Working Group 2: Data Center Infrastructure including Power and Cooling

Agenda:

1. Introductions (~30 minutes)
2. Ground rules
   - No selling
   - Stay at a high level
   - Let everyone participate
3. For each issue (5 at ~20 minutes each)
   a. Review of study objectives and plan
   b. Input on plan and desired involvement
   c. Input on data needs (what data is available and can be provided)
   d. Recommendations regarding incentives, voluntary programs, R&D, Federal government activities, and industry activities
4. Summary of working group outcomes and next steps (~30 minutes)
5. Each participant requested to provide contact information, topics of interest, desired role, and time frame for input (i.e. data) using the follow up form provided in the workshop packet

The following issues will be addressed by this working group:

A. Growth and efficiency trends, market segmentation, and potential cost savings
B. Electrical grid benefits
C. Non energy impacts of improved efficiency
D. Benefits of distributed generation/cogeneration (e.g. fuel cells)
E. Incentives, voluntary programs, R&D, and industry activities

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

Relevant HR 5646 Text (edited)

- An overview of the growth trends associated with data centers in the Federal Government and private sector
- Analysis of the industry migration to the use of energy efficient computing designed to reduce the costs associated with constructing, operating, and maintaining large and medium scale data centers
- Analysis of the potential cost savings to the Federal Government, large institutional data center operators, private enterprise, and consumers available through the adoption of energy efficient data centers

Study Plan

1. **Derive estimates of growth trends utilizing existing data sources**
2. Utilize forthcoming Jon Koomey study for estimates of server energy use and determine factors for extrapolating this estimate to data centers.
    - Estimate ratio of server energy to total IT equipment ratio to derive estimate of total
    - Assume business-as-usual case: total data center energy = 2 times IT equipment (commonly used rule of thumb, generally supported by benchmark data)
    - Assume best case (maximum savings with existing and emerging technology): total energy = 1.2 times IT equipment (80% infrastructure improvement, 40% overall improvement)
    - Pick two points in between business-as-usual and best case for moderate and aggressive efficiency scenarios
3. Determine split of Federal vs. non-Federal, and other market segmentation subject to available data
4. **Include qualitative discussion of general industry trends that may affect energy use**, such as server utilization, transition to "services" architecture, cooling issues, etc
5. **Perform rough quantitative evaluation of base case (no intervention) energy use in data centers over next 5 years.**
    - Assume multiplier of estimated IT equipment load (i.e. 2x)
6. **Look at 2-3 plausible efficiency scenarios** (minimal, moderate, maximum technology) to project savings if more efficient data centers are deployed.
7. Savings results will be reported by scenario, not broken out by technology or component. Potential savings will be allocated to Federal and private sectors using rough allocation factors.
8. Impact (reduced cost) on medium and large data centers

Data Needs

1. Data center square footage and energy use (**historical and forecast**)
    a. Total all sectors
    b. Federal vs. non-Federal

c. Large Institutional
d. Private enterprise
e. Consumer?
f. Geographical
g. Other available market segmentation (e.g. HPC)

2. Typical energy savings ranges associated with identified measures at the level of the data center

B. Electrical grid benefits

Relevant HR 5646 Text (edited)

- Analysis of the potential cost savings and benefits to the energy supply chain through the adoption of energy efficient data centers and servers, including reduced demand, enhanced capacity, and reduced strain on existing grid infrastructure, and consideration of secondary benefits, including potential impact of related advantages associated with substantial domestic energy savings

Study Plan

1. **Translate energy savings from Task 3 into peak load savings**, and estimate avoided generation capacity using integrated forecasting model (National Energy Modeling System).
2. **Qualitative discussion of transmission and distribution benefits from peak load savings.** (Grid impacts are very time- and location-dependent, thus are difficult to quantify).

