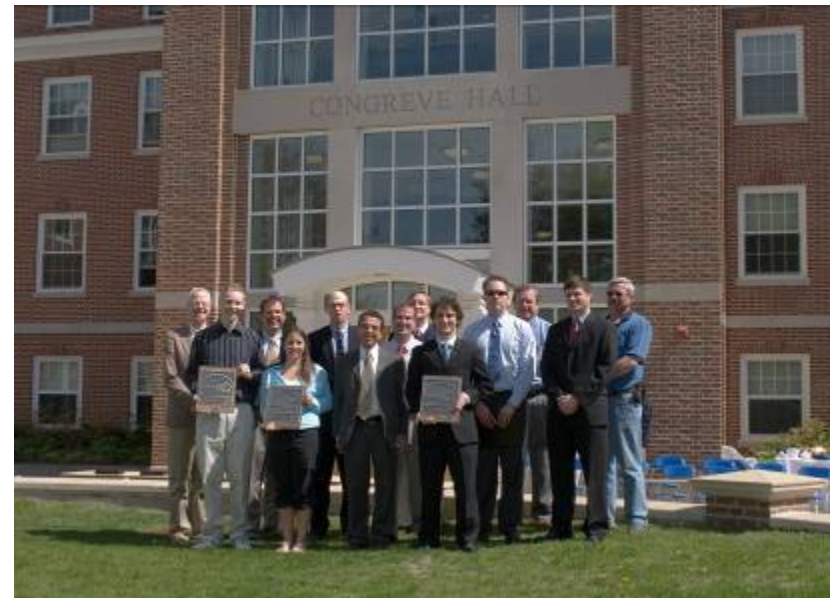


- U.S. Environmental Protection Agency energy management program.
- Provides proven solutions to help public and private sector building owners and managers reduce their energy consumption.
- Offerings for new construction and existing buildings.
- Works in markets with a focus on:
 - ◆ Commercial property (offices, retail, hotels)
 - ◆ Public sector (government, K-12, higher ed)
 - ◆ Healthcare
 - ◆ Small business and congregations

The ENERGY STAR for Buildings



- ENERGY STAR labeled buildings use 35 percent less energy than average buildings.
- Nearly 8,000 buildings have earned the ENERGY STAR label for energy efficiency.



Is Your Building Performing Well?



Fuel Efficiency
MPG



Is 18 MPG high or low for an automobile?

Is 80 kBtu/SF/YR high or low for a building?

Energy Performance
EPA Benchmarking

STATEMENT OF ENERGY PERFORMANCE			
Margrave High School			Date SEP Generated: March 30, 2004
Building ID: 1021129 For 12-month Period Ending: January 31, 2004			
Margrave High School 3200 Hwy 98 Longmont CO 80501 Gross Building Area: 351,365 SF Year Built: 1982		Owner: Catholic Group Contact: John Doe 5225 North St. of Main Ohio Suite 200 Arlington VA 22206 (703) 247-8900	
Facility Space Use Summary			
Space Type	Area(SF)	Number of Students	Number of PCs
Computer Data Center	154	N/A	N/A
K-12 Classroom	343,221	1,225	425
Site Energy Use Summary			
Electricity (kBtu)	5,649,861	Professional Verification	
Process (kBtu)	320,419	John Doe	
Natural Gas (kBtu)	0	5225 North St. of Main Ohio	
Total Energy (kBtu)	5,970,280	Suite 200	
		Arlington VA 22206	
		(703) 247-8900	
		License Number: 123456789	
		State: VA	
Rosetta			
Energy Performance Rating (1-100)	94		
Energy Intensity*			
Site (kBtu/SF-yr)	17		
Source (kBtu/SF-yr)	49.4		
Emissions			
CO ₂ (1000 Btu-yr)	6,765		
SO ₂ (1000 Btu-yr)	266		
NO _x (1000 Btu-yr)	21		
Energy Cost			
Cost (\$/yr)	\$24,435		
Intensity (\$/SF-yr)	\$9.12		
Indoor Environment Criteria*			
Index of problems remedied?	Yes		
Adequate ventilation provided?	Yes		
Thermal conditions met?	Yes		
Adequate illumination provided?	Yes		



EPA's Energy 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.
 - Tracks energy use accounting for weather and operational changes over time.

