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NASA's Federal Data Center Consolidation Initiative

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Federal Data Center Consolidation Initiative (FDCCI)

- Issued February 2010 by Federal CIO Vivek Kundra
- Objective: To generate savings to the government by:
  - Consolidating underutilized data centers
  - Virtualizing applications and systems in data centers
  - Migrating appropriate applications to cloud computing
  - Reduce data center energy consumption through "green" improvements
  - Eliminating unnecessary leased real estate used for data centers
    - Requires tremendous amount of detailed reporting about data centers and data center assets.
- 25 Point Implementation Plan to Reform Federal Information Technology Management issued December 9, 2010
  - Consolidate at least 800 data centers by 2015
  - Create a government wide marketplace for data center availability
  - Shift to a "Cloud First" Policy

Additional Federal Initiatives Affecting Data Centers

Sustainability

- NASA Strategic Sustainability Plan, Goal 7 (Originally Goal 9)
  - Requires energy metering of all data centers by end of FY12
- Various sources mandating reduction of energy consumption in data centers at a rate of 10% per year for the next 3 years and requiring extensive reporting on NASA's consolidation progress

Consolidation

- Presidential Memo dated June 10, 2010 imposing moratorium on further expansion of data centers and directing data center consolidation to occur within 5 years

NASA Profile

- NASA is comprised of 10 campuses and 1 leased building in Washington DC
  - All campus property and buildings are owned by NASA (not GSA) and not leased
  - Campuses are generally 30+ years or older
- Funding distributed to mission directorates (Science, Aeronautics, Space Operations and Exploration) and they are typically responsible for managing their mission-specific IT requirements and implementations and managing the data from their endeavors.
- Data centers are comprised of rooms in buildings, (generally no entire buildings devoted to data centers) and owned by the consuming organization either at the mission directorate, program or project level
  - Most campuses also have one general purpose data center owned by the site CIO
- NASA deals with tremendous amounts of data from missions: petabytes are routine
- NASA has a substantial high end computing capability devoted to science analysis, modeling, and engineering
- NASA reported 79 data centers (in April 2010) ; current count is 54 and heading down to 22
  - Includes “data centers” eliminated because of evolving definition

