



U.S. Department of Energy
**Energy Efficiency
and Renewable Energy**

Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

Federal Energy Management Program

Reforming Your Data Center: Save Energy Now



Bill Tschudi - LBNL

representing Will Lintner

DOE Federal Energy Management Program

June 3, 2009

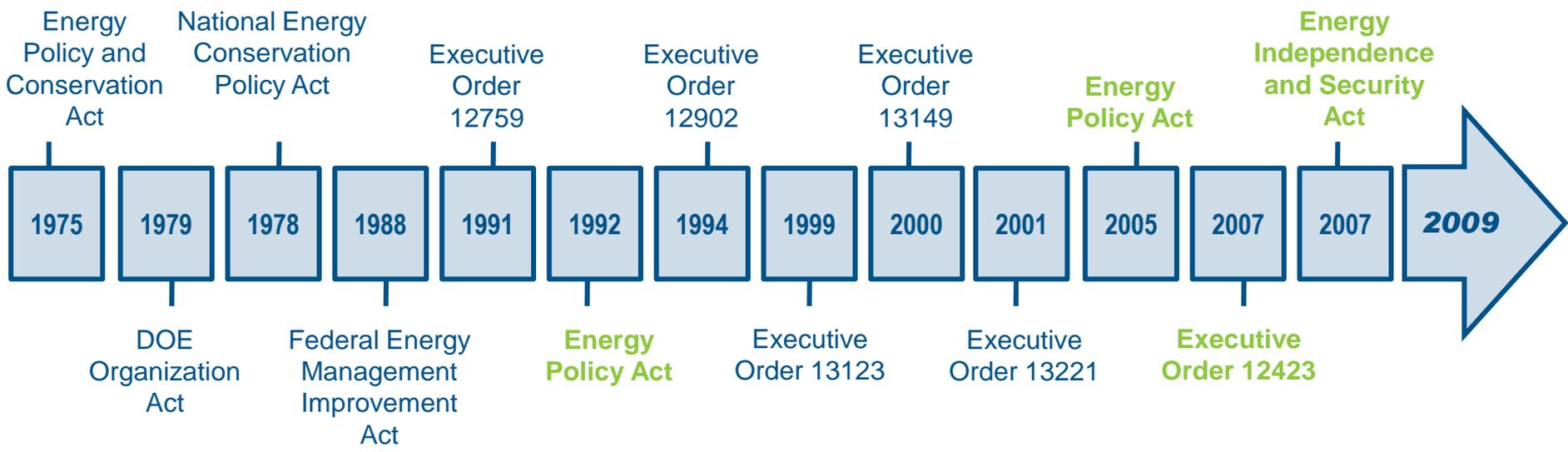


Outline

- Overview of Federal mandates
- Data center energy use
- Data center assessment tools (DC Pro)
- Best practices
- Efficiency initiatives
- Current projects
- Collaborative efforts
- Contact information/Questions



Public Laws & Executive Orders



FEMP Facilitate the Federal Government's implementation of sound, cost-effective energy management & investment practices to enhance the nation's energy security & environmental stewardship