Energy Performance Rating System – Technical Foundation



- Analyze national survey data
 - ◆ Energy Information Administration’s Commercial Building Energy Consumption Survey (CBECS) for most building types.
- Develop regression models to predict energy use for specific building types based on operations.
- Create scoring lookup table
 - ◆ Ratings based on the distribution of energy use for a given building type and expressed on a 1-to-100 scale where one point represents one percentile of buildings.
 - A rating of 50 indicates that the building performs better than 50% of all similar buildings nationwide.
 - A rating of 75 indicates that the building performs better than 75% of all similar buildings and can earn the ENERGY STAR label.

EPA Rating Building Types



Hospital



Retail



Office



Hotel



Medical Office



Wastewater Treatment Plant



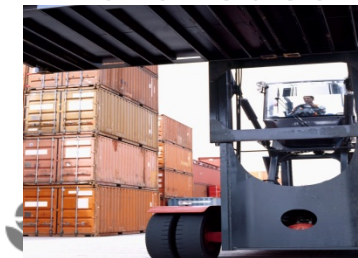
Courthouse



Bank/Financial



Warehouse



Dormitory



Supermarket



K12 School



Goals for the 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.
- Provide users with information and links to additional resources to aid in their efforts to determine next steps after receiving an energy performance rating for their building.
- Offer the ENERGY STAR label to data centers with a rating of 75 or higher (performance in the top quartile).

Major Barrier to Rating Development – Lack of Data



- Most ENERGY STAR building rating models use CBECS data - collected every 4 years by DOE.
- Few data center facilities have historical data on whole building energy use (or data center portion) and/or IT energy use.
- Data must be measured in the same way.
- **Solution:** Gather data over a 12-month period going forward.

What is the ENERGY STAR Rating for Data Center Infrastructure?



- **Unit of Analysis:**

Energy Usage Effectiveness (EUE)=Total Facility Energy/UPS Energy

- **How:** Express EUE as an ENERGY STAR 1-to-100 rating
 - ◆ Each point on rating scale equals 1 percentile of performance.
 - ◆ Adjust for operating constraints outside of the owner/operators control (e.g. tier level).
 - ◆ Factors for adjustment to be determined based on results of data collection and analysis.

Rating Development Timeline



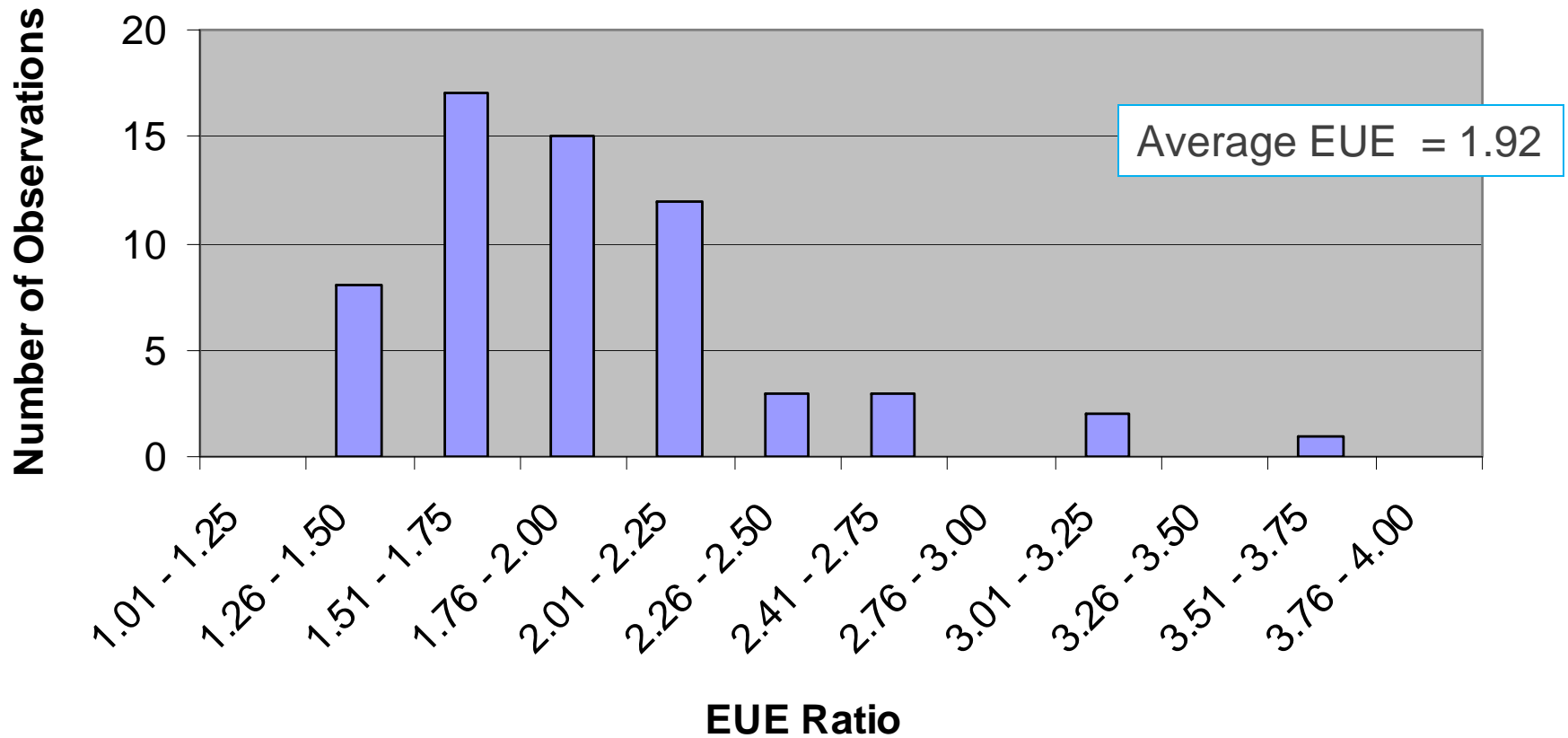
- October 2007 – March 2008
 - ◆ Consultations with industry stakeholders
 - ◆ Agreed on use of the ratio: Total Energy/IT Energy
 - ◆ Developed data collection template
- March 2008 – June 2009
 - ◆ Data collection
- August & November 2008, May 2009
 - ◆ Updates to industry
- June – November 2009
 - ◆ Analysis, Rating Development, Industry Input
- Spring 2010
 - ◆ Data center rating scheduled for release in Portfolio Manager

