WORKING GROUP 1: IT EQUIPMENT

EPA Technical Workshop on Energy Efficient Servers and Datacenters in the United States

February 16, 2007

Santa Clara Convention Center

Summary Notes for Working Group 1 (IT Equipment)

A: Estimation of growth trends and trends in IT equipment energy use

Topics of discussion:

- Deriving estimates of growth trends utilizing existing data sources

  Ideas generated:

  — Use historical data on IT equipment shipments from IDC

  — Try to understand key demand behavior that is fundamentally driving growth

  — Must understand trends toward increasing consolidation/virtualization

  — Must understand trends related to utilization

  — ASHRAE Power Trends might offer useful information

  — Consider looking to trends on data transactions as proxy for growth (perhaps large users such as banks, healthcare, etc. can help)

  — Consider looking at trends in shipments of power supplies as a proxy for the trends in shipments of servers (a company will typically spend 2% of server budget on power supplies)

- Deriving estimates of power use by servers, storage devices, and network equipment

  Ideas generated:

  — Peak versus idle power by component might be important to consider

  — Koomey study results and approach for server energy use seem reasonable

  — Consider characterizing trends that show that energy performance is improving while total power consumption is going up due to demand increasing faster

  — Historical facility benchmark data may be useful for understanding trends

  — Data on energy use breakdown among servers, network, and storage devices is needed, but it is not clear where such data exist

  — Consider the effects of equipment redundancy (for reliability) when estimating energy use

  — For network equipment, the dynamic range (idle to peak) of power use is small; thus, it is more important for existing equipment to understand how many network devices are connected than to understand utilization

  — Consider surveying IT managers or service providers on how they provision networks

- Determine Federal vs. non-Federal split for installed base of IT equipment

  Ideas generated:

  — Perhaps data on Federal sales are available from large server vendors

B: Definition of plausible efficiency scenarios and estimation of cost savings

Topics of discussion:

- Estimation of future energy use (5 years out) for several plausible future scenarios

  Ideas generated:

  — Three possible scenarios seemed to resonate with the working group:

  1. Business as usual (BAU): a scenario based on projecting current trends in energy use, sector growth, equipment end uses, rates of utilization, etc. This is the "no policy intervention" scenario.
  2. Best practice: a scenario in which all best available technologies and management strategies are employed to reduce the energy use of IT equipment in the data center. This scenario examines what could be done with currently available technologies and management expertise if they were implemented across the board.
  3. Emerging technologies: a scenario in which technologies currently in development but expected to hit market in the next five years are examined. This scenario captures the energy efficiency benefits of the next wave of technology.

  — A key future trend to consider is efficiency improvements at the chip level

  — Low adoption rates are a key barrier to moving from the BAU scenario to the best practice scenario even though more energy efficiency technologies have been available for years; finding ways to overcome this barrier will be key for recommendations

  — The use of virtualization and power management are important trends to capture

  — Data are needed on energy use and trends in energy efficiency for all IT equipment, not just servers and microchips as stated in the H.R. 5646 text

  — Power supply efficiency trends also need to be considered

  — Consider in the scenario analyses that businesses that experience higher power growth trends are more likely to adopt power saving technologies

C: Identification and discussion of reliability and performance issues

Topics of discussion:

- Identification of potential impacts of energy efficiency on reliability, performance, cost, and speed

  Ideas generated:

  — Consider that, in general, by adding more complexity to a system (for example, using power management software) more points of failure are added to a system

  — Thermal conditions are key to IT equipment reliability, thus reliability is tied to HVAC issues

  — Many current practices for reliability lead to redundancy and thus to higher power consumption

  — There is a need to dispel the notion that more energy efficient equipment is less reliable because this isn't the case in many operations and this myth is a persistent barrier to improving the efficiency of data centers

  — MTTR (mean time to repair) might be an important metric to capture

  — Performance "hits" might not matter as long as they are aligned with services that can absorb such "hits"

