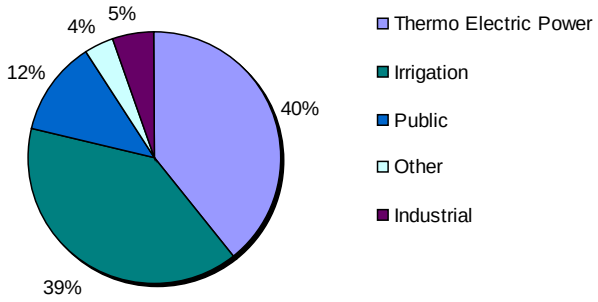
Quenching the Thirst of Power Hungry Data Centers

Exclusive to Data Center Journal

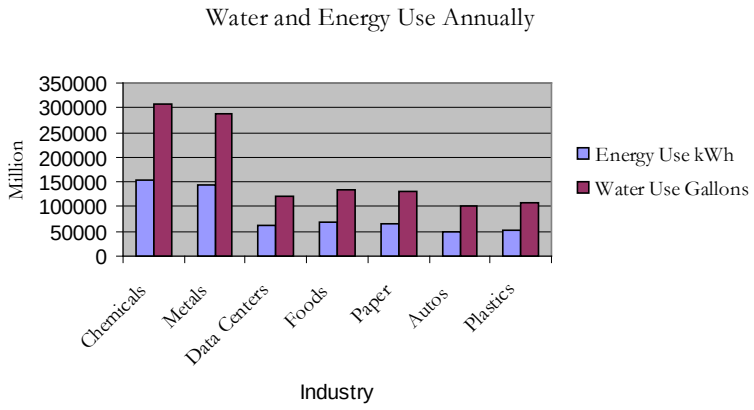
http://datacenterjournal.com/design-editorial/quenching-the-thirst-of-power-hungry-data-centers

The extraordinary amount of water consumed to cool today's data centers is poorly understood at best and largely overlooked at worst. And as data centers continue to grow in size and consume more megawatts of power each year, water supplies are being seriously threatened. According to the USGS, 40% of the water used in the United States is for power production followed by the public sector who taps into 12% of the available supply (which includes water used at data centers- http://ga.water.usgs.gov/edu/wupt.html).



What this tells us is that the energy used at data centers has a bigger effect on the national water tables than most every other industry. Let's get the numbers that prove this out of the way. According to the Energy Information Administration (EIA) only the Chemical industries (153B kWh's a year) and Metal Industries (144B kWh a year) use more water due to their power usage

[http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table1.1_02.pdf].



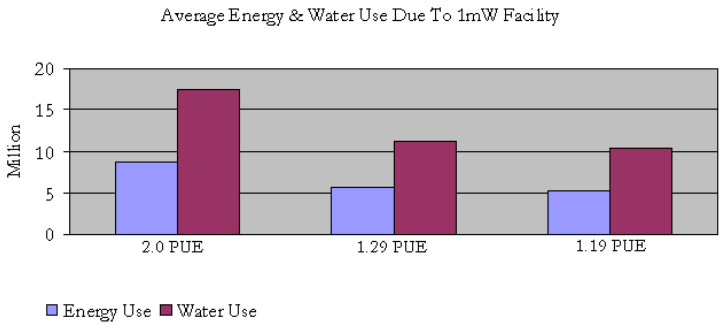
Today's data centers now consume more water than the food, paper, auto, plastics, wood, and petroleum industries. This is based on an EPA study stating that the data center industry devours 61 billion kWh of energy annually. The National Renewable Energy Labs (NREL) equates this energy consumption to 120 billion gallons of water to power data centers each year in the U.S.. http://www.nrel.gov/docs/fy04osti/33905.pdf

As data centers are forecast by the EPA to double their cumulative power and water consumption levels by 2011 and every five years thereafter, the industry faces a legitimate and daunting question: is there enough water supply to support the energy needed for power hungry data centers?

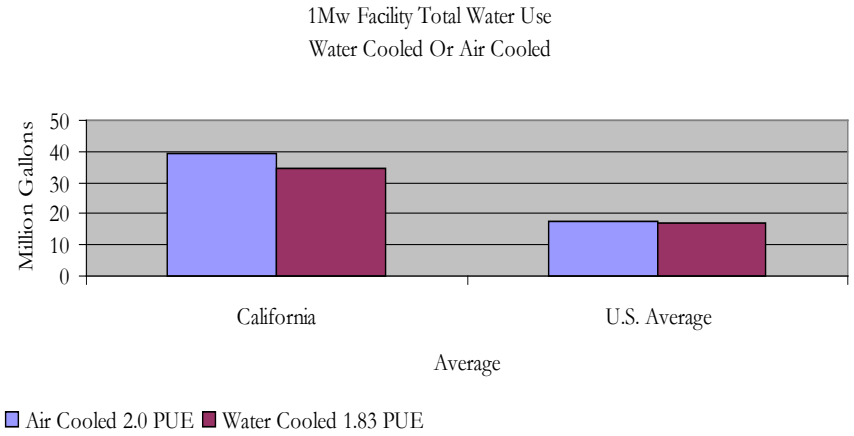
Historically, water use has been seriously overlooked when designing and permitting a data center. Given the total sustainability footprint that data centers leave behind, the industry is now at a tipping point with respect to implementing new solutions that can reduce energy and water consumption significantly.