Data Collection Summary



- 121 Data Centers submitted complete data
 - ◆ All required building attributes
 - ◆ 11 months of energy data
 - ◆ 11 months of IT data
- UPS more common than PDU for IT energy
 - ◆ 108 Data Centers with data from the UPS meter
 - ◆ 42 Data Centers with data from the PDU meter
 - ◆ Above totals include 29 that provided both UPS and PDU data
 - ◆ *EPA rating will likely be based on UPS readings as the proxy measurement for IT energy*

Distribution of EUE Ratios



Data Center Analysis: Model results



- Some surprising results for operating characteristics to be included/excluded, but these are supported by data
- EUE is fairly independent of operating characteristics, as compared with similar models for commercial buildings
- Few operating characteristics expected to be included in a final model
- Relatively low R-squared expected, but still acceptable

Conclusions:

- Variability in energy use is more dependent on energy management practices than operating characteristics
- Despite the low R-squared, regression modeling results in meaningful adjustments for some operating characteristics

Data Center Analysis: Model results



- Variables that **may be** included in the model and are still under investigation by EPA (*Statistically significant in some model options with 80% confidence or better*)
 - ◆ UPS Energy Intensity (IT energy per square foot)
 - ◆ UPS Energy (total IT energy)
 - ◆ Square Feet
 - ◆ Tier (or some similar measure of redundancy)