  — Data on reliability versus number of parts are available, which may help

D: Recommendations regarding potential incentives and voluntary programs

Topics of discussion:

- Identification and discussion of possible recommendations for incentives and voluntary programs

  Ideas generated:

  — Financial incentives (tax credits, energy efficiency rebates) could be built into the cost of IT equipment so that extra work by the end user is not needed to claim the credit/rebate

  — Labels like ENERGY STAR can be effective both for providing the manufacturer with an incentive and for educating the end use customers on the benefits of lower energy use

  — IT managers should be better educated on the cost benefits of energy efficiency

  — Financial incentives could be awarded to the manufacturer then passed along to the consumer

  — Verification of whether or not end users are using power management features is key (but difficult) for seeing if savings are actually realized

  — The SPEC benchmark could be a useful metric for promoting energy savings

  — Federal procurement policies can go a long way since the government is such a large customer

  — Any metrics that are used to characterize energy efficiency must be designed carefully and should encompass performance

WORKING GROUP 2: POWER AND COOLING INFRASTRUCTURE

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Summary Notes for Working Group 2 (Data Center Infrastructure)

A: Growth and efficiency trends, market segmentation, and potential cost savings

The legislation directly dictates segmenting federal vs. non-federal. Segmenting into other markets such as institutional and size are also implied. A proper disaggregating of the data center market is of one of the first challenges in this evaluation. This requires defining a data center and potential sub-categories. The suggested parameters to define and categorize data centers are as follows:

Definition of Data Center (defining characteristics):

Separate HVAC

> LBNL defines a data center as, "a room that has an independent HVAC zone," independent of size. This means the data center could be an entire building or simply a closet with a dedicated HVAC unit.

Emergency Backup Power

> Data centers typically have backup power, though this is not always the case.

Raised Floor

> Data centers typically have raised floors, though this is not always the case.

Security

> Data centers typically have enhanced security

Building Codes

> There are specific codes that already define an IT room or data center. The two codes suggested were the National Electric Code, Article 645; and NFPA 75

Categorization of Data Centers

Floor Area

> The Uptime Institute categorizes data centers into different size tiers by "electrically active" floor area. It was suggested that the performance of the infrastructure may vary significantly be size. The LBNL study, however, did not see a correlation with size, though the study the study did not include any very small (closet size) data centers.

Bus Quantity

> Major data centers have dual bus applications, thus the UPS cannot run better than 50% load. Non-critical data centers only have a single UPS or single bus and can run at higher efficiencies.

Power Demand

> It was suggested that categorizing the size data centers by the power draw (kW) of the IT equipment would be more accurate than floor area.

Cover Groups/Over-provisioning

Bill Kosik, from EYP, did a paper on data center dynamics that separated data center operations in enterprise cover groups and search engine cover groups.

Federal vs. Non-Federal

Boston Sullivan and Venture Development Corporation (VDC) should have some data on this.

New vs. Old Data Centers

It is not clear which is more efficient. New centers have newer equipment, but they are also oversized for anticipated future loads.

Estimating Power Consumption of Data Centers

Jon Koomey's study estimated the power consumption by estimating the critical load from servers (based on server sales) and then using a total power/critical load ratio.

One of the goals of this group is to confirm the Koomey analysis. One strategy could be to take Koomey's data for IT equipment Koomey's estimates, and then estimate the appropriate total power/critical load ratio to use for different efficiency scenarios.

The following total power/critical load ratios were proposed:

Benchmark Source	Ideal Best Practice	Actual Best Practice	Typical	Worst
Uptime (from two papers)	1.6	1.8	2.4-2.6	3.2-3.5
LBNL	1.2	1.3	2.0	3.0

Ratio Adjustments

The above ratios will be modified as more data are received (potential data sources are described below). Ideally, different ratios will be applied to each data center category (i.e. big, small, federal, non-federal).