Data Needs

1. End use regions for federal and private sector

2. Typical data center load shape

Notes:

- Identify participants interested in this topic and consider follow-up conference call.
- Brainstorm and prioritize potential cost savings and benefits to energy supply chain of improved efficiency
    i. Reduced demand
    ii. Reduced strain on existing grid infrastructure
    iii. Secondary benefits (advantages of substantial domestic energy savings)

C. Non energy impacts of improved efficiency

Relevent HR 5646 Text (edited)

- Analysis of the potential impacts of energy efficiency on product performance, including computing functionality, reliability, speed, and features, and overall cost

Study Plan

1. **Perform a qualitative analysis** that considers additional negative or positive impacts of identified energy efficiency strategies, based on interviews with key industry player and analysts.

Data Needs

1. Short list of potential impacts
2. Data on potential impacts

Notes:

- **Focus on non-energy impacts to and from infrastructure**
- Brainstorm and prioritize potential non-energy impacts

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

Relevant HR 5646 Text (edited)

- Analysis of the potential cost savings and benefits to the energy supply chain through the use of stationary fuel cells for backup power and distributed generation

Study Plan

- **Provide input to EPA** for analysis of distributed generation and combined heat and power applied to data centers (Note: expanding topic beyond fuel cells)
- Evaluation of efficiency, emissions, reliability, and economic benefits of DG/CHP
- Consider hierarchy of DG approaches for data centers;
    - Back-up Power – least active, least efficiency benefits
    - On-site prime power – base power to facility
    - CHP – utilize prime power waste heat for cooling or other needs, most efficiency benefits
- Evaluate applicability and technical fit
    - Fuel cells and other DG systems
    - Profile existing systems and case studies
- Analysis of potential cost savings and other benefits

Data Needs

1. Industry perceptions of distributed generation and combine heat and power – experience with, perceived role of DG/CHP, perceived benefits/barriers/issues
2. Typical power supply strategies, power reliability requirements, reliability strategies and approaches, current use and cost of back-up power systems
3. Typical cooling requirements, cooling systems currently used, ability to integrate central cooling loops

Notes:

- Identify participants interested in this topic and consider follow-up conference call.
- Brainstorm and prioritize potential cost savings and benefits to energy supply chain of distributed generation and combined heat and power applied to data centers
- Discuss specific (unique) benefits of stationary fuel cells

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

Relevant HR 5646 Text (edited)

- An overview of current government incentives offered for energy efficient products and services and consideration of similar incentives to encourage the adoption of energy efficient data centers **(focus on incentives for efficient infrastructure)**
- Recommendations regarding potential incentives and voluntary programs that could be used to advance the adoption of energy efficient data centers

Study Plan

1. **Perform a qualitative review** of the range of incentives and policies based on existing data sources.
2. **Focus on Federal policies** (such as tax credits and Energy Star), **but include a broad overview of non-Federal incentives and voluntary policies** (e.g., a few leading utility programs, such as PG&E's incentive program).
3. Provide a qualitative description of recommended Federal incentives and voluntary programs coordinated at the Federal level (e.g. Energy Star).
4. Secondary recommendations to address non-Federal incentives and programs.
5. Include key RD&D needs that are best addressed by the Federal government (making a distinction between basic and applied research).

Data Needs

1. Identify existing policies, R&D, programs, and incentives to reduce energy use in data center facilities (Infrastructure focused)
2. Identify barriers to efficiency and potential incentives, voluntary programs, R&D, and industry activities to overcome them

Notes:

- **Focus on data center infrastructure (vs. IT equipment)**
- Prioritize and develop recommendations for incentives, voluntary programs, R&D, and industry activities

Preliminary categories for incentives and voluntary programs:

- Financial incentives
  - e.g., utility rebates, Federal tax deductions/credits
- Education and training
  - e.g., datacenter operator certification
- Industry standards
  - e.g., energy performance metrics, test procedures
- Endorsement labeling
  - e.g., ENERGY STAR
- Government procurement
  - e.g., EPAct 2005 purchasing requirements

- Government operation
  - e.g., mandatory benchmarking of Federal datacenters, pilot program implementation in Federal facilities
- Research, development, and demonstrations (RD&D)
- Information
  - Technical guidance, awareness campaigns, publication of benchmark data, etc.