*Green indicates law or order is still active



Federal Guidance

EPAAct 2005

Energy management requirements

E.O. 13423

Implementation Instructions

EISA 2007

High Performance Green Buildings



EPA Act 2005 Goals for Green IT

Energy Management Requirements

- All Federal agencies to reduce overall building energy use

Energy Efficient Products

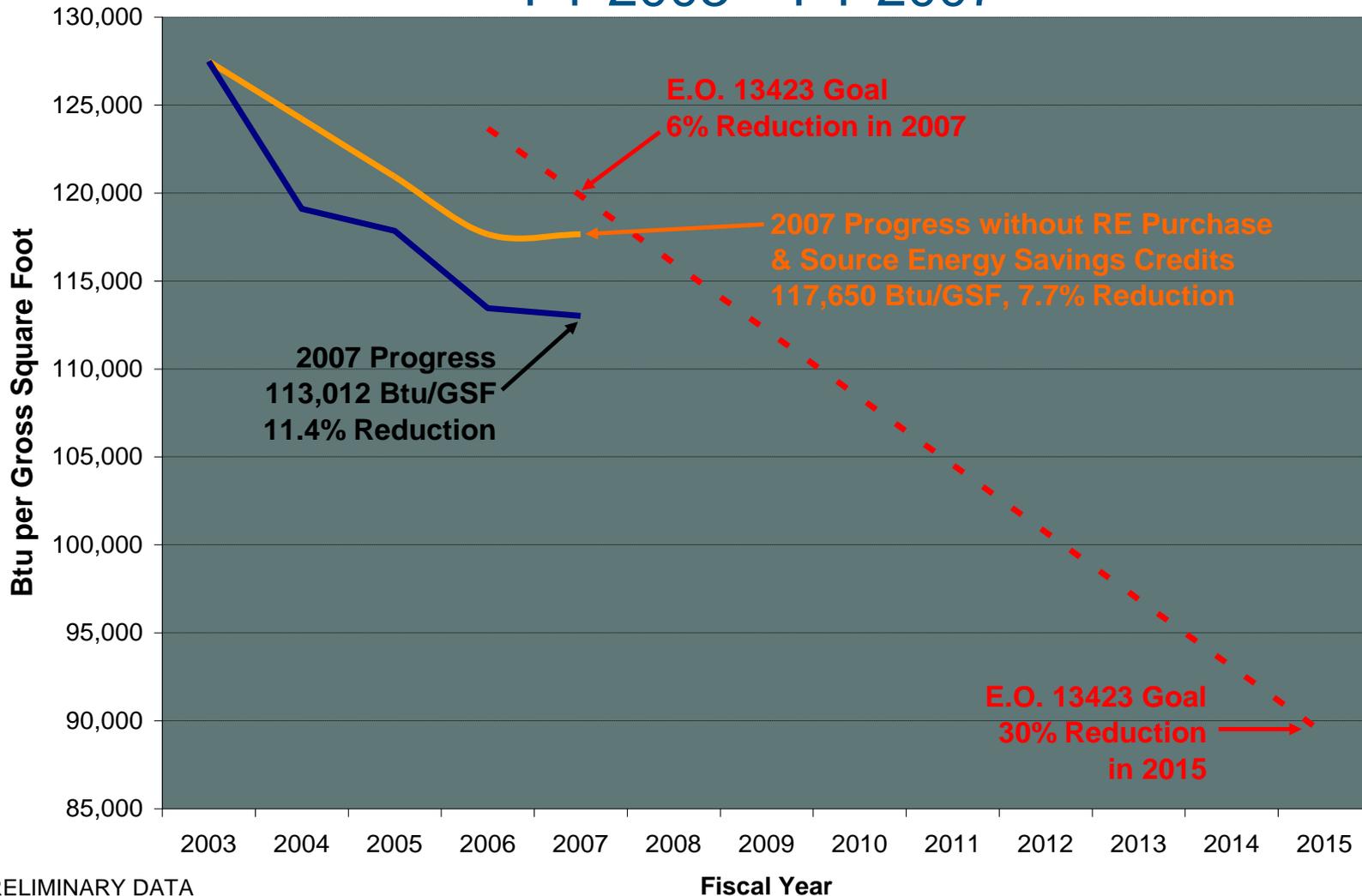
- EnergyStar issued specification for servers
- FEMP and EnergyStar are working on specification for UPS

Energy Efficient Buildings

- Energy for process loads excluded from requirement to save 30% over 90.1 2004 Standard – moving to remove exclusion
- EnergyStar is working on label for data centers