Three Fundamental Deficiencies

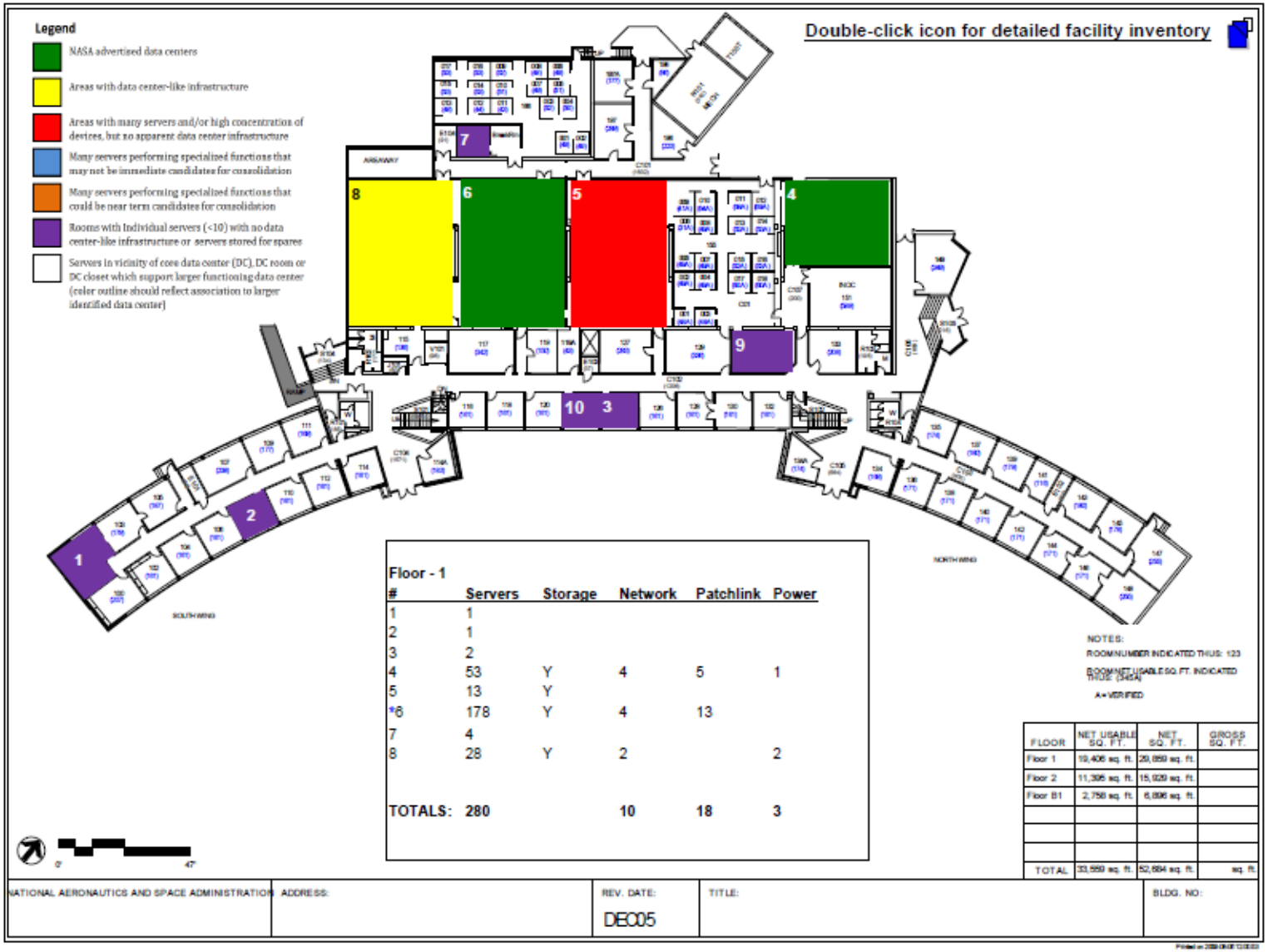
- NASA did not know how many data centers it really had
- NASA did not have an inventory or automated tracking system for its data center assets
- NASA had no way to measure and differentiate the facility vs. IT power consumption within the data center or to document an energy consumption baseline, all of which is needed to assess energy efficiency and measure improvements

These information deficiencies made it impossible to meet OMB reporting requirements and impossible to gauge measurable progress toward Federally mandated goals.

Initiatives to Address Deficiencies

- Overlaid GIS data with manual asset inventory information to identify all rooms containing server class assets (including non-data center located assets such as servers in closets/under desks)
- Implemented an automated asset inventory tool Agency-wide to identify and track data center assets
- Completed a physical evaluation of all NASA data center facilities
- Deploying a power metering capability in data centers to calculate power usage effectiveness (PUE) and to measure the savings from energy related improvements
- Developed Center Data Center Consolidation six month quick win plan of actions and drafting an Agency longer term Data Center Consolidation Strategy.
- Working with Enterprise Architect on the application portfolio looking at candidate applications for virtualization or cloud
- Working with science and engineering communities evaluating appropriateness of cloud computing for science and engineering workloads.

Example Floor Plan: Rooms Containing IT Infrastructure



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Example Floor Plan: Rooms Containing IT Infrastructure

SECOND FLOOR PLAN

FIRST FLOOR PLAN

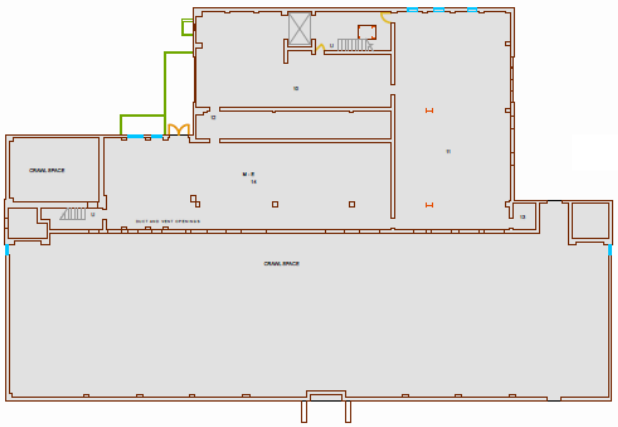
#	Servers	Storage	Network	Patchlink
1	2			
2	40	Y	8	
3	1			
4	4		2	
5	12			
6	97	Y	6	17
7	2	Y	1	
8	88	Y		
9	56	Y	8	
*	*82*		*4*	
*	*4*		*11*	
*	*2*			
TOTALS: 390			**40**	**17**