Ratio Trends

Many felt the ratio would change over time, strictly due to market forces and with no change in policy. The reasons given for this change are:

1. Increased interest in energy efficiency would cause the ratio to drop
2. The change in ratio would be geographically dependent as certain technologies favor specific climates.
3. Data center consolidation would drop the ratio as many small centers are sold and new large centers are built (large centers as considered more efficient and new centers are now built with efficiency in mind)
4. The ratio may increase as centers more to areas with cheaper electricity
5. The ratio may increase due to increase redundancy. In the last five years there has been increased redundancy due to IT availability (more redundancy causes increased electrical power)

Overall, the group felt the base case ratio will probably drop by about 2% per year, with no change in policy. No change in ratio could be expected for the worst case scenario

Identified Data Sources

LBNL (above table)

Data may be skewed towards better data centers due to self-selection.

The Uptime Institute (above table)

Data comes from two studies, measured data representing the total power to run the data center, always running refrigeration (no economizers) and includes both member and non-members of Uptime.

Intel

They have no large compiled set of data, but they have talked with customers to understand where energy is being used.

IDC Reports:

Source of Jon Koomey's study.

Leibert:

Has 79 different data points on CRAC units. Can be split out from 0.5MW to about 8 MW

Representative from Midwest [needs to be identified]

Involved with study that estimate 1-2 million square feet of raised floor (broken out data centers and office space)

Bert and Turner

Gave a presentation last year using the following categorizations:

Size Category	Floor Area	Installed Servers
Small	15,000 ft^2	300-500
Medium	20,000 ft^2	1500-1700
Large	35,000 ft^2	N/A
Very Large	>100, 000 ft^2	N/A

Side Note

Monitoring Equipment

While the critical load is easy to measure, determining the load required to operate a data center can be difficult to obtain. Installed monitoring equipment may be the first step in increasing efficiency: it allows the data center to better understand their relative performance. Such an approach can also be used for reliability and predictive maintenance.

B: Impact on Electric Grid

This part of the report involves converting the energy savings estimated in the previous task to a peak load savings (using the National Energy Modeling System). To do this, we need to understand where the load savings will occur in the grid.

Peak Load Trends

The load is becoming more of a curve than a flat line, due to efficiency measures (economizers, weather) and project schedules (engineers submitting batch jobs on Friday to run over the weekend, rendering being performed at night)

While overall contribution to energy demand may be small (~1.2%), impact may be significant at certain location.

Migration Trends:

More data center consolidation in the Pacific Northwest due to cheap power. This power is cheap because of underutilized generation capacity, but prices will go up as capacity is used up.

The state of Montana is developing energy plans, expecting an increased demand once the rates in eastern Washington begin to increase.

Potential Solutions

Distributed Generation could alleviate peak demand, but a standby connection is always required, which is very expensive.

Thermal Energy Storage

C: Non energy impacts of improved efficiency

Reduced Cost

Potential downsizing due to efficient equipment

Lower maintenance

More efficient systems can delay having to add another facility

Increased Reliability

Running UPS at high efficiency levels extends the lives of electrical systems

Fewer hotspots. More cooling equipment capacity results in a reduced indoor thermal quality (it can be difficult to properly control air as capacity increases, resulting in hotspots)

More consistent temperature. Reduced reliability associated with higher temp and greater variations. Temperature changes cause the expansion/contraction of metals, and cause server fans to ramp up. It may reduce the life, but the question is: is it enough to matter, relating to the savings in the operational cost

Ergonomics

Warmer cold isles will be more comfortable for data center occupants

Hotter hot isles will be unpleasant for data center occupants

Reduced noise

Improved Competitiveness

Increased capacity

Stimulated Economy

Retrofits

D: Benefits of distributed generation/cogeneration (e.g. fuel cells)

DG/CHP Key Issue:

