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Energy and Federal Data Centers

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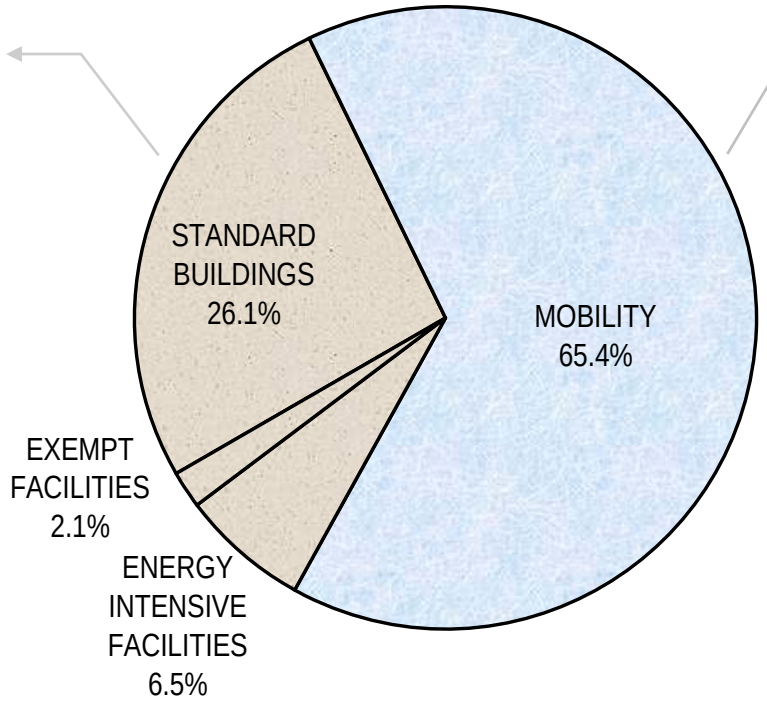
Energy Efficiency and Renewable Energy
Federal Energy Management Program

US Federal Footprint

Building Energy Usage by Type:*

Electricity = **45%**
Natural Gas = **34%**
Fuel Oil = 9%
Coal = 5%
Other = 7%

**The Federal Government operates over 500,000 facilities!*



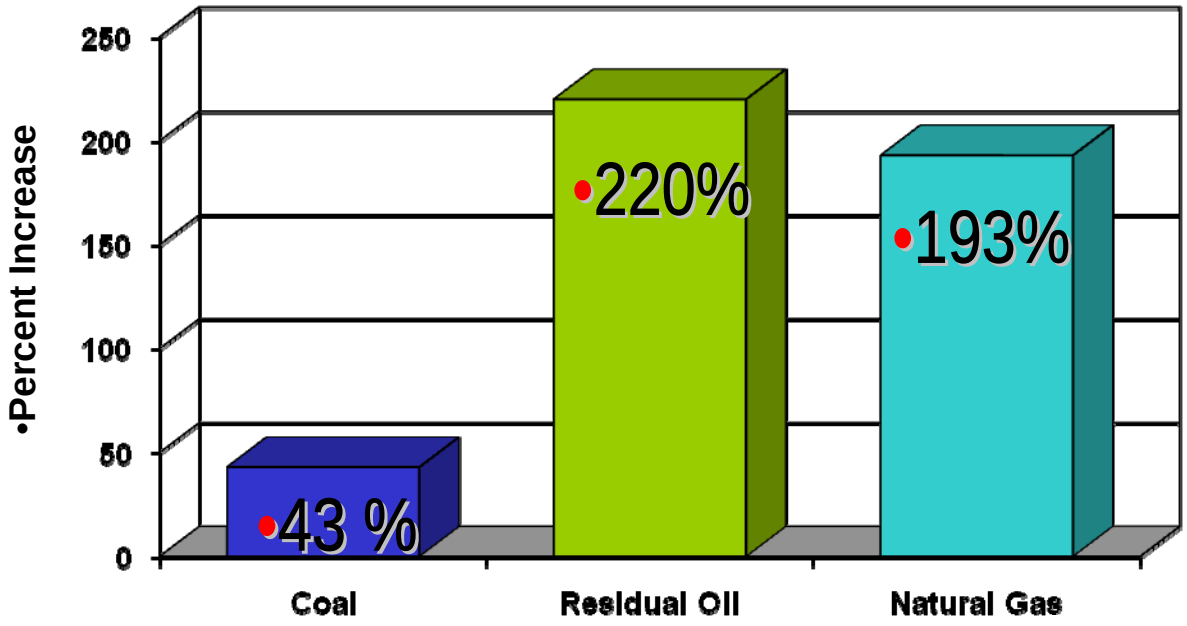
Mobility Energy Usage by Type:

