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REDUCING DATA CENTER CARBON FOOTPRINTS

I. Introduction

Because of their common reliance on fossil fuel-based energy sources, data centers are generating a growing carbon footprint and raising significant concern among industry participants, government entities and environmental groups. Data center carbon emissions have spiraled upward with the increased demand for data center space and power. Factors driving this increase include the proliferation of web-based applications and video, Internet-driven social networking, an overall increase in digital data creation and an increased demand for data retention due to regulations such as Sarbanes-Oxley in the U.S. The data center industry is beginning to understand the scope of this trend and how it's impacting lives and businesses. Initiatives to make greater use of green energy sources and to optimize data center designs are gaining momentum. Global solutions are becoming available that have a positive impact on the data center carbon footprint, as well as the bottom line.

II. The Problem

In the U.S. alone, the power consumption by data centers and servers is projected to grow to 100 million MWh by 2011, requiring the power equivalent of ten new coal-fired or nuclear power plants.[1] As data center power consumption grows, so do carbon dioxide (CO_2) emissions. Gartner estimates that data centers currently generate 23% of all emissions produced by the Information and Communications Technology industry,[2] a figure that continues to trend upward. According to the U.S. Environmental Protection Agency (EPA), U.S. data centers were estimated to produce 44.4 million metric tons (MMT) of CO_2 emissions in 2007 and, based on historical trends, will produce more than 79 MMT of CO_2 in 2011.[1] To put this figure in perspective, it is approximately one half of the total carbon emissions of the entire airline industry, according to McKinsey. Data center emissions are projected to actually exceed those of the airlines by 2020.[3]

Given the growing use of power-hungry hardware in the data center, these trends appear incontrovertible. Ken Brill of the Uptime Institute has stated that it used to take 20 to 30 years for the cost of electricity powering a server to exceed the cost of the server itself. Now, however, the electricity cost exceeds the purchase cost in less than two years. While server processing capability is becoming cheaper, in accordance with Moore's Law, power consumption is increasing at such a rate as to mitigate the resulting hardware cost improvements. The impact of these power consumption increases is what Brill calls the "Moore's Law Economic Meltdown."[4]

Over the past several years, growth in data center carbon emissions has even sparked debate among legislators regarding whether there should be mandated energy usage reductions or improvements in data center energy efficiency. In December of 2006, through Public Law 109-341, the U.S. Congress issued a request to the EPA requiring a study of the growth trends associated with data centers and servers, and how the problem could be best addressed. In its subsequent report, the EPA raised four important consequences of data center energy growth:

- Increased energy costs for business and government
- Increased emissions, including greenhouse gases, from electricity generation
- Increased strain on the existing power grid to meet the increased electricity demand
- Increased capital costs for expansion of data center capacity and construction of new data centers[5]

Similarly, the Warner-Lieberman Climate Security Act was put in front of Congress in 2008. It would likely have resulted in an estimated 20% increase in the price of fossil fuel power if it had passed.[6] The European Union has already issued mandates with target reductions for corporate carbon emissions, and President Obama and the EPA are poised to take similar action in the U.S.[7]

[1] "Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431," EPA ENERGY STAR Program, August 2, 2007, at 58.
[2] "Gartner: Data Centres Account for 23% of Global ICT CO2 Emissions," November 5, 2007, http://engineers.ihs.com/news/gartner-datacentre-co2.htm
[3] Walaika Haskins, "Data Centers May Spew More Carbon than Airlines by 2020," TechNewsWorld, May 1, 2008, http://www.technewsworld.com/story/62840.html
[4] Kenneth Brill, "Moore's Law Economic Meltdown," Forbes.com, June 16, 2008, http://www.forbes.com/2008/06/16/cio-moores-law-tech-cio-cx_kb_0616moore.html
[5] *Id.*
[6] Matt Stansberry, "Carbon Cap-and-Trade Legislation's Impact on the Data Center," Searchdatacenter.com, February 15, 2008, http://serverspecs.blogs.techtarget.com/2008/02/15/carbon-cap-and-trade-legislation%E2%80%99s-impact-on-the-data-center/
[7] *The Wall Street Journal*, "Obama's Carbon Ultimatum," http://online.wsj.com/article/SB122445812003548473.html?mod=googlenews_wsj

III. Proposed Solutions

Along with numerous global initiatives, the EPA findings shown above are creating awareness of the problem. Corporations themselves are increasingly concerned with limiting their carbon footprints, both from a desire to be good corporate citizens and also to limit the future business impact of regulations compliance. According to a study undertaken by Cutter Consortium, 50% of companies stated that they are creating a long-term plan to reduce their overall environmental footprint within the next 24 months.[8]

Improving the energy efficiency of data centers will undoubtedly be a key component of many companies' plans, as a host of solutions are proposed to reduce carbon emissions. Some focus on infrastructure optimization, several on reliable green energy sources and others on corporate responsibilities.

