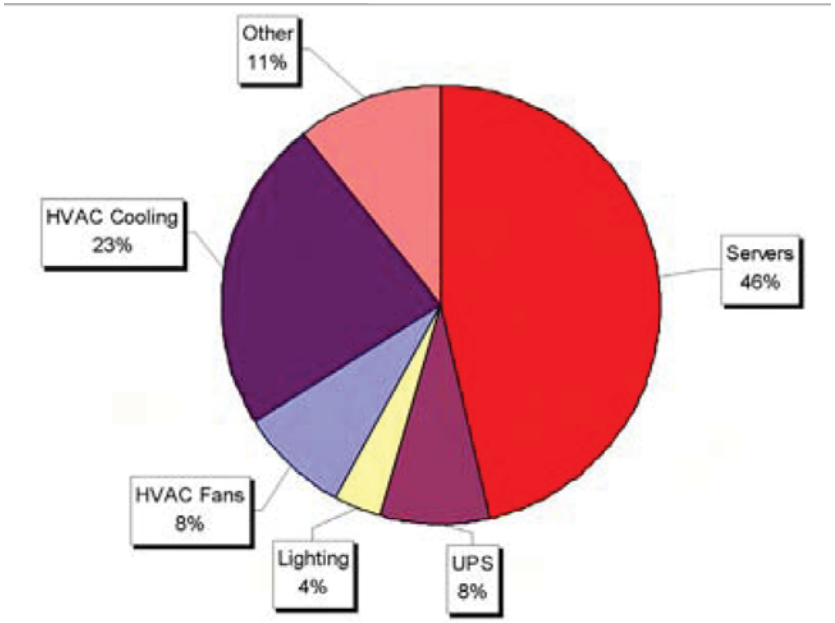
Cooling Load Studies

As revealed in the Energy 10 analysis, the proposed data center is an internal load dominated building. To move the heat from the computing areas to the greenhouse and beyond the envelope of the building, the author studied current best practices in the data center community.

The growth of the Internet has created a growing market for computer servers. The trends in computing equipment point to a rise in power density over time. Again, data center power densities vary from 36 to 100 watts per square foot! This converts to 120 to 340 Btu/ sq.ft./hour! (www.abrconsulting.com
1 2/7/2009)

A Lawrence Berkeley National Laboratory survey (led by Bill Tschudi) of 22 data centers published in 2007 revealed that the power consumption of server equipment as a percentage of total power used varied from 33 to 75 percent! The average amount of energy used for HVAC cooling and fans was 31 percent.

It was the authors intent to minimize the amount of energy used for cooling.



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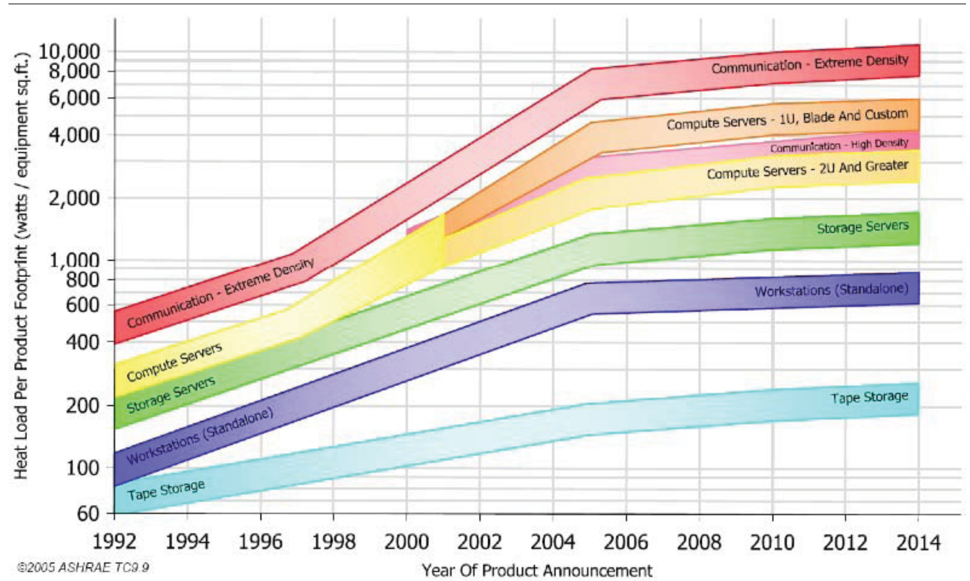

