U.S. DEPARTMENT OF ENERGY | Office of the Chief Information Officer

1.4 PUE – The New Mandate for Federal Data Center Energy Efficiency

Energy's approach to integrate FDCCI with EO 13514 Strategic Sustainability Performance Plan (SSPP)







Outline

- What are the Requirements?
- Energy's Mission & Business Processes
- What are the Challenges?
- Energy's Sustainability Approach
- Resources & Tools
- Summary

What are the Requirements?

EISA & E.O.13423

- 30% Energy reduction by 2015

E.O. 13514

- Average PUE = 1.4
- 100% of data centers metered

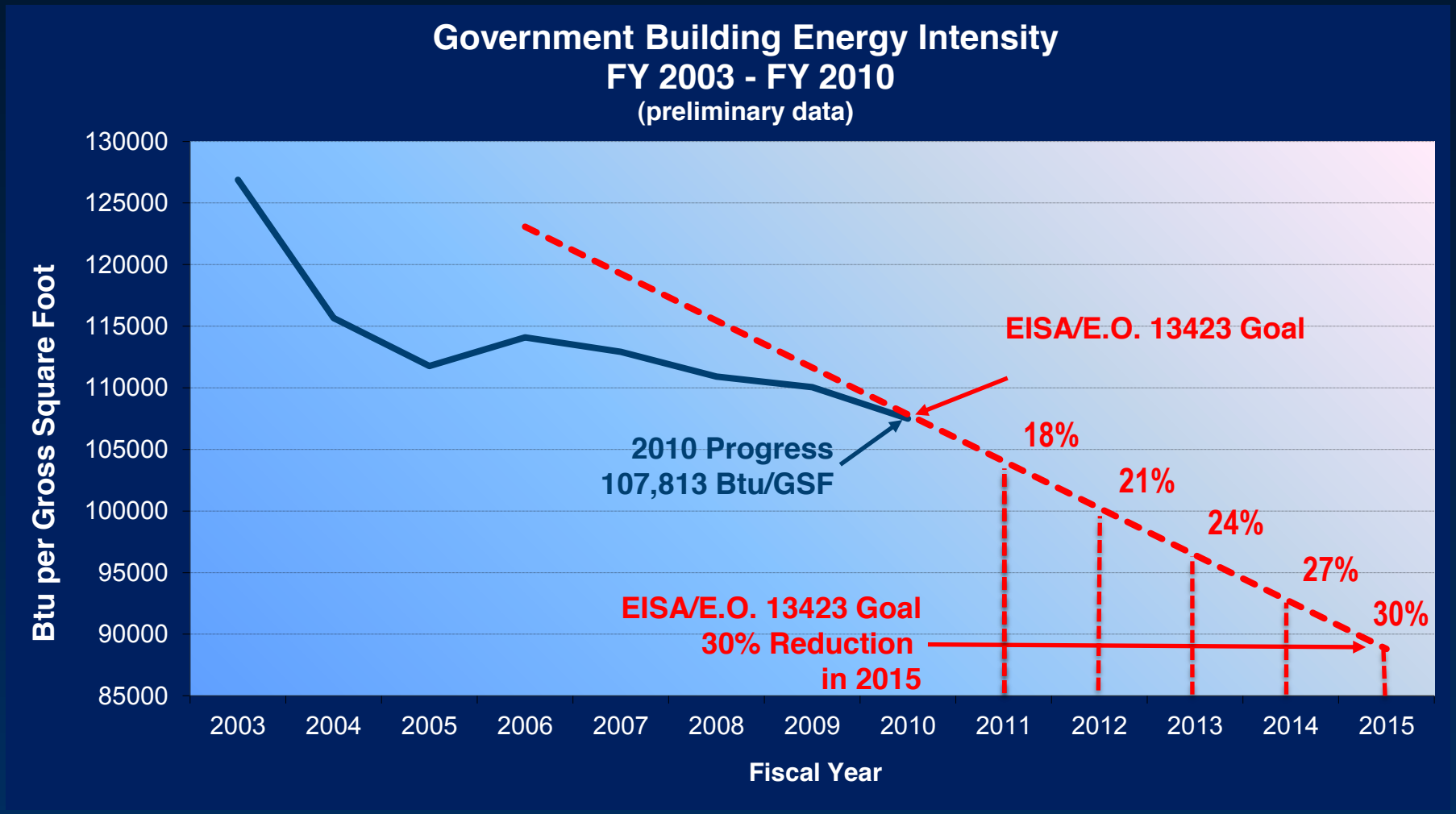
FDCCI

- Close 40% of federal data centers

WH Real Estate Disposal Memo

- Emphasizes reduction of data centers

Federal Government Energy Progress



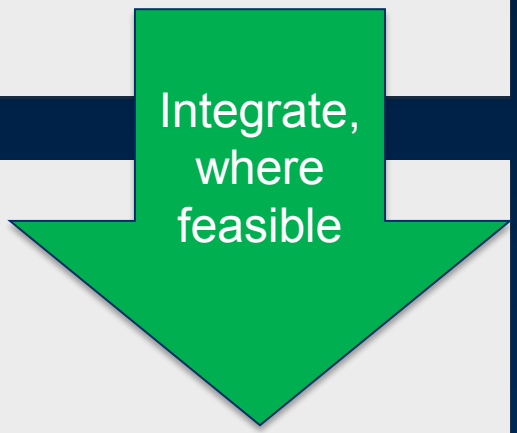
Requirements Integration

25-Point Implementation Plan to Reform Federal IT Management

- Agency CIO's have made commitments (Cloud First, Data Center Consolidation)
- OMB is tracking progress

SSPP

- Mandated by EO 13514
- Agency top-level commitment
- No exemptions
- Aligns to budget processes & funding authorities



EO 13514 - SSPP

ELECTRONIC STEWARDHIP & DATA CENTERS	FY 10	FY 11	FY	FY	FY	FY	FY 16	…	FY 20
% of agency data centers independently metered, advanced metered, or sub-metered to determine monthly (or more frequently) **TARGET**	18	40	60	80	90	100		…	