1. Electricity generation and heat (boiler) on-site: efficiency can get into 70%.
2. Point that makes sense "spark spread"
3. Utility interconnect
4. Reliability: redundancy can be avoided, the grid could be used as backup, but standby charges (access to grid) is very high
5. Incentives to produce power when utility needs it
6. More complicated systems, new unfamiliar business, and data center users are wary to relinquish control to 3rd party providers
7. Regulatory issues (air quality)
8. Lack of critical mass, track record (concern for response during an emergency)
9. Education/training, O&M reliability
10. Fuel cell waste heat not at high enough quality (some technology)
11. Current fuel cell technology efficiency is about 37% (includes reform), though some of the emerging solid oxide technologies are believed to achieve substantially high efficiencies
12. Turbines are more common

E. Incentives, voluntary programs, R&D, and industry activities

Key Barriers

1. Risk of new/different technologies
2. Inadequate monitoring
3. Huge standby charges
4. Lack of knowledge
5. Split incentives (different budgets), IT doesn't pay utility bills
6. Lack of information (lower temp of range always chosen)
7. Mature design/build (old school mentality)
8. First cost
9. Required redundancy, conservative marketplace (risk to owner and risk to A&E)
10. ROI varies with change in energy prices (uncertainty in cost of fuel)
11. Short time horizon, IT vs. facility
12. Other management issues

Group Recommendations

1. Incentives to manufacturers
2. Building or finance DG
3. Energy star for HVAC equipment
4. LEED for data centers
5. Incentives for efficient systems and operations
6. Education training: owner/operators, designers (show value through assessment programs)
7. Government investment demonstration projects: showcase cutting edge technologies with case studies (see which ones fail, succeed). For example Canadian government only buys efficient equipment
8. Incentives for monitoring
9. Technology development: R&D, demo, incentives
10. Test standards and ratings: COP, total/IT
11. Top down approach: get the CEO/CIO on board
12. Government could reduce “load” on data center
13. Roadmap with target goals (coming up with technically feasible goals)
14. Roadmap performance tied to (tax) incentives (i.e. set efficiency target for UPS, then government will purchase an initial amount)
15. Work with ASHRAE, IEEE, Green Grid
16. Greater utilization of all component without reducing reliability (incentive to remove legacy equipment)
17. R&D: Improve cooling chain, power chain, address from a system approach, computational output
18. Incentives to increase utilization and virtualization

WORKING GROUP 3: INTEGRATED DESIGN, OPERATION, AND MANAGEMENT ISSUES

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Summary Notes for Working Group 3 (Integrated Design, Operation, and Management Issues)

Disconnect between IT and facilities

- IT pays their power bill by square foot, not by power consumption -> make users pay true cost
- integration of responsibility for construction and operations (integrate IT and facilities)
- better planning: mismatch between installed capacity and actual loads (overbuilding)
- defining business purpose is difficult
- create better incentives for people in charge of buying servers (right now they don't care about buying efficient servers)

- organization matters

- convert facilities requirements into business goals (buy efficient/more expensive servers, b/c we'll pay less for energy in the long term)

- integrate design and operations

- standard model for total cost of ownerships of servers
    - not just cost of server, but space, power, cooling, operations
    - understand the dependency of software (how much power is my application using?)

- what should we measure?
    - rack, server power consumption
    - real time
    - capacity utilization
    - infrastructure
    - total power/IT load

- what to report? what are the right metrics?

- power and thermal management go hand in hand
    - standardization of airflow to allow hot/cold aisle
    - waste heat

- low utilization of servers
    - different departments don't share the equipment

Risk will often trump energy efficiency!

- heroics = risk

- data centers require certain temperature and humidity, but do servers really fail more often when running outside these regions?