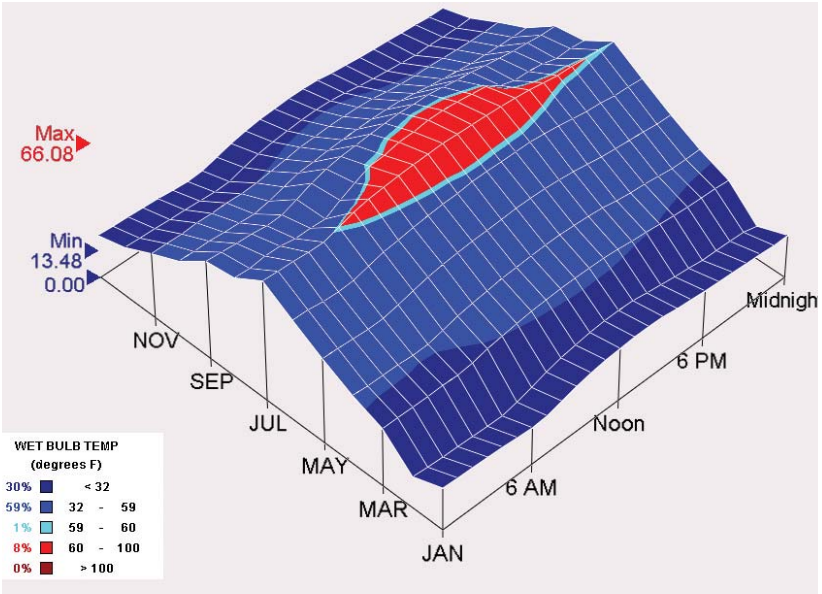

Cooling Load Studies

The first best practice relates to environmental criteria where the location of the data center affects amount of “free cooling.” Also the buildings local proximity to a 28 megawatt hydroelectric plant substantually decreases electrical transmission losses.

The site also has great potential to take advantage of economizer cycles. This design uses water-side economizers which bypass the chiller/condensers and can be used 92 percent of the year at a 70F supply air temperature. This is competitive compared to other major US cities. Raising the supply air set point to 75F significantly increases the number of hours in the economizer cycle to 98 percent of the year. (ASHRAE 5.4.1)

			Atlanta	Chicago	Boston	Seattle	Denver	Lewiston
Outdoor Air Wet-Bulb F(C)	Cold Water Supply F(C)	Supply Air Temperature F(C)	% of Year below Wet Bulb	% of Year below Wet Bulb	% of Year below Wet Bulb	% of Year below Wet Bulb	% of Year below Wet Bulb	% of Year below Wet Bulb
64 (18)	71 (22)	75 (24)						98%
59 (15)	66 (19)	70 (21)	56%	75%	75%	90%	93%	92%
53 (12)	60 (16)	64 (18)	44%	64%	63%	68%	77%	81%

Cooling Load Studies

The use of mechanical systems for cooling is minimized. Heat is first rejected to the greenhouse space when needed, then to alternate heat rejection equipment.

Liquid cooling is used at the back door of the server racks. The IBM Rear Door Heat eXchanger may dramatically unburden existing AC units by cooling the air before it exhausts from the electronics into the hot aisle. Preliminary lab tests have shown that up to 55% of the heat in a rack may be removed as air is moved through the rack and past the door's coils.

The unit uses a cold water supply of 18C which can match that of the Compter Room Air Handlers (CRAH) cooling coils. Because the IBM Rear Door Heat eXchanger uses above-dew-point chilled water no condensation should occur on the unit and no drain facilities should be required.

HVAC Schematic

Using the ASHRAE reference as a guide, the author designed the HVAC schematic. Best practices related to airflow distribution include enlarging filter sizes and separating air supply and returns via isles. Using the hot/cold isle approach is recommended. CRAH are aligned at the end of the hot isle (ASHRAE 5.6)