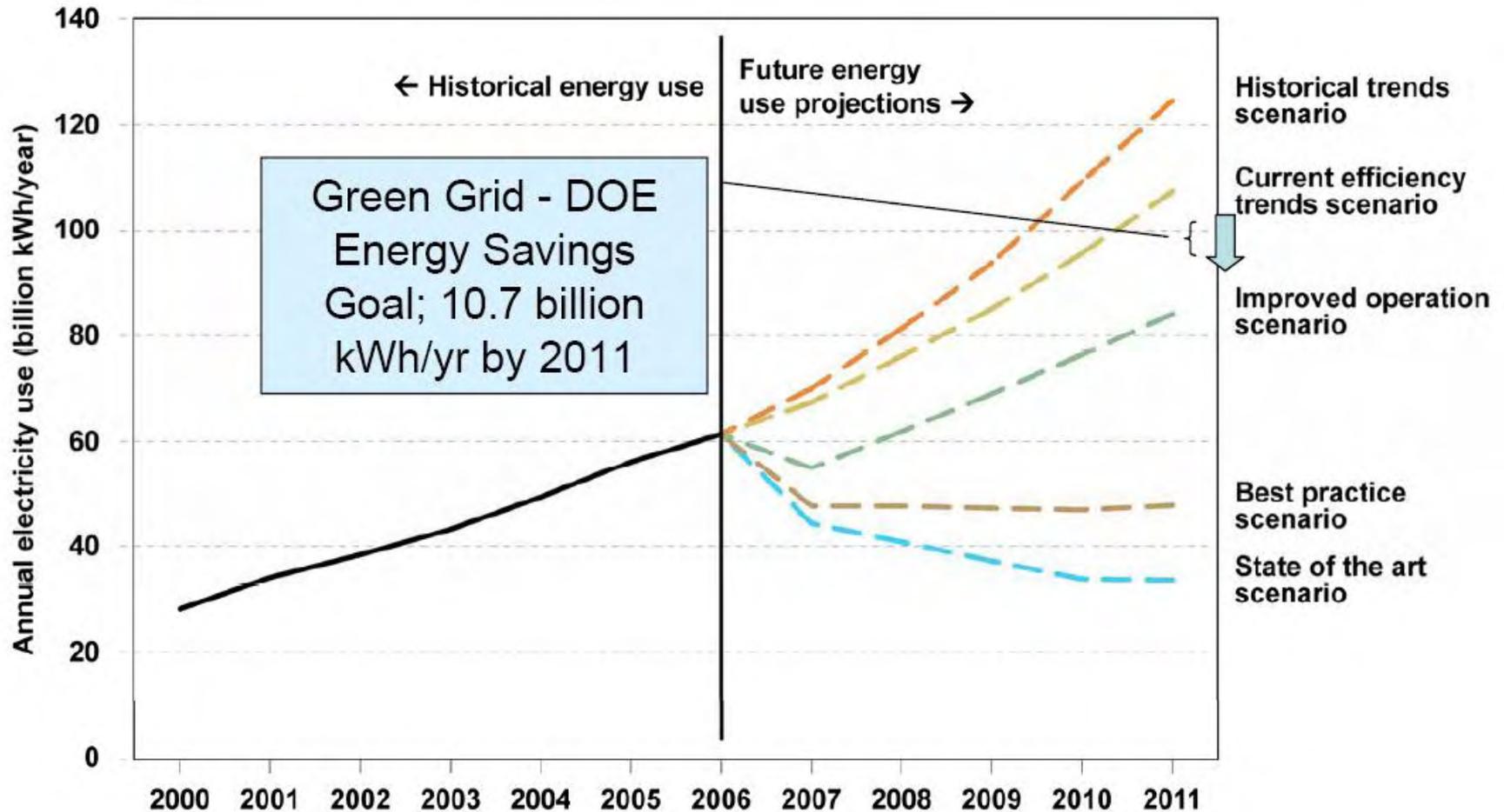


Government Building Energy Intensity FY 2003 – FY 2007





U.S. Data Center Energy Use (Five scenarios projected through 2011)





Increase Energy Savings and Security

Adopting best practices could save the U.S. government
6 billion annually kWh in 2011!

Lower energy bills

Adopting best practices could
save 410 million dollars annually
by 2011!

Avoid GHG emission

Adopting best practices would
avoid 3.8 MMT of CO₂ emission
in 2011!





Industrial Technologies Program

Working to improve the energy efficiency of U.S. industry

U.S. industry consumes 32 quadrillion Btu per year -- almost 1/3 of all energy used in the nation

Partnerships with energy-intensive industries (e.g., steel, paper, refining) are key to ITP's success:

- 5 quads of energy savings, 86 MMTCE reduction

Save Energy Now is working to reduce industrial energy intensity 25% by 2017

Data centers are an important and growing “industry”:

- Consumed 1.5% of all electricity in the U.S. in 2006
- Power demand is growing about 12% per year
- Power and cooling systems are “industrial” in scale and complexity

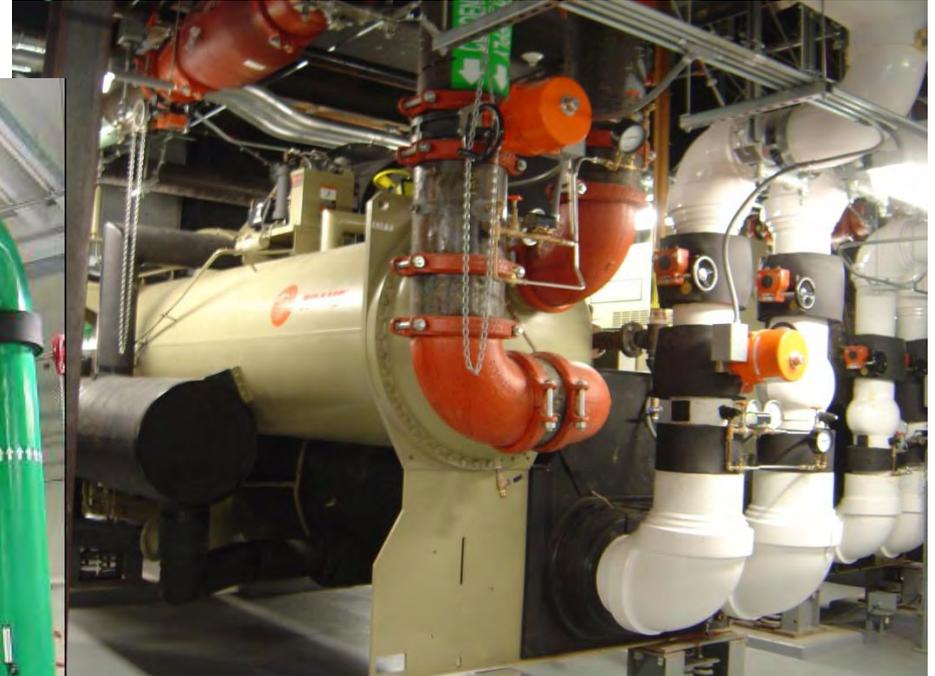




U.S. Department of Energy
Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Data Centers can be large industrial facilities





