

Operating Cost Benchmarks for Data Centers

DOE Facility Cost Planning Workshop

May 24, 2011

Sheraton Fisherman's Wharf Hotel
San Francisco, CA

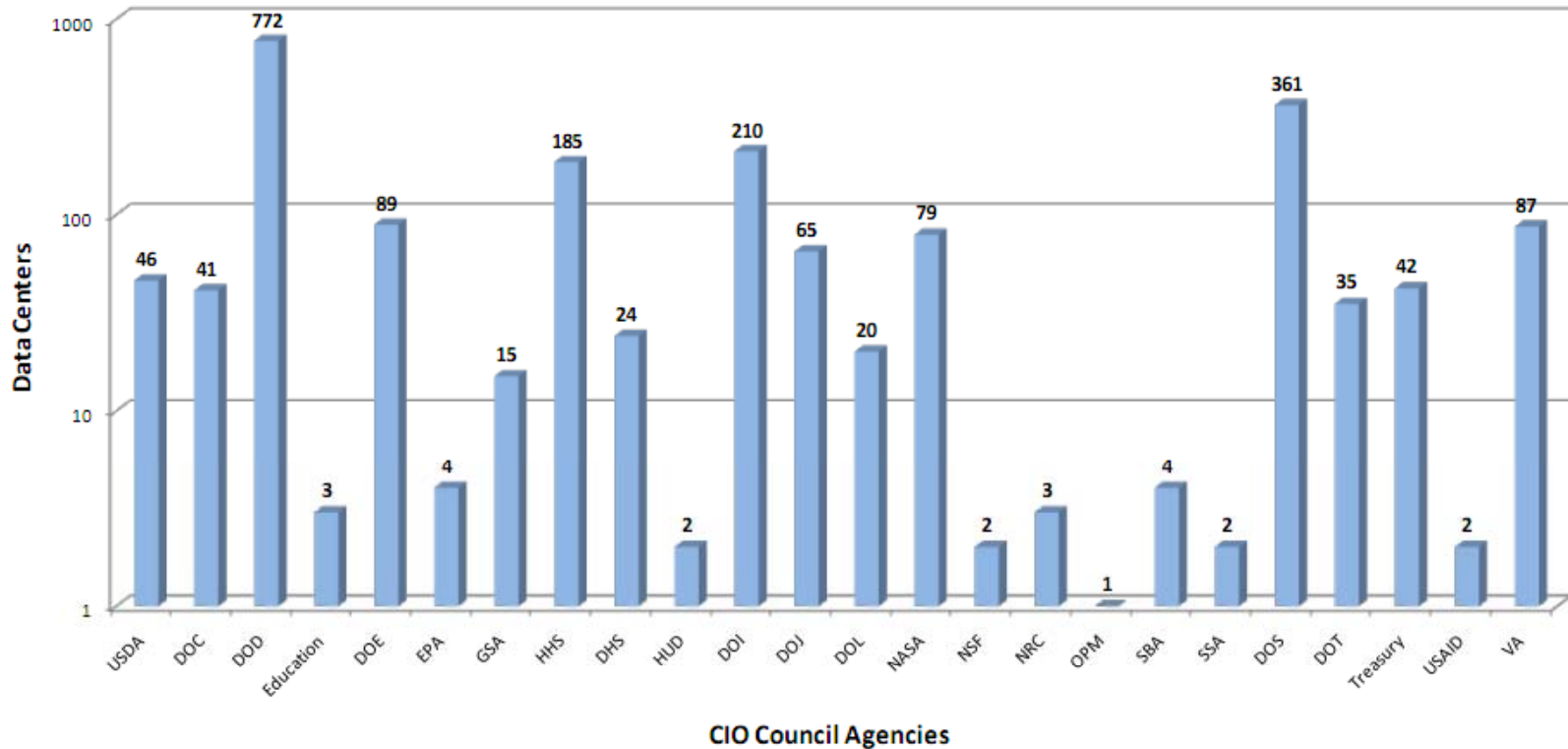
Mike Towers
Whitestone Research Corporation

Data centers are expensive

- Government servers and data centers used 6 billion kWh of electricity in 2006
- Often inefficient with low utilization rates
- No broadly accepted operating cost benchmarks



Data Centers are Distributed Widely Among Federal Agencies



The number of federal data centers increased from 432 in 1998 to over 2,000 in 2010.

Recent Attention on Rising Costs

Recent mandates focus on consolidation of data centers and reducing energy consumption:

- Executive Order 13514—Federal Leadership in Environmental, Energy, and Economic Performance
- The Federal Data Center Consolidation Initiative
- Presidential Memorandum—Disposing of Unneeded Federal Real Estate

Project: Cost Benchmarks for Large U.S. Agency

Purpose: to estimate savings opportunity from data center consolidation.

Five data center cost profiles were produced for Tier I, II, III, IV, and tier-less:

- Models were defined for small data center spaces (500 GSFT of computing space) in mixed use buildings
- Computing intensity for base operations, not high intensity research computing
- Components selected to meet Uptime Institute's tier requirements

Tier Requirements Summary

Data centers categorized in tiers according to the redundancy of mechanical equipment and the independence of electrical distribution paths.



