Data Centers and Energy Use
A Facilities Perspective

Chuck Skidmore

Take Away

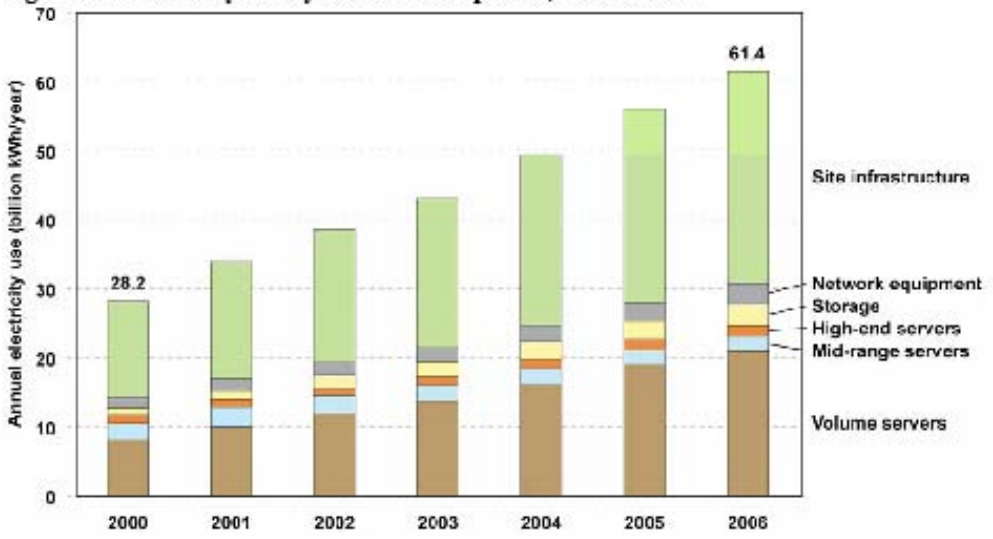
- Investing in new, more energy efficient technology is worth doing.
- Data Centers, server rooms, etc. should be isolated from the building HVAC system. They require a totally different approach.
- The best cooling for computing equipment is as close to the component level as possible.

The Really Big Picture

- Desktop computers and the various forms of networks that serve them consume enormous amounts of electrical energy, generate enormous amounts of heat, and require enormous amounts of energy to remove that heat.

Enormous Amounts of Energy are Consumed by Computing Equipment

Figure 2-1. Electricity Use by End-Use Component, 2000 to 2006



End use component	2000		2006		2000 – 2006 electricity use CAGR
	Electricity use (billion kWh)	% Total	Electricity use (billion kWh)	% Total	
Site infrastructure	14.1	50%	30.7	50%	14%
Network equipment	1.4	5%	3.0	5%	14%
Storage	1.1	4%	3.2	5%	20%
High-end servers	1.1	4%	1.5	2%	5%
Mid-range servers	2.5	9%	2.2	4%	-2%
Volume servers	8.0	28%	20.9	34%	17%
Total	28.2		61.4		14%

As Figure 2-2 shows, more than one-third (38 percent) of the electricity use is attributable to the nation's largest (i.e., enterprise-class) data centers.

Consequences of Using 3000 Older, Less Efficient PC

- Total kWh consumed during the 5-year period = 26,446,990
- Cost of that energy = $4,469,998.00
- Pounds of CO2 emitted by power plants = 35,967,906

Benefits of Energy Star PC

- Total kWh consumed during the 5-year period = 11,620,650
- Cost of that energy =$1,284,229.00
- Pounds of CO2 emitted by power plants =15,804,084

The savings on the electric bill could pay for the new computers within 5 years

- Cost of energy to power old style PC = $4,469,998.00
- Cost of energy to power Energy Star = $1,284,229.00
- Savings over 5-year period = $3,185,769.00/3000 PC = $1061.92 per PC