U.S. Department of Energy Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable





U.S. Department of Energy
Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

And they have specialized equipment





DOE Save Energy Now Data Center Program

Major Program Elements

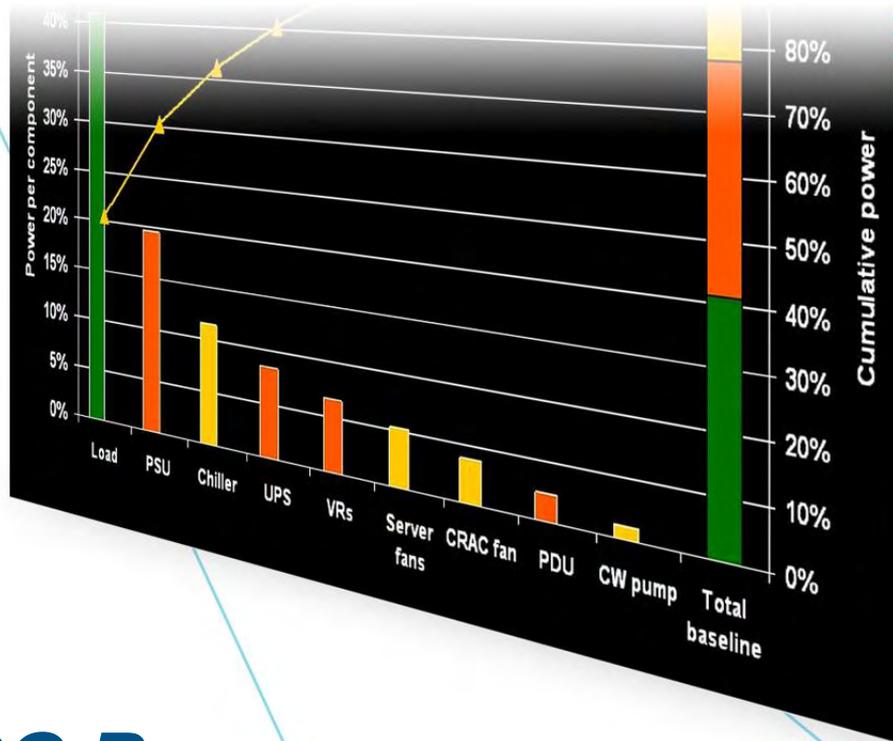
1. “DC Pro” Software tools
2. Save Energy Now case studies
3. Joint ASHRAE-DOE, awareness training curriculum
4. Data Center Certified Practitioner program
5. Best practice guidelines for “Best-in-Class” data centers
6. Validation of Technology Demonstrations
7. Assistance in improving Federal data centers
8. Collaborative research program with industry





U.S. Department of Energy Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable



DC Pro Tools define baseline energy use and identify key energy-saving opportunities

- Determine overall performance
- Benchmark subsystems
- Assess energy savings potential
- Track energy intensity improvement
- Provide quantification of key metrics including cost (\$), primary energy (Btu), and carbon
- Encourage continual improvement