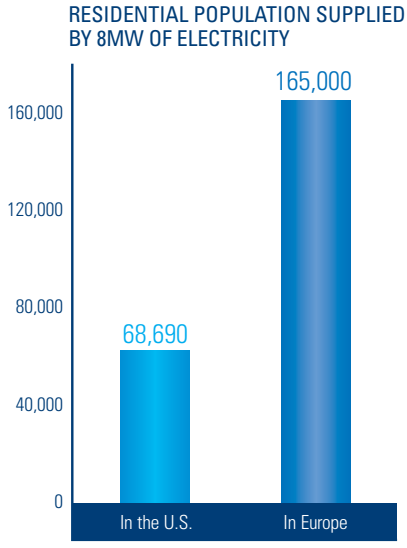
The first set of solutions has focused on reducing overall energy consumption through optimization of data center design and server utilization. In its study, *Guidelines for Energy-Efficient Datacenters,* the Green Grid (a non-profit trade organization formed to address power and cooling issues in the data center) outlined best practices for energy-efficient data center design. Key best practice areas are as follows:

- Efficient system design, including proper floor layout (e.g., hot-aisle/cold-aisle configurations), proper server software configuration and vented flooring
- Rightsizing physical infrastructure to the IT load and reducing underutilized hardware infrastructure
- Installation of power-efficient equipment, including the use of technologies such as the latest generation of UPS systems, which are up to 70% more efficient
- Adoption of server virtualization, which can result in drastic server consolidation across facilities
- Cooling technology improvements, which include the use of close-coupled cooling solutions, utilization of air conditioner economizers and coordination of air conditioning[9]

The Case for Iceland: Avoidable Environmental Impact

ENVIRONMENTAL IMPACT OF 8MW OF ELECTRICITY GENERATION USING FOSSIL FUELS[10]	
Thousands of Pounds of Carbon Dioxide	121,000
Hundreds of Gallons of Water for Cooling	296,000
Pounds of Sulfur Dioxide	288,900
Pound of Nitrogen Oxides	244,100

FUEL EQUIVALENT USAGE FOR 8MW OF DATA CENTER LOAD[11]	
Gallons of Gasoline	1,999,000
Pounds of Coal	19,950,000
Therms of Natural Gas	2,394,000
15lb Pieces of Firewood	2,280,000



[8] Ed Cone, "Momentum Builds for Green IT," July 8, 2008, http://blogs.cioinsight.com/knowitall/content001/momentum_builds_for_green_it.html
[9] "Guidelines for Energy-Efficient DataCenters," The Green Grid, February 16, 2007, at 4.
[10] http://www.wattsonschools.com/
[11] *Id.*

While efficient design can significantly reduce energy use, it is only a partial solution for reducing carbon emissions. For significant and lasting change, the optimal solution is the use of renewable energy, which produces zero carbon emissions. For new data center deployments, this means that location is a critical consideration. Companies need to evaluate the availability of reliable green power sources for a new site and whether the regional climate is conducive to data center operation. Iceland, for example, has instituted a robust national power grid which is 100% sourced from geothermal and hydroelectric power plants. A customer who transfers 8 MW of critical load power to a data center in Iceland would save approximately 50,000 metric tons of CO_2 annually.[12] This is equivalent to a savings of hundreds of thousands of dollars annually if the customer were to purchase carbon offsets on carbon exchanges.

With its cool, moderate climate, Iceland has also proven to be ideally suited to support data center deployments.[13] The country's environmentals are enabling companies such as Verne Global to provide year-round, 100% free cooling, so that not only is the power "green," but less of it is used for the same amount of IT capacity.

A final area of consideration is organizational. For example, while the CIO is often responsible for making data center hardware purchasing decisions, energy costs related to IT equipment have historically been charged to facilities management. As Richard Hodges, a Principal at GreenIT, a consulting firm in Sonoma, California, has stated, "IT and facilities can no longer afford not to talk to each other."[14] Going beyond improved communication, the Uptime Institute recommends transferring financial accountability for data center facilities from the corporate real estate group to the CIO, tying operating cost responsibility to purchasing decisions.[15] This would encourage IT spending decisions which both maximize IT performance capabilities and reduce energy use and associated emissions. The Uptime Institute also recommends that corporations appoint an internal IT energy officer accountable for increasing energy efficiency and reducing energy consumption.

IV. Conclusion

Data centers are faced with the dual challenges of growing power consumption and increased carbon emissions. As organizations begin to evaluate these issues and how to optimize their data center infrastructures, there are a number of factors to consider: better utilization through facility design and software optimization, organizational alignment, environmental implications and pending regulatory mandates toward reducing carbon emissions, and addressing fossil fuel price volatility and energy stability from the grid. A comprehensive strategy will be required to ensure that companies effectively consider all of these components.

V. The Verne Global Data Center Solution

Wholesale data center company Verne Global is a market leader in adopting best practices for green data center design. Its initial location in Iceland and its implementation of best practices has resulted in a data center offering uniquely suited to minimizing data center carbon footprints. The features being designed into Verne Global's facilities include 100% free air cooling, low-cost power derived exclusively from renewable hydroelectric and geothermal sources, the use of renewable materials, and a flexible design to allow for efficient separation of heat within the facility.

All of these features contribute to a significant reduction in cooling costs and carbon emissions. Iceland's relatively low ambient temperatures reduce the amount of power spent on cooling, enhancing overall energy efficiency. Verne Global's design uses variable-speed fan drives to efficiently support a wide range of low- to high-density cabinet deployments, and year-round free cooling allow customers to minimize the effective PUE of their data center deployments. Energy for non-computing uses can be reduced by up to 80% compared to typical data centers.

With Iceland's abundant geothermal and hydroelectric power, Verne Global is able to provide its customers with the multiple benefits of significantly reduced energy costs, long-term power price contracts and reduced carbon emissions. As a result, a data center's operating costs and carbon footprint can both be minimized.

[12] EPA eGRID 2005 National Average Emissions Rate, http://www.epa.gov/greenpower/pubs/calcmeth.htm
[13] Invest in Iceland, http://www.invest.is/resources/images/invest.is/keysectors/dctemp.jpg
[14] David Raths, "Energy Hogs on the Server Farm," *Government Technology*, December 19, 2006, http://www.govtech.com/gt/articles/102970?id=&story_pg=1
[15] See "Moore's Law Economic Meltdown," *supra*.