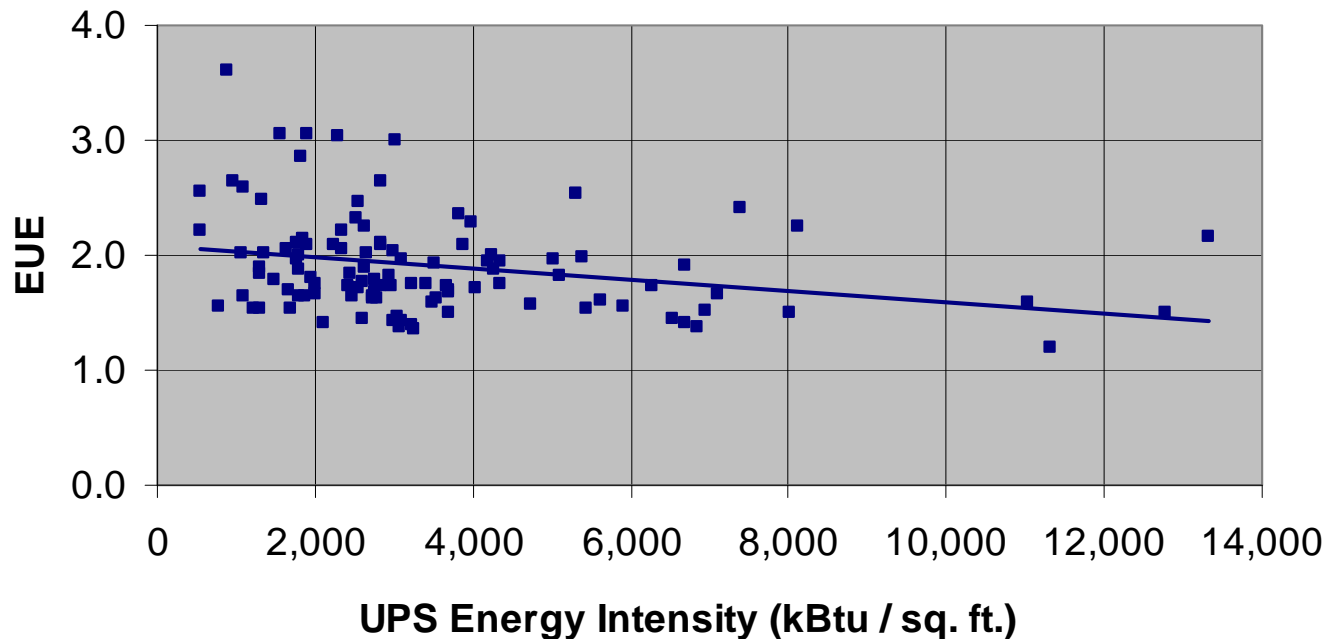
- Variables that are **not** likely to be included in the new model (*Not statically significant in most model formulations*)
 - ◆ Heating Degree Days (HDD)
 - ◆ Cooling Degree Days (CDD)
 - ◆ Data Center Type (traditional, hosting, internet, etc.)
 - ◆ UPS Utilization

Variables that *May be* Included in a Data Center Rating Model

UPS Energy Intensity (kBtu/Sq. Ft.)



- EUE is lower in buildings with high UPS energy intensity
- Consistently significant in regressions
- Dense arrangement of IT equipment likely results in more targeted (and efficient) cooling



UPS Energy Intensity (kBtu/Sq. Ft.)