- organizational issues:
    - real estate
    - facilities
    - procurement
    - IT
    - power/influence

- demonstration projects/case studies in federal facilities

Data from Gartner Data center conference (show of hands, 2000 people)

- 60 - 70% will be replaced in the following 5 years because they don't support high densities

- 90% of data centers will be virtualizing

Smaller working groups (before lunch):

#1: organizational issues
#2: information issues: standards + metrics
#3: time/planning issues
#4: everything else

#1: organizational issues:

1. risk. vs. reward vs. simplification
    - ROI (what's the reward of spending extra money on efficient servers)
    - uptime is still most important

2. cost allocation (need to understand the real cost)
    - need to measure power consumption, efficiency
    - come up w/ metrics to drive decisions
    - capex vs. opex

3. IT and facilities gap
    - people who are in charge of buying servers have no incentive to buy efficient servers

4. optimizing the system redundancy
    - what's the risk vs. reward?
    - but what's really risky? we can make better measurements, better metrics
    - often the energy bill is not significant (compared the other expenses)
    - but this is only when the data center is small
    - some colo's charge by kWh (instead of square feet)
    - IT data centers have very low utilization
    - web services data centers have high utilization (MS -> 80 - 90% utilization)
    - lack of communication inside of company
    - express everything in $$ (easy to understand)
    - need to measure stuff before we can express it in $$

#2: information (lack of):

1. metrics and benchmarking
    - metrics of IT equipment
    - IT power vs. total power
    - cooling vs. total power
    - true DC utilization

2. information sharing between departments
    - requirements to report efficiency
    - end to end analysis when planning the infrastructure
    - social responsibility (report CO_2 emissions)

3. incentives
    - tax incentives
    - incentives to adopt new technology
    - market for CO_2

4. need for quantitative education

#3: time/planning

1. metrics for performance, reliability and efficiency for all components and operations
    - to mitigate risk of adoption of new technology

2. organizational processes and structure to address integrated planning and operations
    - success depends on people working together (integrated planning)

3. segmentation: addressing incentives for different people working in a company
    - one size doesn't fit all

#4: risk and everything else

1. integrated full life-cycle risk model
    - risk increases when we add dynamic provisioning
    - no quantitative way to model the risk and economic effects
    - how do you add capacity as needed
    - how do you structure SLAs?

2. demonstration projects:
    - insufficient sharing of best-practice
    - best-practices become corporate IP
    - ??: who will take the first step to build the first product and share with the community

3. TCO:
    - good and complete model of TCO (umbrella)

Smaller working groups (after lunch):

1. metrics/visibility
    - IP issues?
    - measure improvements, also absolute
    - business continuity
    - separate IT metrics from infrastructure metrics
    - learn from green building movement

2. new models of computing
    - utility computing model
    - dynamic workloads
    - network detached computing

3. analysis of systemic investment
- grid
- assessment of costs and benefits

4. life-cycle risk assessment
- learn from green building movement (bring all designers to the table)
- need integrated architecture metrics (include storage and networks)

#1: metrics/visibility
- metrics
    - I: tax
- integrated data center infrastructure design
    - get seal of approval if you follow a process
- education
    - certificates for engineers/operators
- demonstration projects
    - creating federal DC demo project (central test lab to stimulate innovation
    - federal funding of university project

#2: new models of computing
- metrics and benchmarking
    - integrated & segmented b/m
    - public reporting
- standards and best practices
    - IT components, facility components
    - integrated DC design
    - certificates
    - optimizing redundancy
- incentives
    - external: work with utilities
    - internal: tool & practices to facilitate decision making
- education
    - tool that would help with metrics

#3: analysis of systemic investment
- blind comparison of metrics
- life-cycle risk assessment
    - best practices w/o risking IP

Group #3

Integration issues

Key problem areas

- Organizational issues
- Information issues
- Time/planning issues
- Risk and everything else

#1: Organizational issues

1. risk. vs. reward vs. simplification
   - ROI (what's the reward of spending extra money on efficient servers)
   - uptime is still most important
2. cost allocation (need to understand the real cost)
   - need to measure power consumption, efficiency
   - come up w/ metrics to drive decisions
   - capex vs. opex
3. IT and facilities gap
   - people who are in charge of buying servers have no incentive to buy efficient servers
4. optimizing system redundancy

