Opportunities in a Carbon Constrained World

Andrew Fanara
fanara.andrew@epa.gov
US Environmental Protection Agency
Climate Protection Partnership Division
ENERGY STAR® Program
www.energystar.gov/datacenters
The ENERGY STAR Mission Requires Finding & Building Upon an Intersection of Interests

- Manufacturer/Retailer Interests
- Environmental Protection
- Consumer Preferences
- Utility Program Sponsor Interests

Cost-effective
No Sacrifice in Performance

Consumer / Customer is Key

Consumer Program Sponsor
Defining Energy Efficiency the ENERGY STAR® Way

- A voluntary public-private partnership
- A strategic approach to energy management
- Recognized by over 70% of Americans
- An internationally recognized brand
  - Recognized in Australia, Canada, Europe & Japan
ENERGY STAR
Market Sector Coverage

Residential

Labeled Products
-- for plug loads not system
-- 50+ products / 1700 manufacturers
-- 10-60% more efficient

Labeled New Homes
-- 30% more efficient

Home Improvement

Services
-- beyond products
-- air ducts / home sealing
-- whole home retrofits

Commercial / Industrial

Corporate energy management
-- benchmarking, goals, upgrades
management, systems
-- whole building labeling for excellence
-- technical assistance

Industrial
-- 10 industries

Small business initiative

* Datacenters addressed by labeled products & corporate energy mgnt.

International partnership agreements with 7 countries
GOVERNMENT AGENCIES FORECAST US EMISSIONS TO RISE 35% BY 2030...
Gigatons CO₂e per year

Projected GHG emissions

2005 emissions: 7.2
Expected growth: 2.5
2030 reference case: 9.7

Key growth drivers:
• Expansion of US economy and population
• Above-average growth in buildings and appliances
• Increased coal-fired power generation (without CCS)

* Based on bills introduced in Congress that address climate change and/or GHG emissions on an economy-wide basis and have quantifiable targets
**FIVE “CLUSTERS” OFFER SIGNIFICANT POTENTIAL**
Gigatons CO$_2$e, options less than $50$ per ton CO$_2$e

*Mid-range case*
*High-range case*

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<table>
<thead>
<tr>
<th>Category</th>
<th>Mid-range case</th>
<th>High-range case</th>
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</thead>
<tbody>
<tr>
<td>Projected emissions</td>
<td>9.7</td>
<td>0.7 - 0.9</td>
</tr>
<tr>
<td>Buildings &amp; appliances</td>
<td>0.3 - 0.7</td>
<td>0.6 - 0.8</td>
</tr>
<tr>
<td>Transportation</td>
<td>0.5 - 0.6</td>
<td>0.8 - 1.6</td>
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<tr>
<td>Industry</td>
<td></td>
<td>5.2 - 6.7</td>
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<tr>
<td>Carbon sinks*</td>
<td></td>
<td></td>
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<tr>
<td>Power</td>
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<tr>
<td>Emissions after abatement</td>
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</table>

**Range of proposed reductions**

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Additional potential:
- Options $50$-$100$ per ton
- Demand response changes
- Break-through technology innovations
- Lifestyle choices

*Including abatement in the agriculture sector beyond expanding carbon sinks
**Adjusted for cumulative rounding errors

Source: U.S. EIA, EPA, USDA, McKinsey analysis
Marginal emission reduction costs for the global energy system, 2050

In support of the G8 Plan of Action
Now the US is a major importer of oil and tiny user of newer renewables.
We are facing large transmission & generation investments in an uncertain economic environment

- Managing hydro system constrained by fish, water, treaties & future markets
- Integrating 30 GW of wind in the West by 2020
- Global warming & increasing reliance on coal
- CA market meltdown strands restructuring & transmission expansion
- Integrating new technology that could help: demand response, distributed generation, distribution automation, AMR & phasor data…
- Rising prices & high congestion costs in East & MW
QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.
### Key Findings of EPA Report to US Congress One Year Ago