DC Pro Tools and Protocols



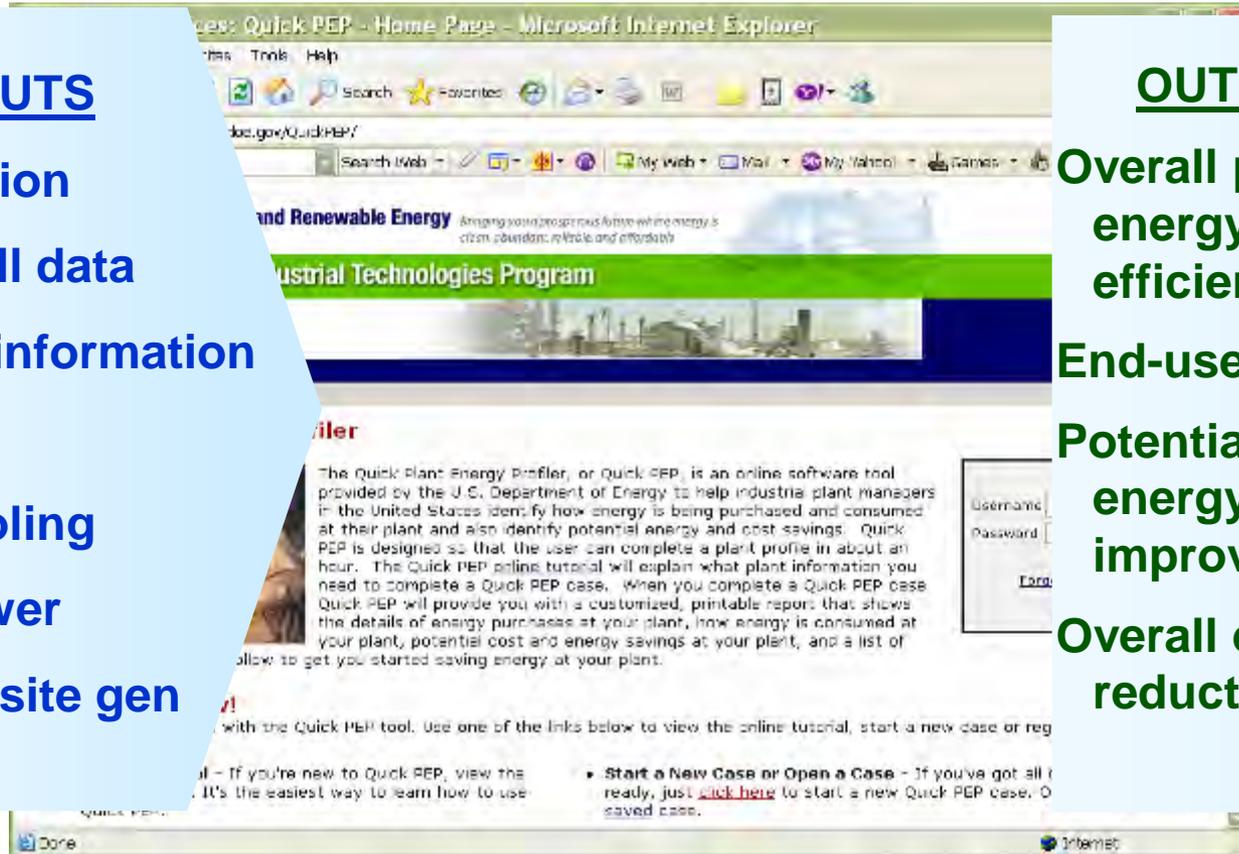
Save Energy Now On-line profiling tool: Data Center Pro

INPUTS

- Description
- Utility bill data
- System information
- IT
- Cooling
- Power
- On-site gen

OUTPUTS

- Overall picture of energy use and efficiency
- End-use breakout
- Potential areas for energy efficiency improvement
- Overall energy use reduction potential





High Level Profiling Tool

- Overall energy performance (baseline) of data center
- Performance of systems (infrastructure & IT) compared to benchmarks
- Prioritized list of energy efficiency actions and their savings, in terms of energy cost (\$), source energy (Btu), and carbon emissions (Mtons)
- Points to more detailed system tools



IT Module

- Servers
- Storage & networking
- Software



HVAC

- Air handlers/ conditioners
- Chillers, pumps, fans
- Free cooling



Air Management

- hot cold separation
- environmental conditions



Power Systems

- UPS
- Transformers
- Lighting
- Standby gen.



On-Site Gen

- Renewables
- use of waste heat



DC Pro results

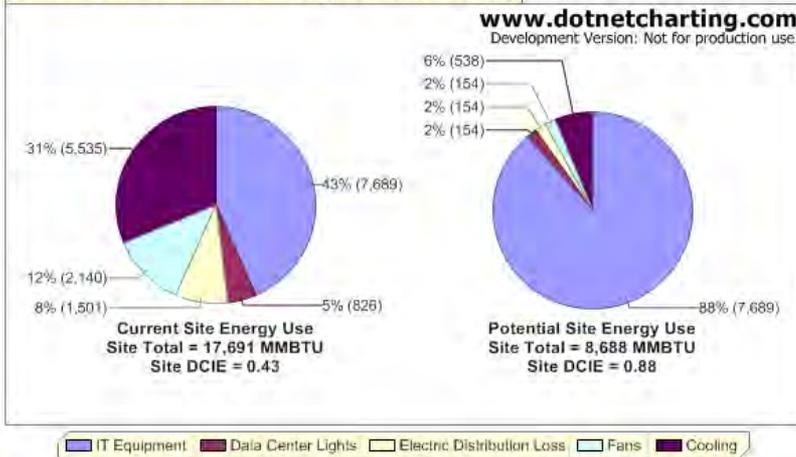
DCPro Report - Berkeley Lab

File Edit View History Bookmarks Tools Help

http://dcpro.ppc.com/DCProReport.aspx?step=&screen=1

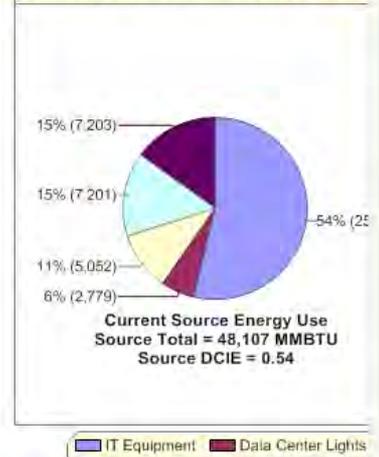
Total	17,691	100%	48,107	100%	8,688	100%	29,236	100%	7,003
DCIE		0.43		0.54		0.88		0.88	