% of agency data centers operating with an average CPU utilization greater than 65%[4] **TARGET**	16	50						…	100
Maximum annual weighted average Power Utilization Effectiveness (PUE) for agency. (#) **TARGET**	1.82	1.8	1.7	1.6	1.5	1.4		…	1.4
% of agency data center assigned a certified Data Center Energy Practitioner (DOE specific) **TARGET**	N/A	20	40		80	100	100	…	100
% of agency data centers that have conducted annual DC-Pro energy assessment (DOE specific) **TARGET**	N/A	20	40						100

23% (estimate)

29% (estimate)

2.0 – 2.5 PUE

Ensuring America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions

THE PILLARS OF ENERGY

Energy

Science

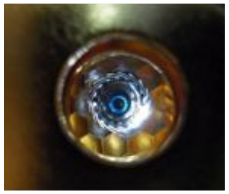
Nuclear Security

DEPARTMENT OF ENERGY PROGRAM PORTFOLIO

ENERGY

Electric Energy

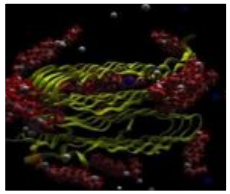
Fossil Energy



Nuclear Energy

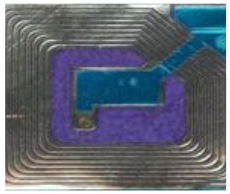
Renewable Energy

SCIENCE

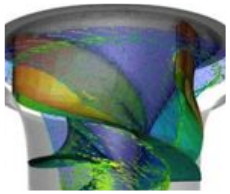


Biological Science

Chemical Science



Computing

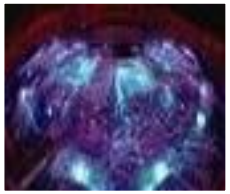


Environmental Science

Materials Science

Physics

NUCLEAR SECURITY



Managing the Stockpile

Preventing Proliferation

Powering the Nuclear Navy

Emergency Response

Recapitalizing Our Infrastructure

Continuing Mgmt Reform

The Department of Energy is a government-owned contractor-operated (GOCO) enterprise.