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Electricity Consumption</th>
<th>Electricity Costs</th>
<th>Environmental Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Today (2006)</strong></td>
<td>Use about 61 billion kWh</td>
<td>Costs $4.5 billion annually</td>
<td>Peak load on power grid is equivalent to the output of 15 power plants</td>
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<td></td>
<td>Doubled since 2000</td>
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<td>1.5% of total U.S. consumed</td>
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<tr>
<td></td>
<td>More than U.S. TVs</td>
<td></td>
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<td></td>
<td>Equivalent to 5.8 million average</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S. households</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current Trends (by 2011)</strong></td>
<td>Use nearly doubles to more than 100 billion kWh</td>
<td>Costs $7.4 billion annually</td>
<td>Requires an additional 10 power plants, more at peak periods</td>
</tr>
<tr>
<td><strong>EPA Scenarios (by 2011)</strong></td>
<td>Annual savings of approximately 23 billion to 74 billion kWh over current trends</td>
<td>Reduces costs by $1.6 billion to $5.1 billion annually</td>
<td>Reduces peak load by equivalent of up to 15 new power plants</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reduces 15 to 47 MMTO2</td>
</tr>
</tbody>
</table>
2008: What’s Changed?

Big Picture Observations, Trends & Responses

- Biggest data center construction boom in history
- Higher power density is pushing electricity consumption to grow faster than the number of servers*
  - Almost 0.5% of world electricity production
  - Doubling from 2000-2006
  - CO² emissions projected to quadruple from 170 Mt to 670 Mt
  - Emissions expected to surpass Airlines by 2020*
- Incremental US energy demand between 2008 & 2010 equal to 10 new power plants (more at peak) -- at a time when few new plants are being built
- Operations mgnt. not keeping up with growing DC complexity & accelerating energy use
- 90% of companies running large DCs need more power and cooling in the next 30 months*
- Growing recognition of need for financial tools to understand impacts on OPx and CAPx from energy consumption

*Source: Ken Brill, The Uptime Institute  [www.uptimeinstitute.org](http://www.uptimeinstitute.org)
Results from Accenture
Silicon Valley Leadership Group Report

This report is a follow on to the EPA report to answer the EPA’s call to action

“Objective, credible information is needed about the performance of new technologies and about best practices as well as the effect of both on data center availability”

Compares the energy estimates of the EPA report with measured results

• To encourage increased adoption of energy saving initiatives
• To help shape potential standardization, regulation, or certification around energy use
• To demonstrate commitment of data center operators to environmental responsibility
3 Strategies for Driving EE

• **Define** energy efficient data centers
  – Benchmarks and common worldwide metrics are essential

• **Advance** energy efficient data centers
  – Employ methods and management systems to continually improve over the long term

• **Reward** energy efficient data centers
  – Use public recognition and monetary incentives
Defining EE Data Centers: US EPA Activity # 1

• ESTAR Datacenter Benchmark Development – Initiated data gathering effort for more than 240 DCs

• What is ENERGY STAR for Buildings?
  • U.S. Government sponsored energy management program providing proven solutions to help public and private sector building owners/managers reduce energy consumption
  • Over 3,000 Partners operating more than 11 billion sf (nearly 20% of space in the US)
  • More than 62,000 buildings measure and track their energy performance using ENERGY STAR’s Portfolio Manager on-line tool
Defining EE Data Centers: ENERGY STAR Rating Goals

- Build on existing ENERGY STAR platform with methodology similar to existing ratings (1-100 scale)
- Usable for both stand-alone data centers and data centers housed within office or other buildings
- Assess performance at building level to explain how a building performs, not why it performs a certain way
- Provide users with additional resources to help determine next steps after receiving an energy performance rating
- Offer the ENERGY STAR label to data centers with a rating of 75 or higher
ENERGY STAR Data Center Infrastructure Rating Development
(Profile of Participating Datacenters)