	Tier I	Tier II	Tier III	Tier IV
Active Capacity Components to Support the IT Load	N	N+1	N+1	N After any Failure
Distribution Paths	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling	Load Density Dependent	Load Density Dependent	Load Density Dependent	Class A

Model Key Components by Tier

Attachment A. Building Systems by Data Center Tier^A					
Building System	Non-Tier	Tier I	Tier II	Tier III	Tier IV
Interior Wall Finish	Sheetrock	Acoustical Tile	Acoustical Tile	Acoustical Tile	Acoustical Tile
Floor Finish	Vinyl Sheet	Access Flooring	Access Flooring	Access Flooring	Access Flooring
Ceiling Finish	Dropped Acoustical Tile	Dropped Acoustical Tile	Dropped Acoustical Tile	Dropped Acoustical Tile	Dropped Acoustical Tile
Plumbing	None	None	None	None	None
Energy Supply	None	Oil Storage Tank	Oil Storage Tank	Oil Storage Tank	Redundant Oil Storage Tank
Heating	None	None	None	None	None
Cooling	Air Cooled Condenser	Air Cooled Condenser	Redundant Air Cooled Condenser	Redundant Air Cooled Condenser	Redundant Air Cooled Condenser
Air Distribution	None	Single Zone Air Handler	Redundant Single Zone Air Handler	Redundant Single Zone Air Handler	Redundant Single Zone Air Handler
Package Units	Air Cooled AC Unit	Air Cooled AC Unit	Redundant Air Cooled AC Unit	Redundant Air Cooled AC Unit	Redundant Air Cooled AC Unit
Fire Protection	Sprinkler System	Sprinkler System	Sprinkler System	Sprinkler System	Sprinkler System
Electrical Distribution	Power Panel Board, Disconnect Switch	Secondary Transformer, Power Panel Board, Disconnect Switch	Main Switchgear, Secondary Transformer, Power Panel Board, Disconnect Switch	Multiple Path Redundant Main Switchgear, Secondary Transformer, Critical System Motor Control Center, Power Panel Board, Disconnect Switch	Multiple Path Redundant Main Switchgear, Secondary Transformer, Critical System Motor Control Center, Power Panel Board, Disconnect Switch
Generator	None	Diesel	Redundant Diesel	Redundant Diesel	Multiple Path Redundant Diesel
Uninterruptible Power Supply (UPS)	None	UPS	Redundant UPS	Redundant UPS	Multiple Path Redundant UPS
Source: Whitestone Research					

Defining Levels of Service

Three distinct energy demand levels (low, medium, high) were identified based on typical computing intensity.

Level of Service	Computing Intensity (W/SF) ^B	Energy Demand (kwh/SF) ^C	Cost/SF ^D
Low	5 - 25	242	\$57.32
Medium	25 - 45	565	\$133.59
High	>45	886	\$209.86

^A Medium Level of Service was used for all Data Center models.
^B Source of Computing Intensity Ranges: Lawrence Berkeley National Laboratory and Stanford University.
^C Energy Demand based on 500 SF of computing area and a general eStar Building Efficiency Ratio of 75.
^D All costs expressed in \$2010.
 Source: Whitestone Research

Custodial, grounds, management, pest control, refuse, road clearance, security, telecommunications, and water & sewer were based on existing Whitestone models.

Draft Cost Estimates

Total operating costs vary from \$176.67 (Non-Tier) to \$295.03 (Tier IV) per GSFT.

Note the small size of these models results in relatively high costs per GSFT.

Table 1. Annual Operations Costs per GSFT by Data Center^A

Operation	Non-Tier	Tier I	Tier II	Tier III	Tier IV
Custodial	\$2.47	\$1.96	\$1.73	\$1.65	\$1.51
Energy	\$133.59	\$133.59	\$133.59	\$133.59	\$133.59
Grounds	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
M&R	\$11.67	\$56.44	\$93.97	\$102.24	\$140.25
Management	\$6.35	\$6.33	\$6.31	\$6.31	\$6.29
Pest Control	\$0.26	\$0.26	\$0.26	\$0.26	\$0.26
Refuse	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Road Clearance	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Security	\$21.92	\$17.14	\$15.02	\$14.20	\$12.89
Telecom	\$0.42	\$0.32	\$0.28	\$0.26	\$0.23
Water/Sewer	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total Costs	\$176.67	\$216.04	\$251.17	\$258.50	\$295.03

^A Cost are based on a 50-Year annual average. All costs expressed in \$2010.

Source: Whitestone Research

Other Key Findings

- Higher tier data centers are not necessarily operating at a higher cost. Computing intensity is the primary driver of energy demand and is unrelated to tier classification.
- M&R and energy costs account for over 80 percent of total requirements.

Summary

While the primary goal of the project was to calculate operating costs for typical federal data centers, these estimates are also applicable to commercial centers.

For more information contact:

Mike Towers

805-879-9923

mtowers@whitestoneresearch.com