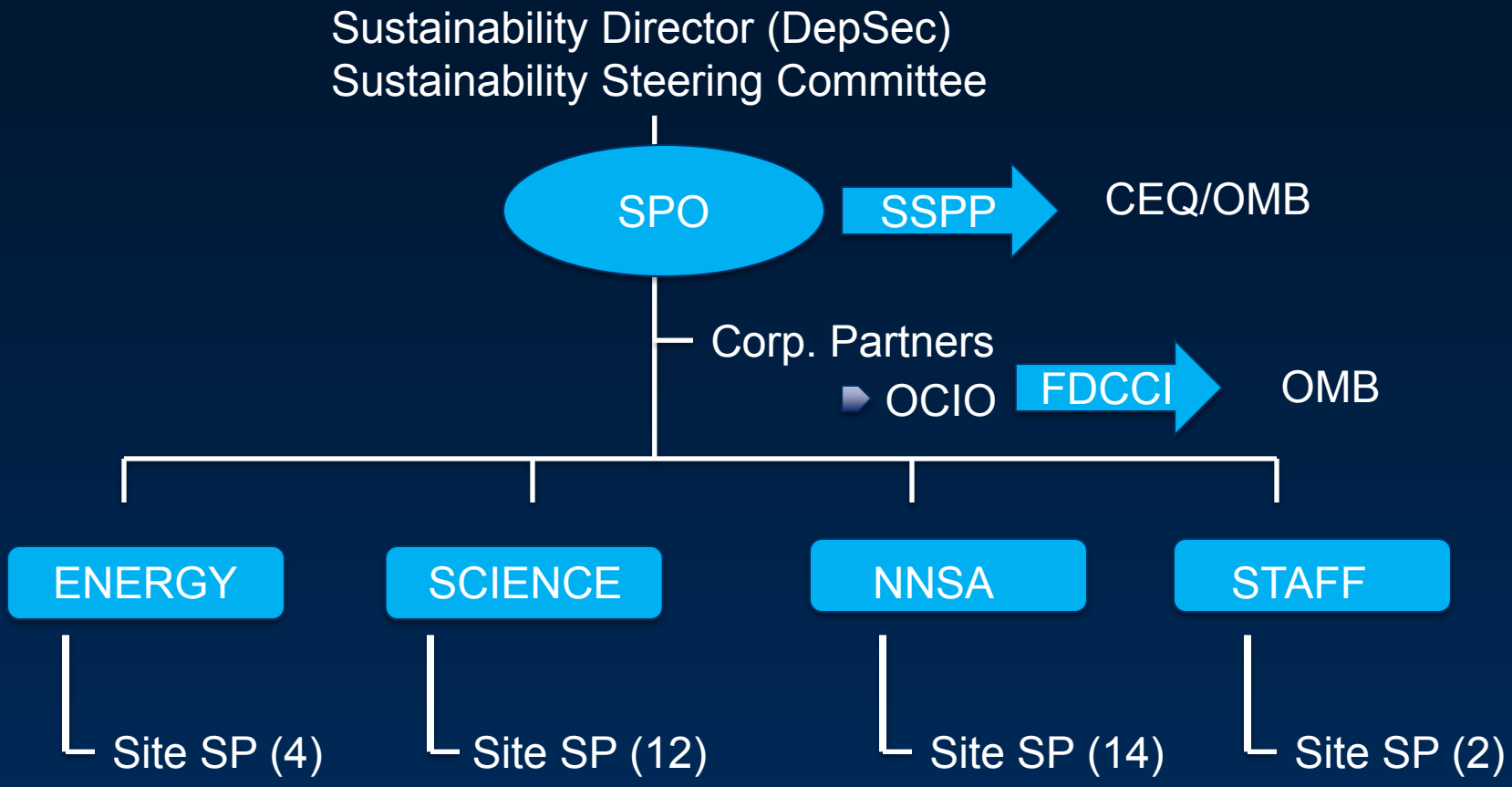
National laboratories provide unique technical capabilities to the government that cannot be effectively met industry, academia, or government in-house resources.

The GOCO model gives the national laboratories greater flexibility than most government organizations in operations, and in attracting and retaining a diverse and highly skilled technical workforce across a wide range of disciplines.

The national laboratories are the Department's strong long-term partners, supporting the diverse research and development needs our missions demand.

The DOE is a nation-wide collection of nearly 100 national laboratories, production plants and environmental clean-up sites

SSPP Governance Structure



Data Center Variability

- Energy / GHG Efficiency vs IT Systems Efficiency

Energy / GHG	IT Systems
• Power sources • Power loses • Cooling • Air Flow Mgmt	• Staffing • Systems consolidation • CPU Utilization • Lifecycle replacement

- Facilities vs IT Systems Management

- High-Performance Computing vs Business Automation

Energy's Integrated Approach

DOE's Broad Data Center Missions:

- **Improving DOE Data Centers – Both Facilities and IT**
- **Bring INNOVATION to the Practice of DC / IT Energy Management**

Data Center **missions** and **processes** vary.