- # of Companies - 126
- # of DCs - 241
- Total ft\(^2\) - 17,693,371

<table>
<thead>
<tr>
<th>Location by EPA Region</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td>13</td>
</tr>
<tr>
<td>Region 2</td>
<td>42</td>
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<td>Region 3</td>
<td>30</td>
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<td>Region 4</td>
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<td>Region 9</td>
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<td>Region 10</td>
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<tr>
<td>International</td>
<td>10</td>
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</table>
ENERGY STAR Data Center Infrastructure Rating Development

Participating Datacenters by Building Type

- Basic
- Redundant Capacity
- Concurrently Maintainable
- Fault Tolerant
- Total

Site Infrastructure
(Uptime Institute Tiers)

- Within Larger Building
- Stand Alone
Participating DCs by Building Type
(as Defined by Uptime Institute)
Participating Datacenters
Rewarding EE Data Centers: Data Collection & Rating Development Process

- July 1, 2008
  - Data center operators begin collecting data
- August 15, 2008
  - EPA collects first data & then monthly
- Quarterly 2008 – 2009
  - EPA holds progress report webinar
- End of 2008
  - Mid-year analysis of data
- January 2010: EPA launches rating in Portfolio Manager (subject to change)
Implementation Timeline for ENERGY STAR Servers

- **Draft 2** – August 2008
- Subsequent drafts as needed
  - Tier 2 development workgroup initiated - Fall 2008
- **Final Tier 1 Spec effective** – January 2009
  - Will include roadmap for future tier 2
- **Tier 2** transition 12 to 18 months after tier 1 is sunset

- Q4 Possible announcement on research into data storage and networking equipment for possible ESTAR product specs
The Long Term Vision for an ENERGY STAR Server Specification

Main Criteria

- Power Supply Efficiency
- Reduced Idle Power
- Power Management & Virtualization
- Energy & Performance Reporting

Projected Effective Date Timeline

Tier 1 - January 2009 to be followed by Tier 2 / 12 - 18 months later
Scope of Coverage for ENERGY STAR for Servers

**Server Characteristics**
- Volume/Mid-Range
- Blades & Chassis
- AC-DC/DC-DC units
- Marketed/sold as server
- Server OS and/or Hypervisors
- 1+ processors/sockets
- Dedicated Mgmt Controller (service processor)
- RASM features
- ECC and/or buffered memory (DIMMS, BOB)

**Other Computers**
- Laptops
- Desktops
- Workstations

**Outside of Scope**
- Networking & storage equipment
- High Performance (> 4 processor) servers not eligible to be covered at this time
Product Development Guiding Principles

ENERGY STAR represents top 25% of performers in energy efficiency

Server graphic courtesy of Sun Microsystems
Possible To Do List

• Share key building & product contacts
  – Organize conf. call to discuss roadmap for cooperation
  – Coordinate with Bruce Nordman bnordman@lbl.gov

• Collect energy and performance data for buildings and products from the field (i.e. real world conditions)
  – Collaborate with other industry stakeholders on basic test procedures to be used

• Prepare basic report on industry background to share with EPA/DOE and to establish interest in cooperation
  – Products, building types, markets, technology etc.

• Plan possible workshop at industry event in Q1 to discuss issues and opportunities

• DOE also interested in telecom facilities.
  – October workshop being planned. Contact:
    KC Mares  408-203-8638 KCMares@MegaWattConsulting.com
Final Take Aways

1. We are waking up to the pervasive nature of our carbon based economy and lifestyle
2. Grappling with energy supply, energy distribution & climate challenges will profoundly change the way we live and work
3. High probability that electricity, regardless of source, will be more expensive - addressing climate change will add to this
4. Increasingly, investors, customers and regulators are demanding discloser of energy use and emissions risk
5. Investment in efficient product design & best operational practices for buildings will be a competitive key and business norm
6. Datacenters are vital national infrastructure and key energy efficiency opportunities
7. Energy efficiency is the cheapest, cleanest, quickest strategy to implement -- complementary to all other strategies
Andrew Fanara
US Environmental Protection Agency
fanara.andrew@epa.gov
(206)-553-6377
www.energystar.gov/datacenters/