Jet Fuel = **66%**
Navy Special = 23**%**
Auto Gas = 6%
Diesel = 4%
Other = 1%

The Federal Government consumes **1.6%** of the Nation's total energy budget, or **$14.5 billion** in annual energy costs

• Energy Costs Increasing

•1999 – 2006



•Source: U.S. DOE/Energy Information (January 2006); EEI Electricity Markets - Future Trends and Challenges

•Energy Reliability

- **We lose billions of dollars every year to blackouts, interruptions and congestion**

- Unreliable power costs America ***more than $100B annually***, the equivalent of a 30-cent surcharge on every dollar spent on electricity *(Galvin Electricity Initiative, 2005)*

- $79B per year just from disturbances and interruptions [i.e. not counting blackouts] *(LBNL, 2004)*

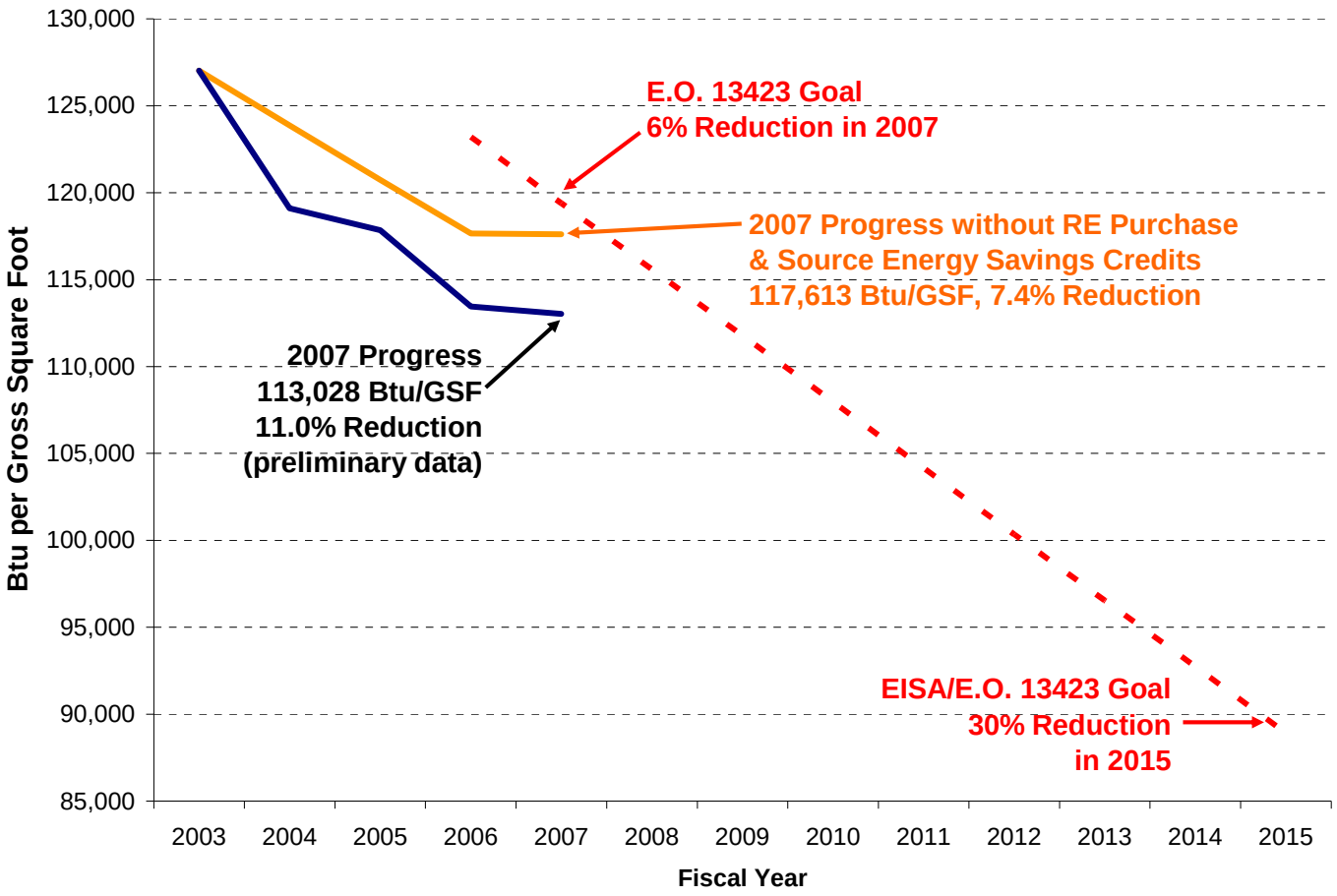
•Executive Order 13423

•Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*

- Improve energy efficiency and reduce greenhouse gas emissions through reduction of energy intensity.
  - 30 % by the end of fiscal year 2015
- At least half of the statutorily required renewable energy (7.5% by 2013) from new renewable sources
- Reduce water consumption intensity.
  - 16 % by the end of fiscal year 2015

•Federal Energy

Federal Government experienced a 29.6% reduction in Btu/square foot in 2005 compared to 1985 (30% was the goal)



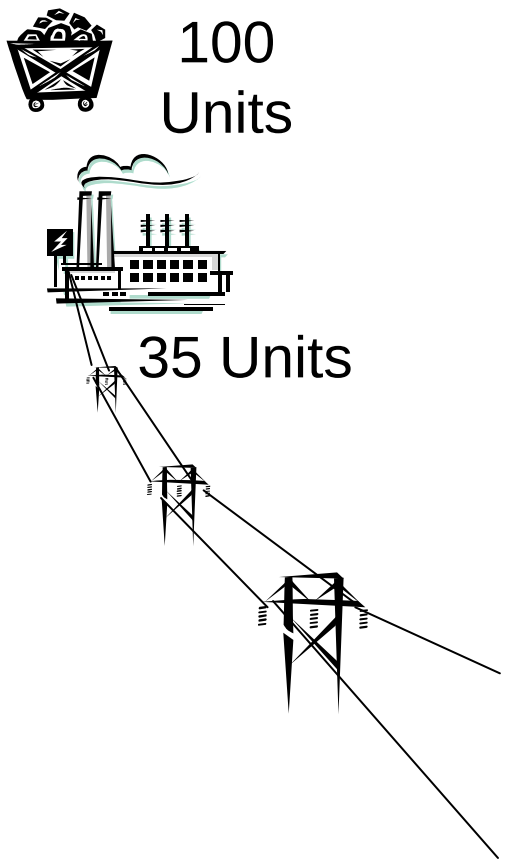
Why Data Centers?