The Facilities Perspective

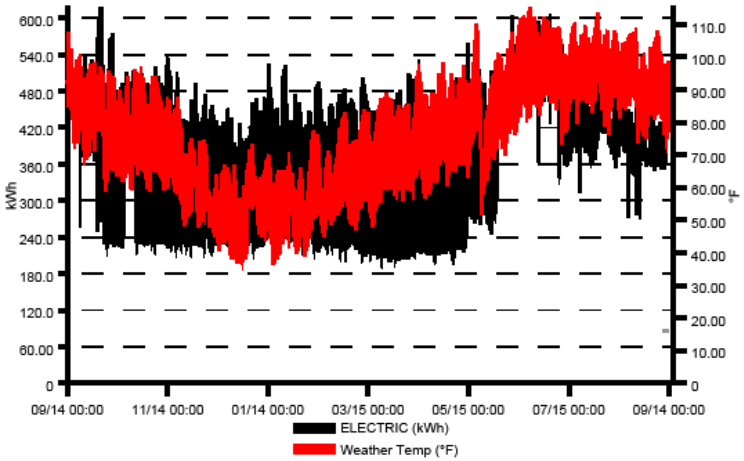
- Data Centers are concentrated, thermally heavy loads that are difficult to adequately cool. They should ideally be isolated thermally, mechanically, and electrically from the main building.
- They are often located in rooms that were never intended for that sort of use and are simply not equipped to handle the load.

Facilities Issues with Data Centers

- Often must run an entire facility 24/7 just to keep one room cool.
- Older buildings often don't have the electrical capacity for the computers and the extra cooling needed.
- Switching power supplies produce harmonics that overheat the electrical infrastructure. Overheated equipment will fail at the most inopportune time.

Run an Entire Building to Keep a Single Room Cool

Load Profile Report



Reporting Period: From 09/14/2007 to 09/13/2008
Selection: Arts

ELECTRIC

Meter Reading Statistics

Max (h) Demand	614.520 KW at 10/03 13:00	Peak hour	614.520 kWh at 10/03 13:00
Min hour	84.240 kWh at 09/12 00:00	Total	3,173,182.563 kWh
Avg	371.002 kWh	LF	60.37%
Estimated #s C02	4,325,047.834		