Annual Data Center Site Energy Use (MMBTU/yr)

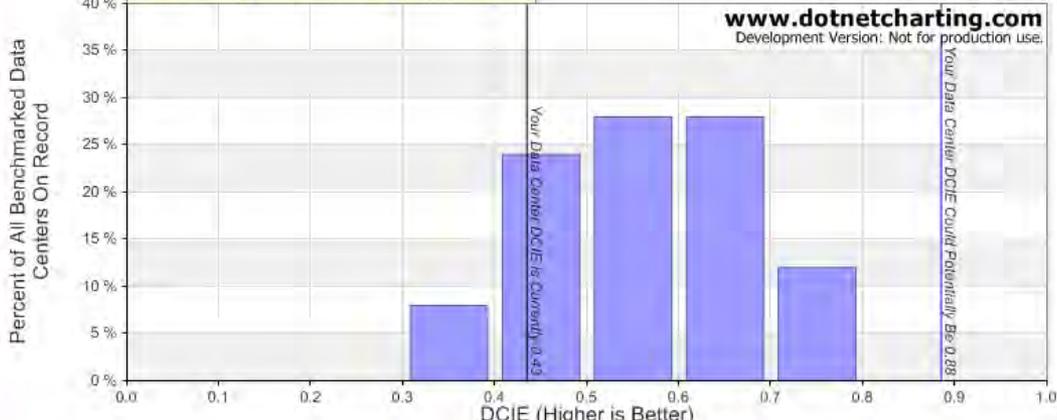


For more information visit: <http://www.dotnetcharting.com>

Annual Data Center Source Energy



Preliminary Assessment of Opportunity



www.dotnetcharting.com
 Development Version: Not for production use.



Many areas for improvement...

Cooling

- Air Management
- Free Cooling – air or water
- Environmental conditions
- Centralized Air Handlers
- Low Pressure Drop Systems
- Fan Efficiency
- Cooling Plant Optimization
- Direct Liquid Cooling
- Right sizing/redundancy
- Heat recovery
- Building envelope

Electrical

- UPS and transformer efficiency
- High voltage distribution
- Premium efficiency motors
- Use of DC power
- Standby generation
- Right sizing/redundancy
- Lighting – efficiency and controls
- On-site generation

IT

- Power supply efficiency
- Standby/sleep power modes
- IT equipment fans
- Virtualization
- Load shifting
- Idle discs



Federal Energy Management Program Data Center Services:

- **Assistance**
 - Implementation of DC Pro Tool Suite
 - Project planning and early design
- **Training (in partnership with GSA and others)**
 - Training developed jointly with ASHRAE
 - Webinars
 - Workshops at GovEnergy and Labs21 Conferences
- **Access to funding sources**
 - Energy savings performance contracts
 - Utility energy savings contracts
- **Development of best practice case studies and other tools**



Getting started with an assessment

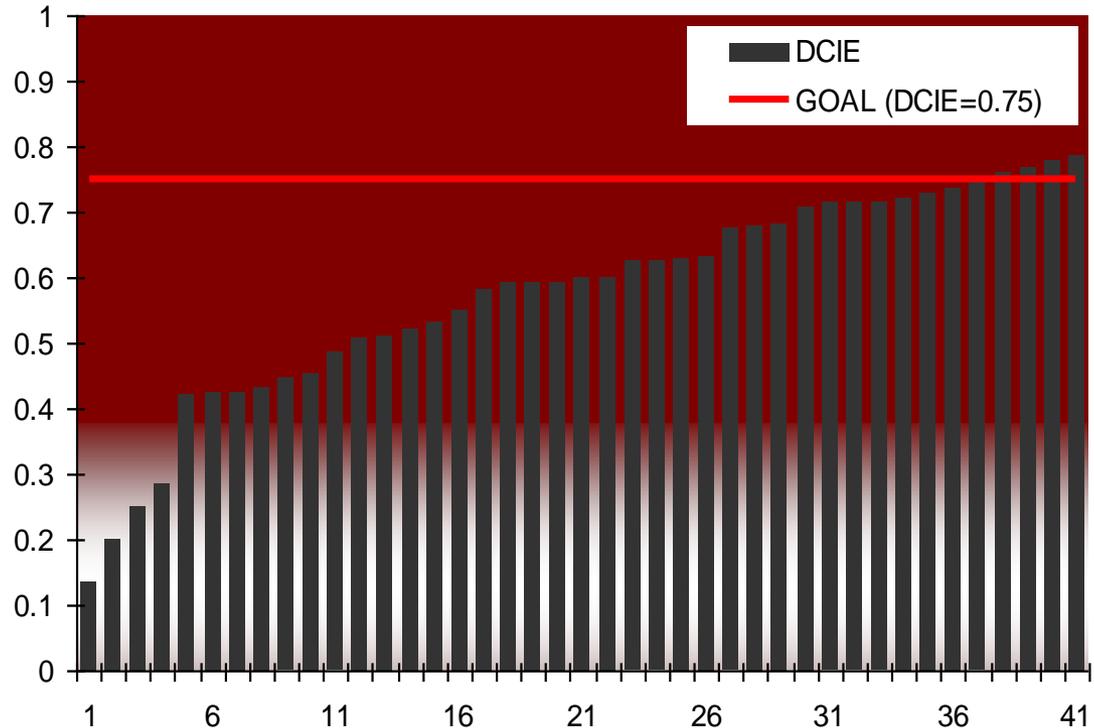
Visit: <http://hightech.lbl.gov/dc-assessment-tools.html>