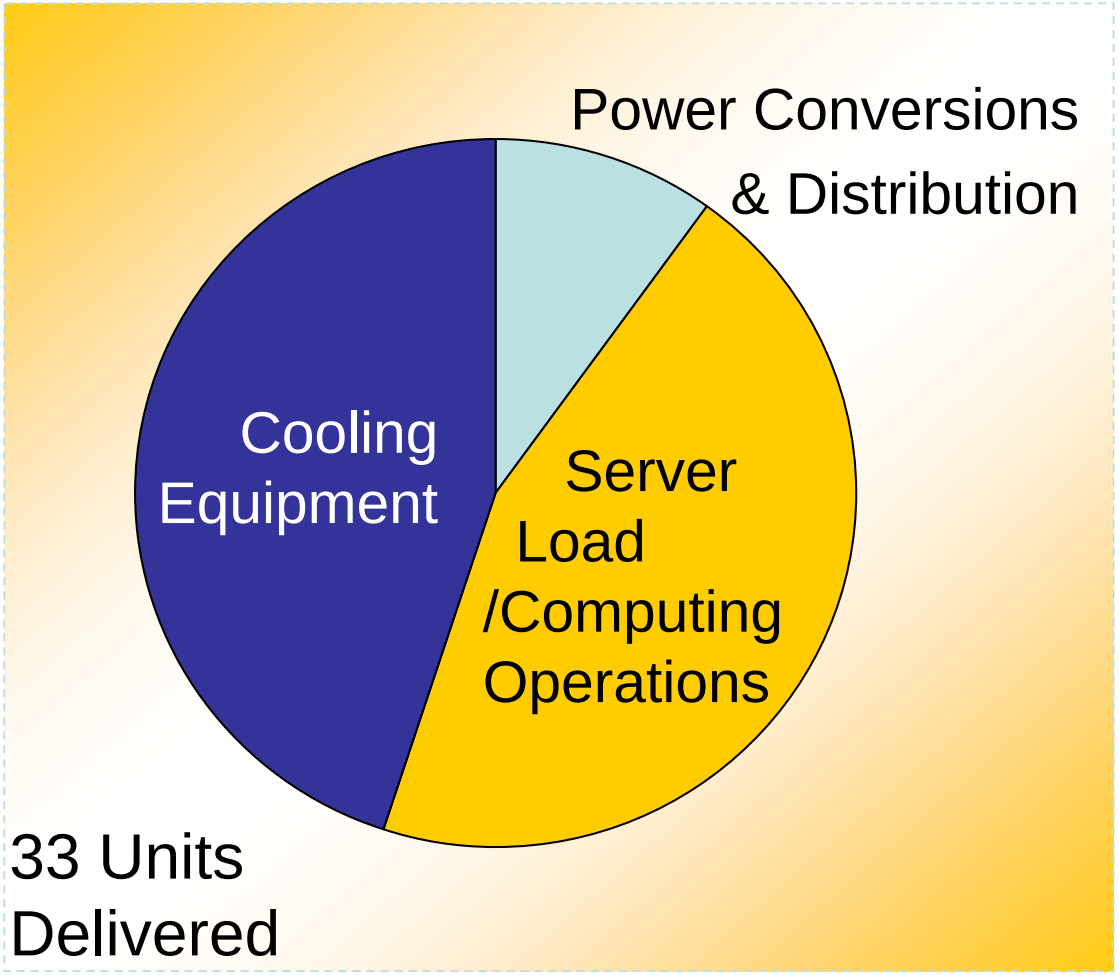
- **Data centers are highly energy intensive and growing at a rapid rate**
- **-** Consume 10 to 100 times more
- energy per square foot than typical
- office building

- **Data center energy use is rapidly growing**
  - Data centers in 2006 consumed twice as much electricity as 2000 and could double again by 2011
  - **About 45 billion kWh in 2005 and 61 billion kWh in 2006**
- - This accounts for nearly 1.2% and 1.5%
- of all U.S. electricity, respectively

- **Data centers require a high level of reliability**

Typical Data Center Energy End Use





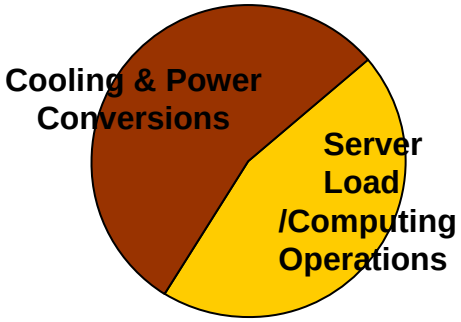
Data Center Performance Varies in Cooling and Power Conversion