**Rooms not found on designated floor plan.*

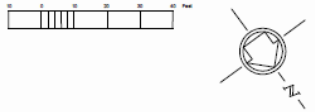
Double-click icon for detailed inventory

Legend

- Advertised data centers reported by Centers
- Area with many servers and data center-like infrastructure. May include special cooling
- Areas with many servers, but no apparent data center infrastructure (could be consolidated)
- Many servers performing specialize functions that cannot be consolidated (mission, embedded lab)
- Many servers performing specialize functions that can be consolidated (i.e. Linux Development lab)
- Individual servers (<10) with no infrastructure or storage or servers stored for spares
- Servers in vicinity of core data center (DC), DC room or DC closet which support larger functioning data center (color outline should reflect association to larger identified data center)



BASEMENT FLOOR PLAN



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NASA's Overall Data Center Goals

- Access to cost and power efficient data centers to meet all NASA computing requirements
  - Fully utilize existing data centers
  - Implement energy saving data center best practices
  - Make strategic improvements to strengthen the health of key data centers
  - Taking a comprehensive look at NASA's computing service delivery
- Transformation of the data center environment
  - Aggressively work to eliminate "server rooms"
  - Consolidate and eliminate underutilized data centers, systems and applications
  - Virtualize systems and applications as appropriate
  - Obtain cloud services where possible instead of building new NASA owned infrastructure
- Ensure a seamless customer friendly interface for the delivery of the comprehensive set of NASA computing services

Data Center Power Monitoring

What Data Center Energy Metrics Are We Required to Report?