#2: Information issues

1. metrics and benchmarking
   - metrics of IT equipment
   - IT power vs. total power
   - cooling vs. total power
   - true DC utilization
2. information sharing between departments
   - requirements to report efficiency
   - end to end analysis when planning the infrastructure
   - social responsibility (report CO_2 emissions)
3. incentives
   - tax incentives, incentives to adopt new technology
   - market for CO_2
4. need for quantitative education

#3: Time/planning issues

1. metrics for performance, reliability and efficiency
   – all components and operations
   – mitigate risk of adoption of new technology
2. organizational processes and structure
   – address integrated planning and operations
   – success depends on people working together (integrated planning)
3. segmentation: addressing incentives for different people working in a company
   – one size doesn't fit all

#4: Risk and everything else

- (lack of) integrated full life-cycle risk model
  - risk increases when we add dynamic provisioning
  - no quantitative way to model the risk and economic effects
  - how do you add capacity as needed
  - how do you structure SLAs?
- insufficient sharing of best-practice
  - best-practices become corporate IP
  - demonstration projects
  - who will take the first step to build the first product and share with the community
- (lack of) good and complete TCO
- emerging business models

Problem Solutions

Problem	Solutions
importance of IP	• IT natl'l center for best practices – like Sematech – nat'l resource for energy eff.
lack of information	• metrics • education • tools
lack of correct incentives	• align TCO + ROI w/ incentives
risk mitigation	• demonstration project • integrated risk model
things change fast	• understand emerging tech (eg emerging computing models)
siloed organizations, suboptimal decisions	• structure organizations to use info, standards, and incentives to reduce TCO

solution areas

1. metrics/visibility
   - IP issues
   - measure improvements, also absolute
   - business continuity
   - separate IT metrics from infrastructure metrics
   - learn from green building movement
2. new models of computing
   - utility computing model
   - dynamic workloads
   - network detached computing
3. analysis of systemic investment
   - grid
   - assessment of costs and benefits
4. life-cycle risk assessment model
5. economic disincentives for inefficiency
   - CEO reporting

WORKING GROUP 4: INCENTIVES AND VOLUNTARY PROGRAMS

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Summary Notes for Working Group 4 (Incentives and Voluntary Programs)

Summary

At the end of the working group session, the facilitators pulled together an outline summarizing the key points brought up by the working group for the purposes of reporting to the afternoon general session:

1. 3 Key positive drivers
    a. $ savings
    b. Environmental savings (carbon, etc.)
    c. Grid relief – fewer blackouts
2. Key desired outcomes
3. Then show barriers and policies to overcome these barriers
    a. Top down, education and awareness
4. Top down approach (i.e., initiative must come from upper management) needed to overcome barriers
    a. Corporate / government challenge for data center efficiency - praise and shame
    b. Government can set an example
    c. Standard metric is key – must be supplier independent
    d. Top 100 List of most efficient data centers
    e. Money is key
        i. Demonstrate the business case
        ii. Financial incentives for efficient data centers (tax incentives and utility incentives)
        iii. The right decision maker needs to see the incentive
5. Awareness / Education / Certification / Training
    a. Educate sustainability officers within the organization using the data center
    b. "Carbon police"
    c. Audits
    d. Government case studies
6. Research and Development (R&D)
    a. Demos
    b. X-prize challenge
    c. Data center test lab
7. Harmonized utility programs – several utilities across a region coordinating their programs for data center efficiency
8. Industry standards
9. Focus on areas of great change – volume servers, federal facilities
10. "No CIO Left Behind" program – incentives for achievement in data center efficiency
11. Structure:
    a. Desired outcome – e.g., 90% or greater power supply efficiency
    b. Policies to achieve this