We need a **comprehensive approach** that **recognizes differences** in purpose yet **drives efficiencies**.

Data centers are 2 Lines-of-Business with Different Incentives

IT Infrastructure	Facilities Infrastructure
IT Systems Performance & Availability	Utility Service Provider – Only
Operational Control of Floor Space	Pay the Electric Bill
Energy Efficiency NOT an Incentive (if you don't pay the power bill!)	**No Operational Control (therefore, no way to lower the costs)**

- **DC Efficiency Requires Unified Management!**

What is PUE?

Power Usage Effectiveness (PUE)

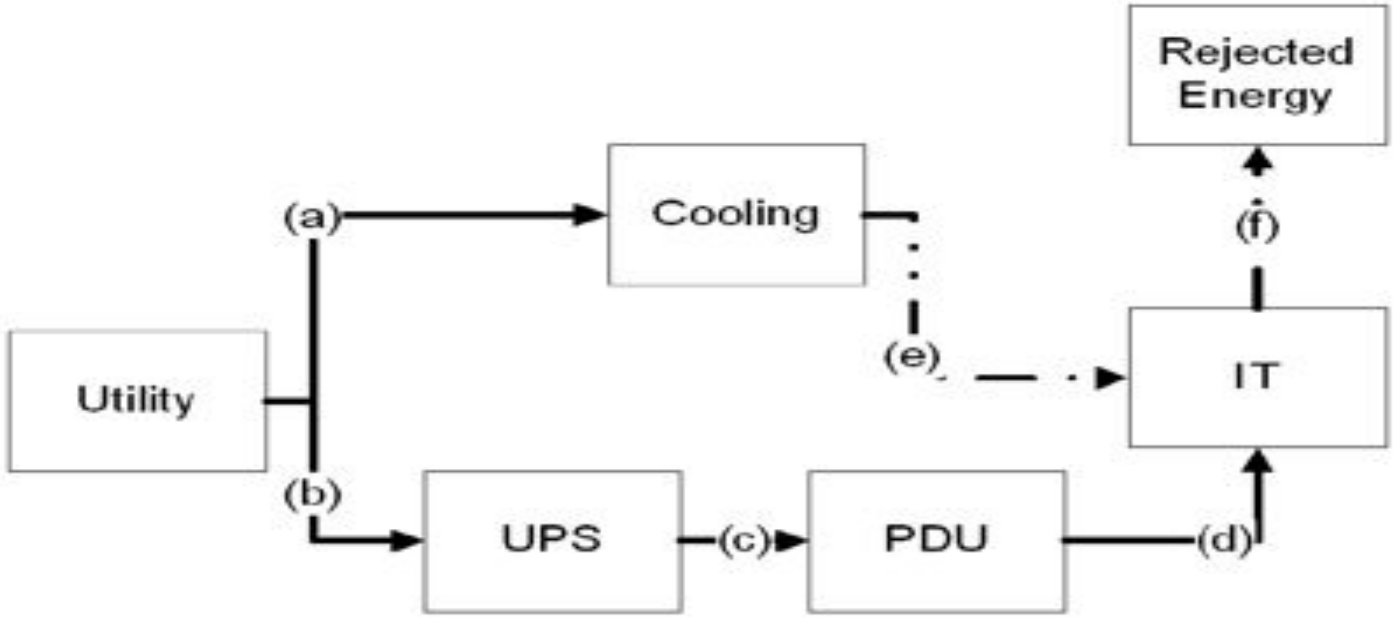
$$PUE = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

Total Facility Power Consists of:

- IT Equipment Power
- Mechanical Cooling
- Lighting
- Electrical Line Loss & Conversion

Why is PUE important?