From Federal Data Center Consolidation Initiative

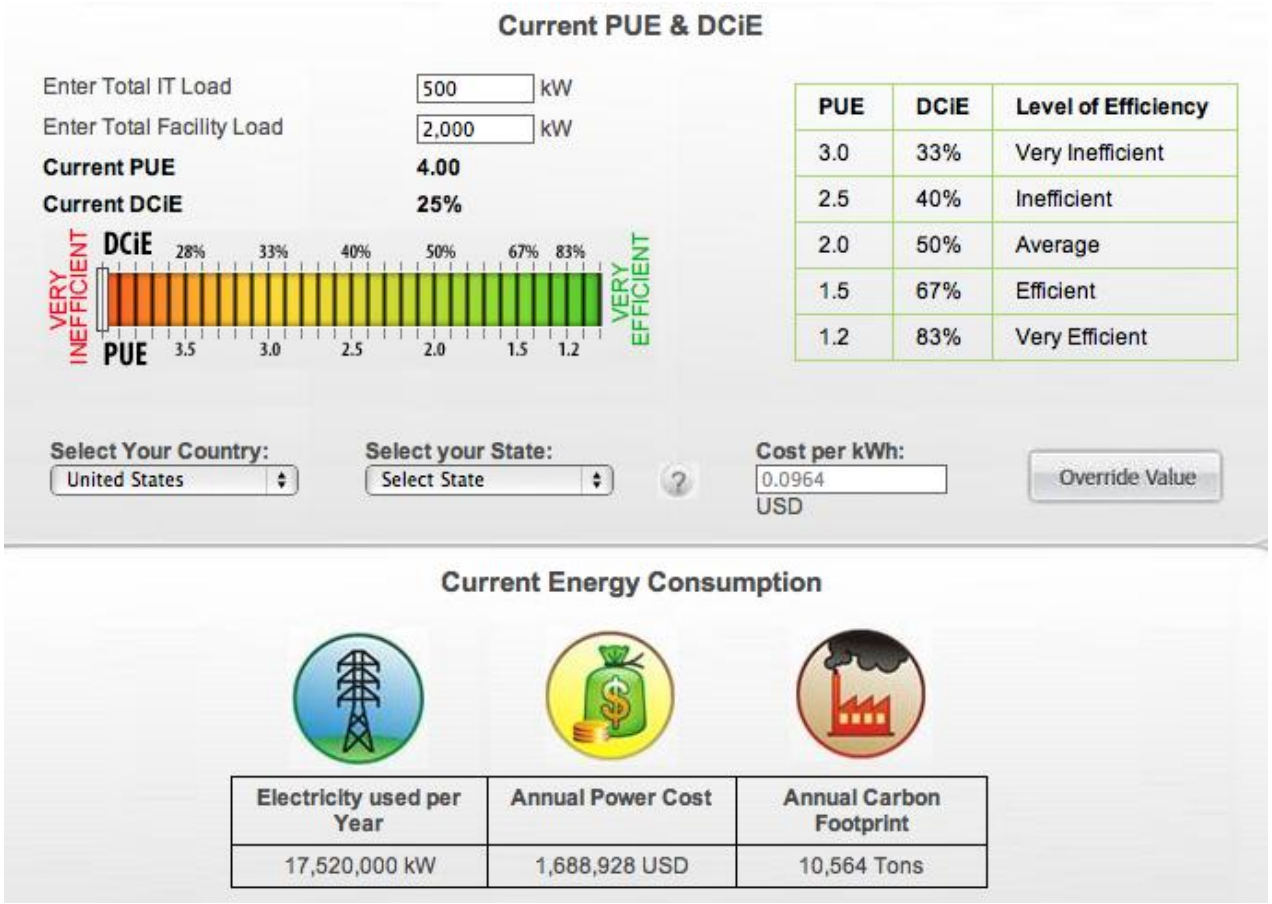
- Average Power Density Usage Equivalent (W/sq.ft.)
  - » Typical results: 50-100 W/sq. ft.
  - » Target results: 150-250 W/sq. ft.
- Power Usage Efficiency (PUE)
  - » (PUE=Total facility power/IT equipment power)
  - » Typical results: 3-2 **(NASA Average Result Estimated at 4)**
  - » Target results: 1.6-1.3

From NASA's Strategic Sustainability Plan

- Percent of agency data centers independently metered or advanced metered and monitored on a weekly basis
  - » FY11 target: 90%
  - » FY12 target: 100%
- Number of Agency data centers operating at a PUE range of 1.3-1.6
  - » FY11 target: 25%
  - » FY12 target: 50%

Inefficient Data Center Cost Scenario

- Average PUE of 4.0



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Results of Data Center Efficiency

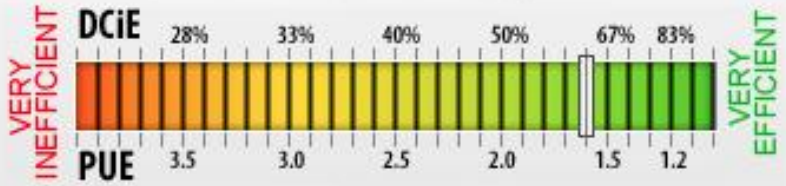
Current PUE & DCiE

Enter Total IT Load: 500 kW

Enter Total Facility Load: 800 kW

Current PUE 1.60

Current DCiE 63%



PUE	DCiE	Level of Efficiency
3.0	33%	Very Inefficient
2.5	40%	Inefficient
2.0	50%	Average
1.5	67%	Efficient
1.2	83%	Very Efficient

Select Your Country: United States

Select your State: Select State

Cost per kWh: 0.0964 USD

Override Value

Current Energy Consumption

Electricity used per Year	Annual Power Cost	Annual Carbon Footprint
7,008,000 kW	675,571 USD	4,226 Tons

***Roughly 60% Reduction in Energy cost**

How To Improve Your Data Center Efficiency

- Hot / cold isle isolation
- 80.6F inlet temperature, ASHRAE recommendation
- Variable speed fans in cooling units
- Outside air economizer
- More efficient servers
- Fill up your data centers
- Eliminate underutilized servers and applications

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