- **Assessment process description**
- **Assessment worksheet**
- **Standard report template**
- **Master list of actions**
- **Link to DC Pro profiling tool and available system level tools:**
 - **Electrical systems tool**
 - **Air Management tool**



DOE DCIE - Actual and Target

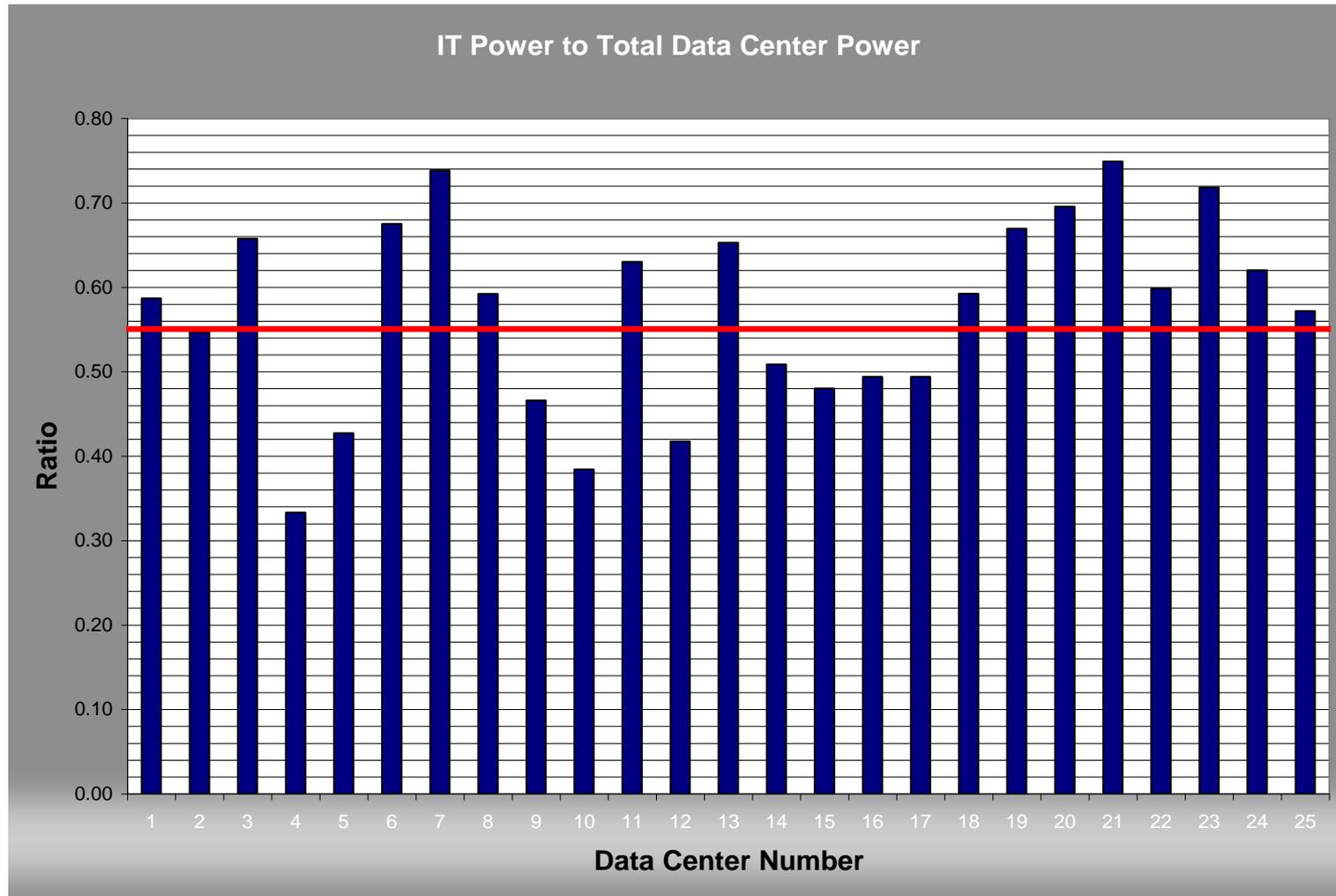
- Gathered energy use data from 41 data centers to see where we stand
- Encouraged sites to use DC Pro
- Set Goal: Increase DCIE from 0.57 to 0.75



Data centers throughout the Federal Government should adopt similar goals!