PUE – simple and effective



$$PUE = \frac{Total\ Energy}{IT\ Energy} = \frac{Cooling + PowerDistribution + Misc + IT}{IT} = \frac{a+b}{d}$$

PUE – The "Holistic Approach"

Actual Energy Usage ***vs*** ***Energy Needed***

IT Infrastructure

ENERGY WASTE

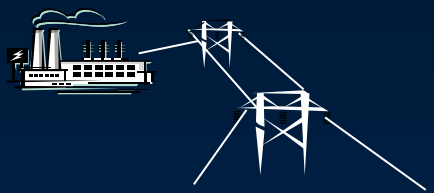
Facilities Infrastructure

PUE = 2.0

PUE=1.4 What does that mean?

$$\text{PUE} = \frac{\text{Facility Energy + IT Energy}}{\text{IT Energy}} = \frac{30\%+70\%}{70\%} = 1.4$$

Energy Efficiency Opportunities



- Server innovation
- Virtualization
- High efficiency power supplies
- Load management

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

Power Conversion & Distribution

Server Load/ Computing Operations

Cooling Equipment

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

Alternative Power Generation

- On-site generation Including fuel cells and renewable sources
- CHP applications (Waste heat for cooling)

Potential Benefits of Data Center Energy Efficiency

Directly supports Energy's Sustainability Mission

- 20-40% savings typical
- Aggressive strategies can yield 50+% savings
- Extend life and capacity of infrastructures
- But is mine good or bad?

Federal Data Center Resources

- Best Practices Guide
- Benchmarking Guide
- Data Center Programming Guide
- Technology Case Study Bulletins
- Procurement Specifications
- Report Templates
- Process Manuals
- Quick-Start Guide

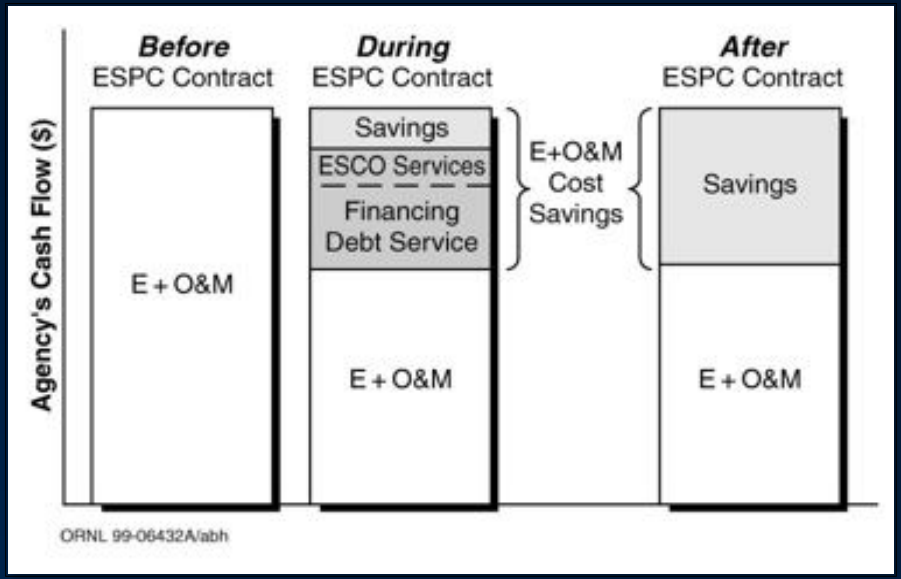
DOE Green IT – Data Center Profile Tool

The DOE IT Sustainability Dashboard (DOEGRIT) is a tool that sits at the crossroads of compliance -based initiatives and addresses the following business needs for Federal agencies:

- **Reduce the burden of data calls on IT and facility managers**
- **Quickly and accurately estimate the PUE of agency data centers**
- **Support prioritizing the consolidation and closure of data centers through quantifiable measures,**
- **Automate the creation of the Sustainability and Energy Scorecards.**

ESPC Data Center Project

An Energy Savings Performance Contract (ESPC) is a method of financing energy efficiency improvements in which the cost savings generated by installed conservation measures are used to pay all financing and investment costs for the project.



The HQ ESPC Data Center project has two major objectives:

- Evaluate the use of an ESPC contract to support data center consolidations and IT infrastructure transformation
- To conduct a pilot ESPC effort at HQ to consolidate HQ data centers and IT systems, relocate the EITS ABQ data center, and fast tract implementation of next generation IT services.

Summary

- Identify all requirements
- Integrate with established budget & funding authorities
- Establish partnerships – IT, Facility & Energy Managers
- Provide tools to decision-makers
- Explore alternative financing options
- Work to a common goal

Jake Wooley

IT Program Manager - Sustainability

702-234-1645

Jake.Wooley@hq.doe.gov

energy.gov/cio