To understand the magnitude of the water consumption problem in data centers, consider the following. If you take a typical 2.0 PUE (Power Usage Efficiency) rating at a 1 mW facility, conventional thinking assumes the water use will be limited to humidifiers and HVAC equipment. These assumptions are seriously flawed. A 1 mW facility uses 17,520,000 gallons of water at the power plant annually. If this facility were improved to a PUE of 1.29, the water use could be reduced to 11,300,400 gallons per year. And a PUE of 1.19 could reduce this consumption to 10,424,400 gallons a year. These metrics are not the product of wishful thinking. Recently, Google

showcased a 1.25 PUE Water Side Economized facility; Fortune Data Centers are just completing a 1.38 PUE Water Side Economized facility; and Sonic.net, an ISP and co-location provider in Santa Rosa, California recently completed their facility retrofit sporting a lean 1.29 PUE refrigerant side economized system. While these efficiency levels are impressive, some industry experts believe obtaining a 1.18 to 1.19 PUE facility is very possible, without compromising any environmental standards.



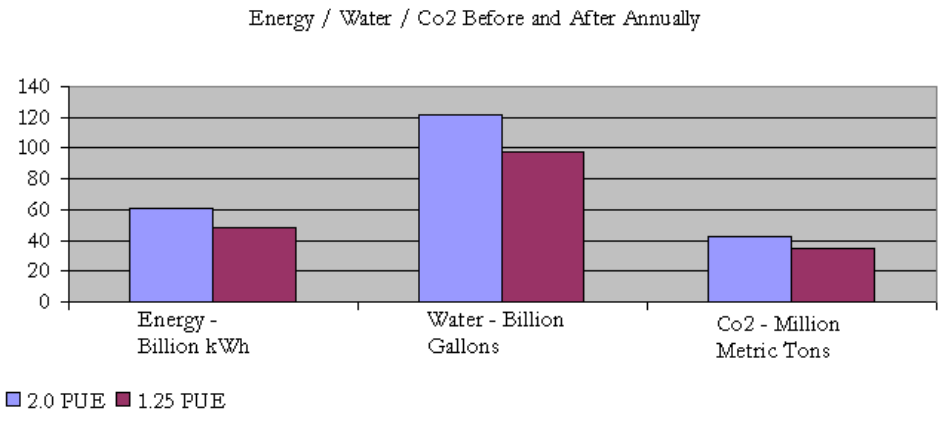
Meanwhile, there is an ongoing debate at the facility level that air-cooled systems have achieved "good enough" status to achieve adequate water savings. However, according to most experts in chiller technology, an air-cooled system uses 20% more energy than a water-cooled system. Air Cooled Chillers in general use more energy than water-cooled chillers due to the differences in most manufacturers' design condensing temperatures. Consequently, if a 2.0 PUE data center transitioned from an air cooled to water cooled chiller, it could realize a 1.83 PUE.



It is important to recognize that data centers use water at two places; at the facility level and the power plant. According to the Baltimore Air Coils Condenser handbook, a water-cooled chiller uses a minimum of 2.31 and up to 4 gallons per minute (GPM) of water per 100 tons of cooling at a

1mW facility (142 ton) chiller load. Despite the fact that water-cooled chillers use more than 2 million gallons of onsite water drawn from the public sector annually (depending on cycle rate and tower treatment) for the cooling towers, they still reduce aggregate water consumption compared to air-cooled chillers in California. That said, simply changing from an air-cooled chiller to a water cooled chiller is not enough to save water in all applications, due to the energy and water use at the power plant. Each facilities energy and water use should be evaluated on a state-by-state, site-by-site basis. In data center facilities in California, the issue of water consumption is even more precarious. According to the NREL, California uses 4.64 gallons of water to produce 1kWh of energy, due to its use of hydro-electric power production. Consequently, for the 1 mW facility in California, this equates to more than 40 million gallons of water used at the power plant each year. The change from an air-cooled chiller to a water-cooled chiller in California would result in a 5.2 Million gallon aggregate water reduction.

Based on these revealing statistics, data center managers should be highly motivated to investigate how to cut down their PUE levels, not only to curtail power consumption but the water required to cool their IT infrastructure. From a best practices perspective, consider the following report put out by Google http://www.google.com/corporate/green/datacenters/summit.html. They suggest that their new data center averages a PUE of 1.25 annually. For context, lowering data center PUE's in the US from 2.0 to 1.25 could save on average 45 billion gallons of water annually and 22 billion kWh of energy. And according to the EPA, this PUE drop could eliminate 9,000,000 metric tons of Co2 annually.



This points to numerous sustainability issues facing data centers. As an industry, serious thought must be put into every aspect of making data centers much more efficient in view of the fact they are fast becoming the largest industrial energy user in the United States.

About the Author

Rick Cockrell is Chief Technical Officer at Core4 Systems, Inc. [www.core4sys.com]. Core4 Systems is an innovative data center cooling vendor that delivers next-generation CRAC and AHU systems to cut cooling costs up to 72% and save up to 28% of water usage at power plants and onsite facilities. You can email Rick at: rcockrell@core4sys.com.