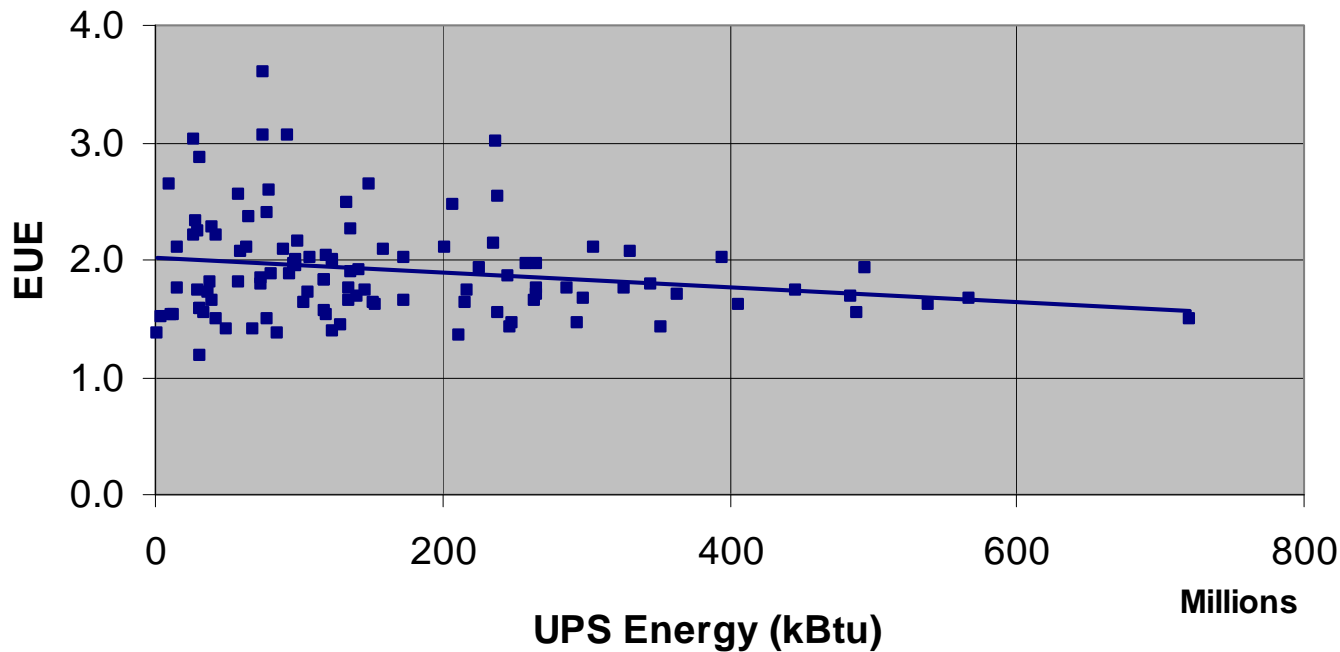


- EPA believes UPS Energy Intensity may be a type of “efficiency measure”
 - ◆ Dense arrangement of IT equipment results in efficient cooling
- If so, it should be **excluded** from the regression model
 - ◆ EPA models normalize for operational characteristics outside of an operator’s control (Ex. Operating Hours for Offices)
 - ◆ EPA models do not normalize for efficiency measures (Ex. High efficiency lighting for Offices)
 - ◆ Buildings utilizing “efficiency measures” use less energy, and therefore receive higher ratings
- *Question: Do you agree with this assessment? Is density of IT equipment considered in design?*

UPS Energy



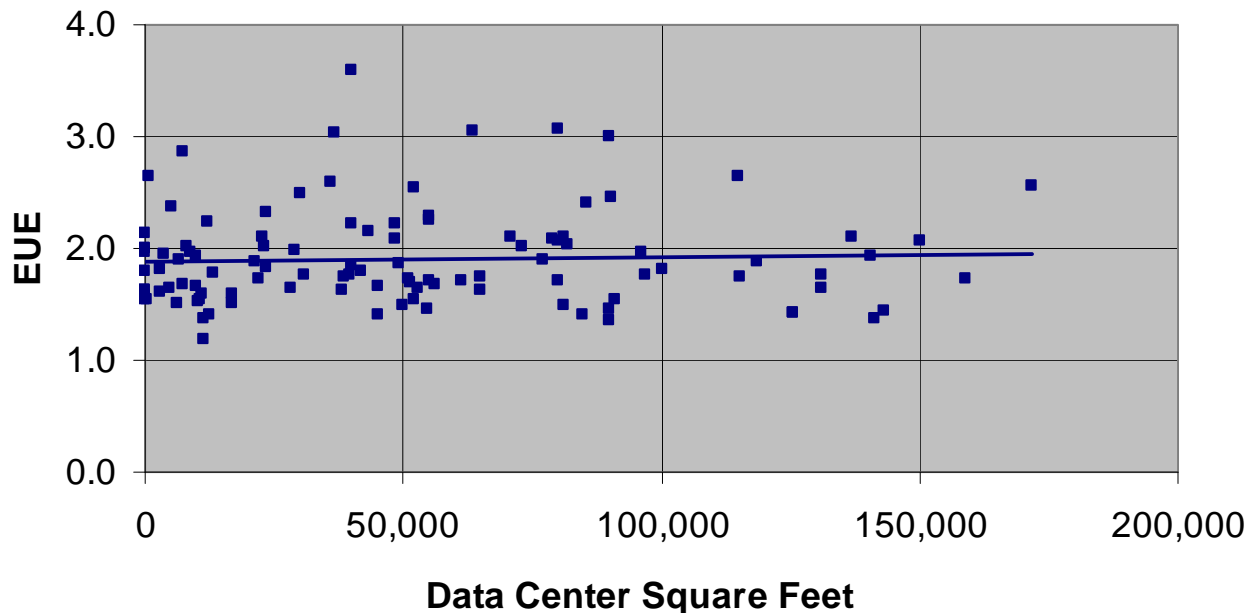
- EUE is lower in buildings with higher total UPS Energy
- Consistently significant in regressions
- Likely due to economies of scale



Square Feet



- EUE is slightly higher in larger buildings
- Consistently significant in regressions
- Correlations exist between square foot, UPS Energy Intensity, and UPS Energy
- *Question: Do you have any theories as to why larger buildings would have higher EUE's?*