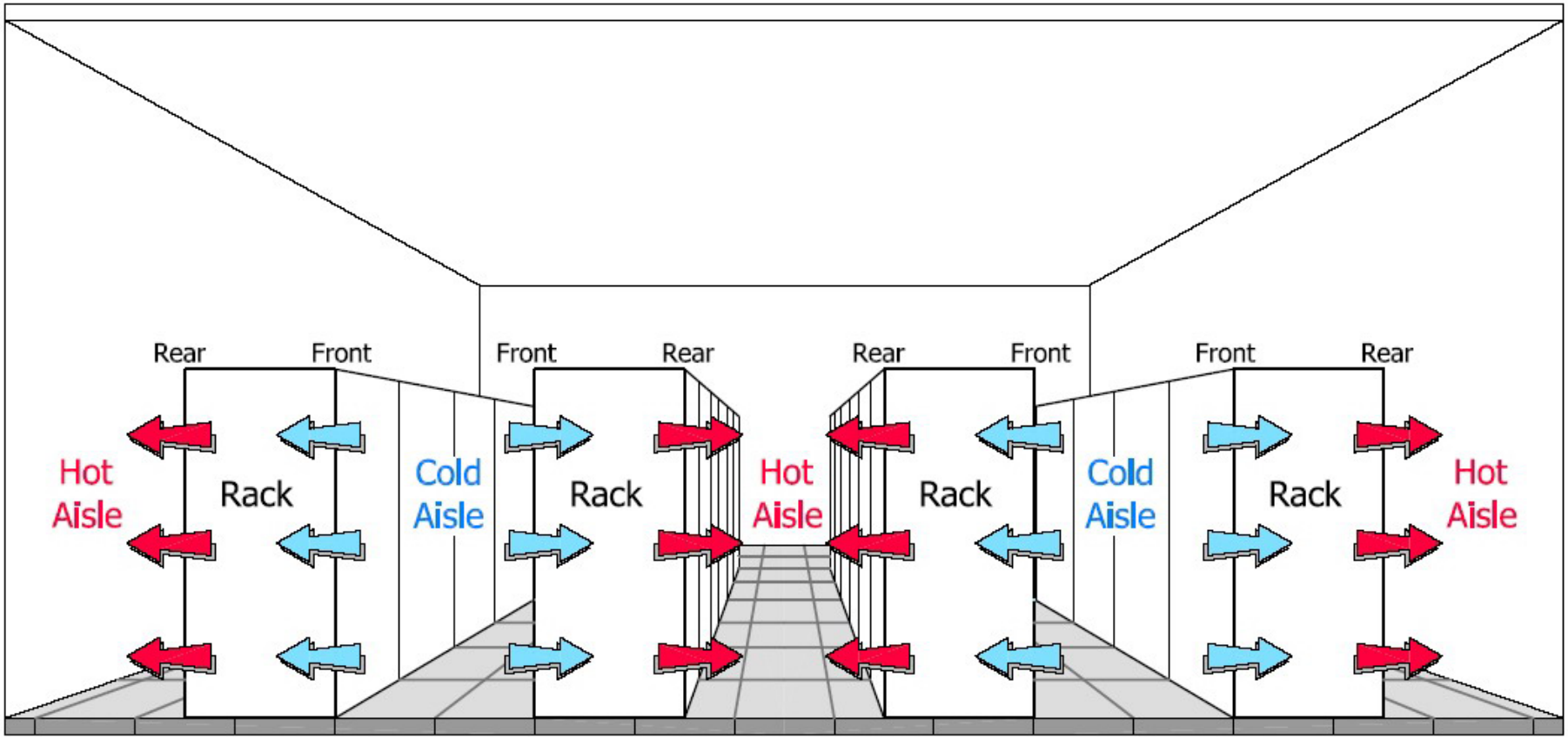
Reporting Period: From 09/14/2007 to 09/13/2008
Selection: Arts

Weather Temp

Meter Reading Statistics

Peak hour	114.625 °F at 08/21 16:00	Min hour	35.750 °F at 01/17 07:00
Avg	75.222 °F		

A Common Approach to Cooling Data Centers



Cooling

NEW Liquid Cooling Package (LCP) Solution

The Future is Here!

Cooling and heat removal, in the data center and at the enclosure level, have quickly become the most critical factors in data center design. Unmanaged heat removal may cause equipment damage or even failure, resulting in costly downtime. With the exponential increase in deployed servers, heat loads have almost quadrupled in the last seven years, leaving many facilities today unable to support such temperatures.

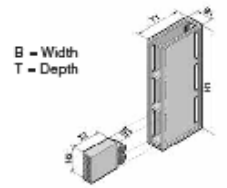
Developed to remove high levels of waste heat from server enclosures, the high density cooling solution from Rittal utilizes our new LCP air/water heat exchanger providing uniform, effective and affordable cooling for servers and similar IT equipment. The special horizontal airflow of the LCP represents an adaptation of this widespread cooling principle, providing cooled air uniformly throughout the complete height of the enclosure.

Modular, upgradeable and temperature neutral cooling concept.

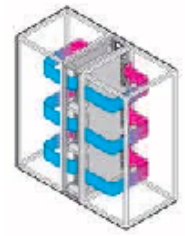
- Up to 20 kW (1410 cfm) cooling output, with three cooling modules possible per equipment rack
- Controlled variable speed fan and water flow based on actual heat load generated in cabinet
- Constant temperature cold air provided at the front intake for optimized equipment use, hot air removed from rear
- Even air distribution along the entire height of the front 482.6 mm (19") mounting angles
- LCP bayed with one TS server rack and an option for a second TS server rack
- High energy efficiency in removing waste heat with no temperature impact in the room

Technical Specifications:

- RAL 7035 (light grey) textured paint
- Overall bayed dimensions - H = 2000 mm (80"), W = 900 mm (36") and D = 1000 mm (40")
- 482.6 mm (19") full height mounting angles front and rear, 2000 lbs loading, depth adjustable
- Ten1/4 turn Velcro cable managers
- Set of PDS mounting brackets
- Air baffle to block air recirculation path outside 19" space between front 19" rails and TS frame
- LCP with three air/water heat exchanger cooling modules, 12-20 kW, up to 1410 cfm air throughput
- 3/4" Quick coupling connectors for input and return from cold water
- 3/8" Condensate drain hose
- LCP Controller ready for connection to optional SNMP CMC-TC for incorporation into network monitoring[1]
- Package of captive nuts, screws and leveling feet



		Enclosure + 1 module		Individual module	
Part #		**3301230**	**3301210**	**3301250**	**3301240**
Rated operating voltage V, Hz		230, 50/60	120, 50/60	230, 50/60	120, 50/60
Dimensions mm (inches)	H W D	2000 (79) 300 (12) 1000 (40)		550 (22) 250 (10) 950 (35)	
Useful cooling full configuration					
15°C (59°F) Water, 15 l/min (4 gpm), 30°C (86°F) Air		12000 W/40697 BTU	10500 W/35810 BTU	4000 W/13565 BTU	3500 W/11870 BTU
6°C (43°F) Water, 15 l/min (4 gpm), 35°C (95°F) Air		20000 W/68300 BTU	18375 W/62315 BTU	6600 W/22530 BTU	6125 W/20770 BTU



Rated current max.	1.8 A /module	
Pre-fuse T	5.0 A	
Cooling medium	Water (specifications may be found in the manual)	
Water inlet temperature	> 1°C+ +30°C (>34°F to 86°F)	
Permissible operating pressure p. max.	29 - 73 psi (2-5 bar)	
Temperature range	+5°C to +40°C (+34 to 104°F)	
Protection category to EN 60 529/10.91	IP 30 (protection against solid objects 2.5 mm in diameter)	–
Duty cycle	100%	
Type of connection	Current: Connection cable with grounding-pin plug. Water: 3/4" quick-release fastener	
Weight	max. 160 kg (352 lbs)	approx. 25 kg (55 lbs)
Color	RAL 7035 light grey	
Air throughput of fans	max. 2100/2400 m³/h (1412 cfm)	700/800 m³/h (471 cfm)
Noise pressure	Free field on reflective floor, distance 1 m, 58 dB(A)	
Temperature control	Electronically controlled magnetic valve and 4-way fan control	

1) Flow, leakage, inlet/return, intake/exhaust temperature.
The general remarks on air/water heat exchangers (available on the Internet) apply.

Part #	Description
On request	LCP equipment enclosure w/ TS suite hardware and sidewall
7320100	CMC Processor for SNMP communication
7320440	1U Shelf for CMC
7320470	Connection cable from LCP to CMC Processor
7857416	3kVA UPS, 2U, 208/240 V AC, C20, 1xC19, 9xC13
9070824	19" 4 post mounting kit for 3kVA UPS
7857417	6kVA UPS, 3U, 208/240 V AC, 10' cord with L6-30P, 4xC19, 4xC13
9070825	19" 4 post mounting kit for 6kVA UPS

* Cold water chillers and water/water HX available upon request
* SNMP monitored or controllable power strips available upon request

Part #	Description
9070822	SNMP card for UPS
9070750	Vertical Power strip 30A, 6' L6-30, 24xC13, Amp Display
9070730	1U Power strip 30A, 6' L6-30, 12xC13, Amp Display
9070800	20A ATS for dual power circuit supply to LCP, 2xC20, 8xC13
9070811	6' C19 to L6-20P Power Cord
7200215	6'C13 to C14 Power Cord
9070016	1U Blank panel, toolless
9070017	3U Blank panel, toolless
9069073	1U Console drawer with15" TFT