DCiE (Data Center Infrastructure Efficiency) < 0.5

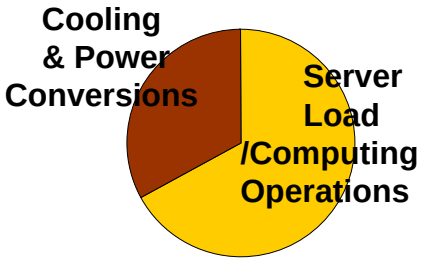
- Power and cooling systems are far from optimized
- Currently, power conversion and cooling systems consume half or more of the electricity used in a data center:
  Less than half of the power is for the servers

DCiE
Data Center Infrastructure Efficiency

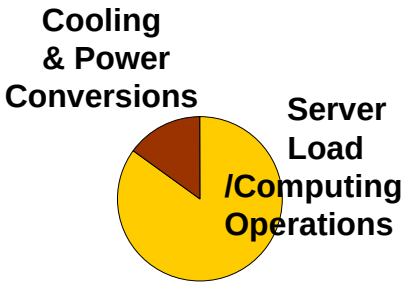
$$\text{DCiE} = \frac{\text{Energy for IT Equipment}}{\text{Total Energy for Data Center}}$$



Typical Practice
DCiE < 0.5

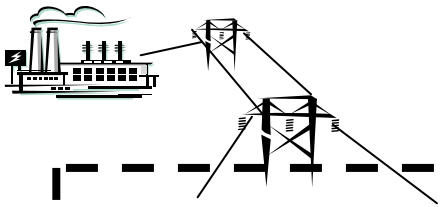


Better Practice
DCiE = 0.7



Best Practice
DCiE = 0.85

Technologies, Tools and Metrics Help Find Energy Efficiency Opportunities



- Computational load management
- Server innovation

- Better air management
- Move to liquid cooling
- Optimized chilled-water plants
- Use of free cooling

Power Conversion & Distribution → Server Load/ Computing Operations → Cooling Equipment

- High voltage distribution
- Use of DC power
- Highly efficient UPS systems
- Efficient redundancy strategies

Alternative Power Generation

- On-site generation
- CHP applications
- Waste heat for cooling
- Use of renewable energy
- Fuel cells

Key Barriers to Energy Efficiency

- Lack of definitions for equipment and data center efficiency
  - Service output difficult to measure, varies by application
  - Need for metrics and more data:
    How do we account for computing performance?
- Differing priorities
  - IT and facilities managers
- Risk aversion
  - Reliability concerns; energy efficiency perceived as a change with uncertain value and risk

DOE Save Energy Now Data Center Program

Major Program Elements

1. Develop and test “DC Pro” Software using pilot energy assessments
2. Create consensus metrics
3. Create and publicize Save Energy Now case studies based on pilot energy assessments
4. Create best practice information and a training curriculum
5. Develop Qualified Specialists program for Data Centers
6. Create guidelines for “Best-in-Class” data centers and validate with Technology Demonstrations
7. Create and implement a collaborative research program with industry

Federal Energy Management Program

- Pilot Workshops and Tools from SAVENERGY NOW
- Awards Program available to showcase Best Practices at Federal data centers
- Encourage/assist Federal agencies to implement best practices through private sector financing mechanisms
- Pilot adoption of Best-in-Class guidelines at Federal data centers and
- Encourage adoption of to-be-developed industry standard for Best-in-Class at newly constructed Federal data centers

Ingredients for Data Center Energy Efficiency

Start Right

- Adopt "Best-in-Class" technologies, design practices, standards & guidelines
- Verify energy efficiency performance

Manage Energy

Create and apply energy management plan and standards considering required system flexibility & reliability

Data Center Energy Efficiency

Continually Improve

- Benchmark data center
- Assess for energy saving opportunities
- Implement energy efficient best practices
- Adopt latest technology

Achieve Superior Performance

FEMP

Save ENERGY Now

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