Key points of discussions on incentives and voluntary programs captured during the working group session:

1. Market segments
   a. Own vs. lease
   b. Care about energy efficiency or not
   c. Only care if power/cooling problems
   d. Carbon goals – environment is a driver
2. Over provision – education needed
3. Energy concern driven by power/cooling constraints
   a. More data centers in this group
4. Forecasting compute and power/cooling requirements
   a. Metrics
   b. Dashboard tools
5. Data centers located in a larger building
   a. How to meter/benchmark?
6. Need education and incentives to get better estimates of compute load
7. Coordination between IT and facilities
8. Facilities learn how IT equipment works
   a. IT heat loads
   b. More sophisticated cooling
9. Technical education needed to be improved
10. Personal risk – e.g., dead servers don't get turned off
11. Why don't managers track server utilization / data IO?
    a. No credit for efficiency
    b. Key thing is rolling out new apps and keeping them running
12. Demand-based switching
    a. 10% implementation
13. Organizational change needs to be top-down (starts with CIO)
14. Efficient solution is a risk
    a. Have leaders demo new technologies
    b. Sell cases where energy efficiency reduces risk (outside air)
    c. Government leadership
    d. Small innovators – small firms
15. Drivers (top down)
    a. Save money
    b. Savings carbon
    c. Grid reliability
16. Energy efficiency tie-in to other issues
    a. Sprawl
    b. Manageability
17. Key is reducing # of servers
18. Small firms – someone has responsibility for entire problem
    a. Can be more innovative
19. Need someone in the organization who understands energy issues
20. CIO Magazine – energy costs are a large part of total cost of ownership (TCO)
21. IT doesn't measure energy, but facilities department does
    a. How to create a model where IT personnel see the energy price?
22. Energy is not cheap – it's a major part of TCO now
23. Don't forget infrastructure energy use
    a. Incentive for running data center at better IT/infrastructure ratio
24. What to do with legacy data centers?
25. Problem is not the components, it's how they are used
26. Concerns (drivers)
    a. Heat density
    b. TCO

    c. Carbon cap
27. Incentives:
    a. Technical audits (performance contracting)
        i. Need follow-up over time
    b. DOE program doing energy audits
    c. Tax credit for investment
28. Different situations – greenfield, expansion, existing data center retrofit
29. Low or no cost – audit
30. Meter data centers and do benchmarking
31. Shorten payback
32. Develop customer demand for energy efficiency (e.g., Wal-Mart)
33. Incentive for efficient servers
34. Benchmark site infrastructure
    a. Government endorsement for companies to do this
35. Data center rating and certification
    a. Malcolm Baldridge Quality award
    b. LEED
    c. Recognition for improvement in energy efficiency rating
36. Harmonized utility programs
    a. National SBC
37. Get unused equipment turned off
    a. servers ship with power management turned on
38. Need three things for successful energy efficiency
    a. Awareness
    b. Capability
    c. Motivation
39. Government can identify a metric for benchmarking
    a. Separate benchmark for IT and infrastructure
40. Influence CIO/CFO
    a. Government case studies
41. Government procurement
    a. Use energy efficiency as a factor in selecting data center contractors
42. Educate corporate environment / responsibility officer
    a. Sustainability – DJ sustainability index
43. Top 100 energy efficiency organizations in CIO magazine – sponsored by EPA
44. Tax credits get CFO attention
45. Carbon credits
46. Industry-harmonized set of metrics (what to measure and report)
47. AEE certification for IT efficiency
48. Basic technical education for data center operators
49. Auditor for training – 1000 data center Challenge
50. National Data Center Test Lab
51. Federal government IT installations
    a. Demonstrate benchmarking
    b. Challenge private sector to match federal
    c. Enforcement of federal procurement rules
        i. Anecdote about VERY inefficient servers at SLAC
52. Sponsor data center upgrade to best practice efficiency