LBLN benchmark data shows similar performance





LBNL Air Management Improvements:

- Wireless monitoring system
- Hot and cold aisles
- Blanking panels
- Tune floor tiles
- Reconfigured air delivery and return

Results:

- 21% additional IT capacity
- CRAC unit set 3°F warmer
- Fewer hot spots
- 15 kW CRAC turned off





Data Center Working Groups

The Federal Partnership for Green Data Centers

- An Inter-Agency forum to exchange ideas, develop policy guidance & tools to improve data center performance

DOE Data Center Energy Efficiency Working Group

- A group working to increase the DCIE of DOE 's data centers to 0.75
- Consists of DOE program offices with data centers and those responsible for structuring energy policy

High Performance Computing Working Group

- A forum for sharing information on best practices in scientific computing
- Includes members from the public and private sectors





Plug in to Available Resources

Industrial Technologies Program

- Tool suite & metrics for baselining
- Training
- Qualified specialists
- Case studies
- Recognition of high energy savers
- Best practice information



Federal Energy Management Program

- Workshops
- Federal case studies
- Federal policy guidance
- Information exchange & outreach
- Access to financing opportunities



GSA

- Workshops
- Quick Start Efficiency Guide



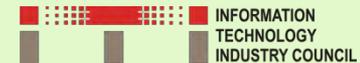
EPA

- Metrics
- Server performance rating & ENERGY STAR label
- Data center benchmarking



Industry

- Tools
- Metrics
- Training
- Best practice information
- Best-in-Class guidelines
- IT work productivity standard





Keeping Up with FEMP



***Visit the
FEMP Website for:***

- Program Activity Information
- News Updates, Announcements & Policy Initiatives
- Upcoming Workshops & Training Events

<http://www.eere.energy.gov/femp/>

Data Centers Page:

http://www.eere.energy.gov/team/data_centers.html



Bill Tschudi, P.E.

Lawrence Berkeley National Laboratory

wftschudi@lbl.gov

510-495-2417

*For more information and to
get involved:*

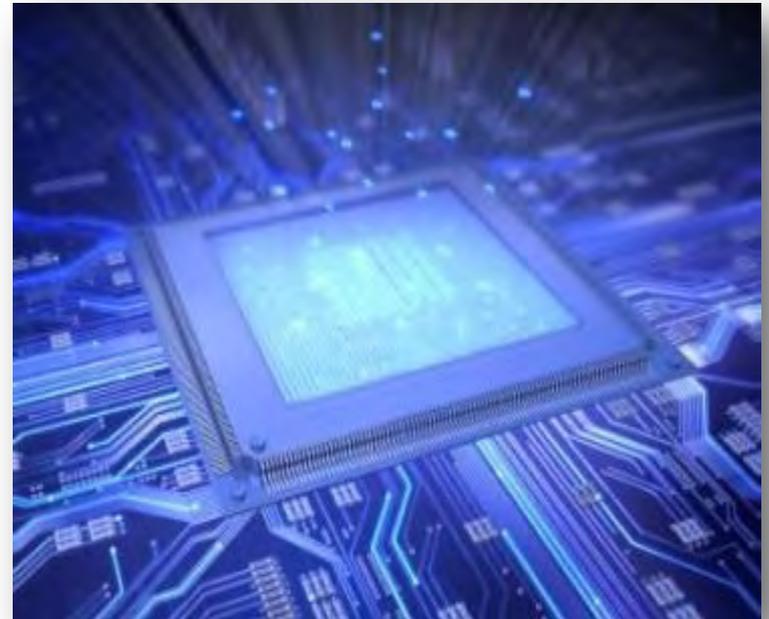
Will Lintner, P.E.

Data Center Initiative Coordinator

Federal Energy Management Program
Energy Efficiency and Renewable Energy
Department of Energy

202-586-3120

william.lintner@ee.doe.gov





U.S. Department of Energy
Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Back – up slides



Executive Order 13423 GOALS

- **Increase energy efficiency & renewable energy use**
- **Reduce water consumption**
- **Procure sustainable and efficient products (EPEAT and EnergyStar)**
- **Extend useful life of agency electronic equipment**
- **Ensure new construction follows Guiding Principles**
 - Employ Integrated Design Principles
 - Optimize Energy Performance
 - Enhance Indoor Environmental Quality
 - Reduce Environmental Impact of Materials