Tier



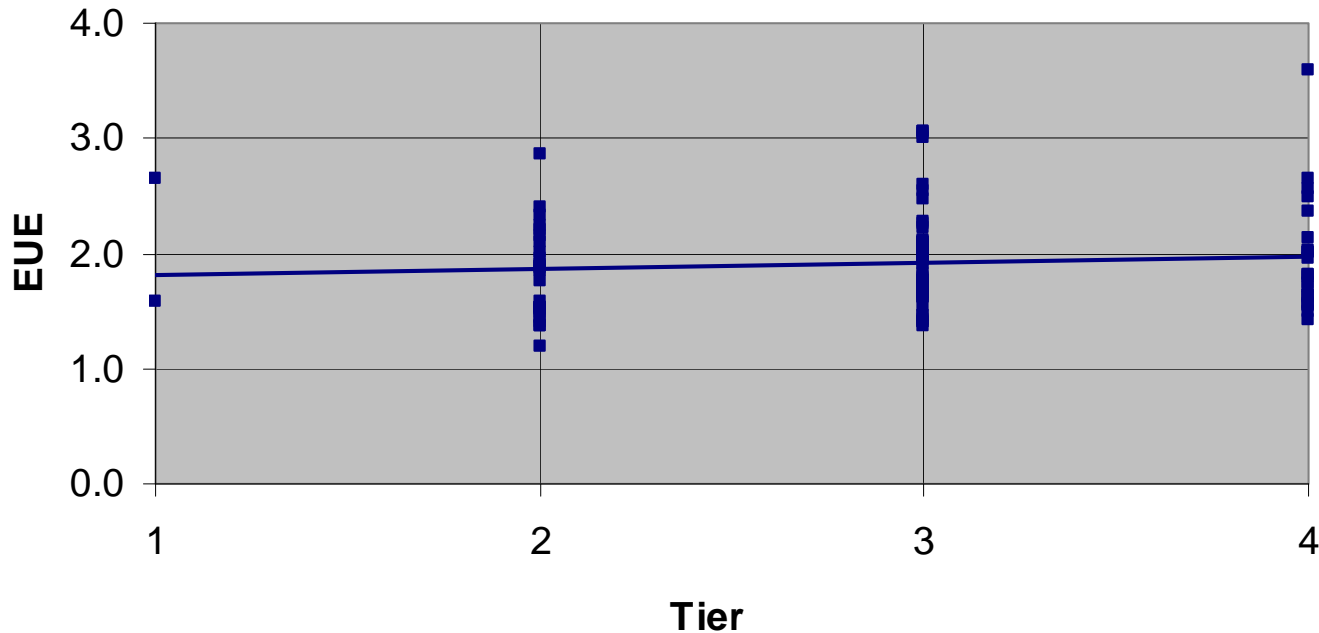
- Small differences in EUE across Tier levels
- Only two Tier 1 data centers, both are Enclosed
- High Tier (3 & 4) vs. Low Tier (1 & 2) distinction also being investigated

Tier level	Count	Percent	Average EUE
Tier 1	2	2%	--
Tier 2	27	25%	1.81
Tier 3	56	52%	1.92
Tier 4	23	21%	1.96
All	108	100%	1.91
Tier 1 & 2	29	27%	1.83
Tier 3 & 4	79	73%	1.94

Tier



- Slight positive trend line in graph of EUE vs. Tier
- Marginally significant in regressions
- Inclusion in models results in more consistent ratings for each Tier level



Use of the Data Center Rating



- Hope to have the rating apply to stand-alone data centers and those in larger buildings.
 - ◆ For those in larger buildings, will require that the user be able to isolate the full energy use of the data center from the rest of the building.
 - ◆ Will enable offices and other buildings with more than 10 percent of square footage as data center to receive an ENERGY STAR rating.
 - ◆ Will allow rating for offices and other buildings with data centers to account for the higher energy use of the data center portion of the building.
- ENERGY STAR Label will be available only for stand-alone data centers.

Next Steps

- September 29, 2009
 - ◆ Webinar to present results of analysis.
- By October 6, 2009
 - ◆ Submit comments regarding the analysis presented in September 29 webinar.
- November 2009
 - ◆ Webinar presenting additional results.
 - ◆ Final model selected.
- Spring 2010
 - ◆ Data center model scheduled for release.



For More Information



Please send questions to:

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Check the ENERGY STAR Web site for updates:

www.energystar.gov/datacenters