Smart Data Centers:

Trends and Practices to Reduce Costs and Carbon Footprint

BASE PARTNERS INC.

GLUMAC

Many factors drive business growth, but at the foundational level, two elements are paramount: facilities infrastructure and technology

According to the data center association AFCOM, more than half of all data centers will have to relocate to new facilities or outsource some applications by 2010. As the demand for data center facilities heats up, many businesses have begun facing an additional challenge: insufficient and affordable power to support their IT operations. Adding to this: the age of Web 2.0 is dawning, heralding increased reliance on collaboration, social networking, and Web-based software and applications. As such, the role of the data center is becoming ever-more critical. To stay ahead of the curve—and adopt more environmentally sensitive practices—businesses are looking at several strategic approaches to reduce carbon footprint and ensure facilities and technology infrastructures scale to meet demand without super-sizing the budget.

According to a McKinsey survey, data centers have expanded significantly during the past 10 to 15 years, matching the increase in IT spending. In fact, it asserts that a typical large enterprise allocates hundreds of millions of dollars toward server farms, mainframes, networking gear, and storage devices; supporting this equipment requires staggering amounts of electricity. Depending on the size of a company, a data center can consume anywhere from 50 to 1000 Watts per square foot [W/sf] of power. And, depending on its location, this can translate to hundreds of thousands of tons of carbon dioxide on an annual basis.

Green Without Envy

Interestingly, several approaches aimed at reducing data center carbon emissions and power consumption do not cost more money—rather, they can actually cut costs dramatically.

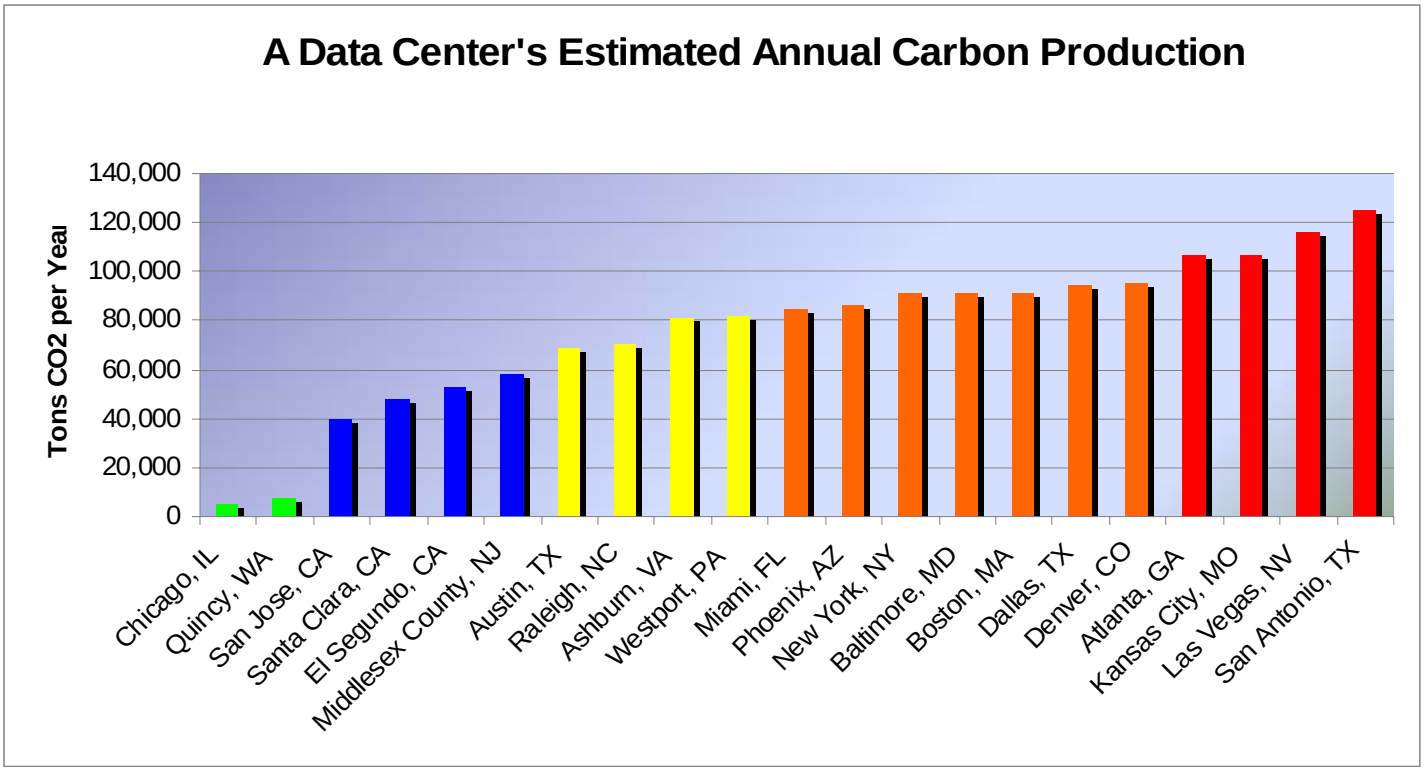
One of the chief strategies companies are deploying to reduce emissions is identifying strategic locations to establish data centers, where they can take advantage of renewable resources. Google, Microsoft Yahoo, and other tech giants are springing up in previously unheard of towns, like Quincy, Washington, because of the availability of hydroelectric plants that sell cheap electricity and the abundance of space that comes at a lower cost per square foot. According to an article in *Fortune*, Microsoft reportedly will be able to purchase power for two cents a kilowatt-hour in Quincy, compared to 11 cents a kilowatt hour in California. Google is also establishing a major data center in Council Bluffs, Iowa; it will be powered by wind and other renewable energy sources.

Since a data center consumes enormous amounts of electricity, day and night, throughout the year, this makes the utility bill by far a data center's largest expense through its lifetime. Picking the right location may be the most significant choice when looking at carbon footprint and utility costs. Even small increases in efficiency have huge implications. For example, with a 20 Megawatt (MW) data center, a mere 10 percent reduction in electrical consumption is equivalent to taking 1500 cars off the road.

An Illustration in Action

To demonstrate how much carbon a data center produces, Base Partners and Glumac, consulting engineers who specialize in sustainable projects, developed an energy model of a hypothetical data center. Energy runs were performed in 21 cities across the United States to see how much energy the servers would consume throughout a given year. The model included a theoretical 160,000-square-foot data center with about 110,000 square feet of raised floor. A constant power density of 150 W/sf was assumed on the raised floor. While the mechanical system needed to cool a data center consumes a significant portion of energy, this factor was excluded. The efficiency of a data center's mechanical systems can vary wildly depending on its climate and how it is designed, constructed, controlled, and maintained.

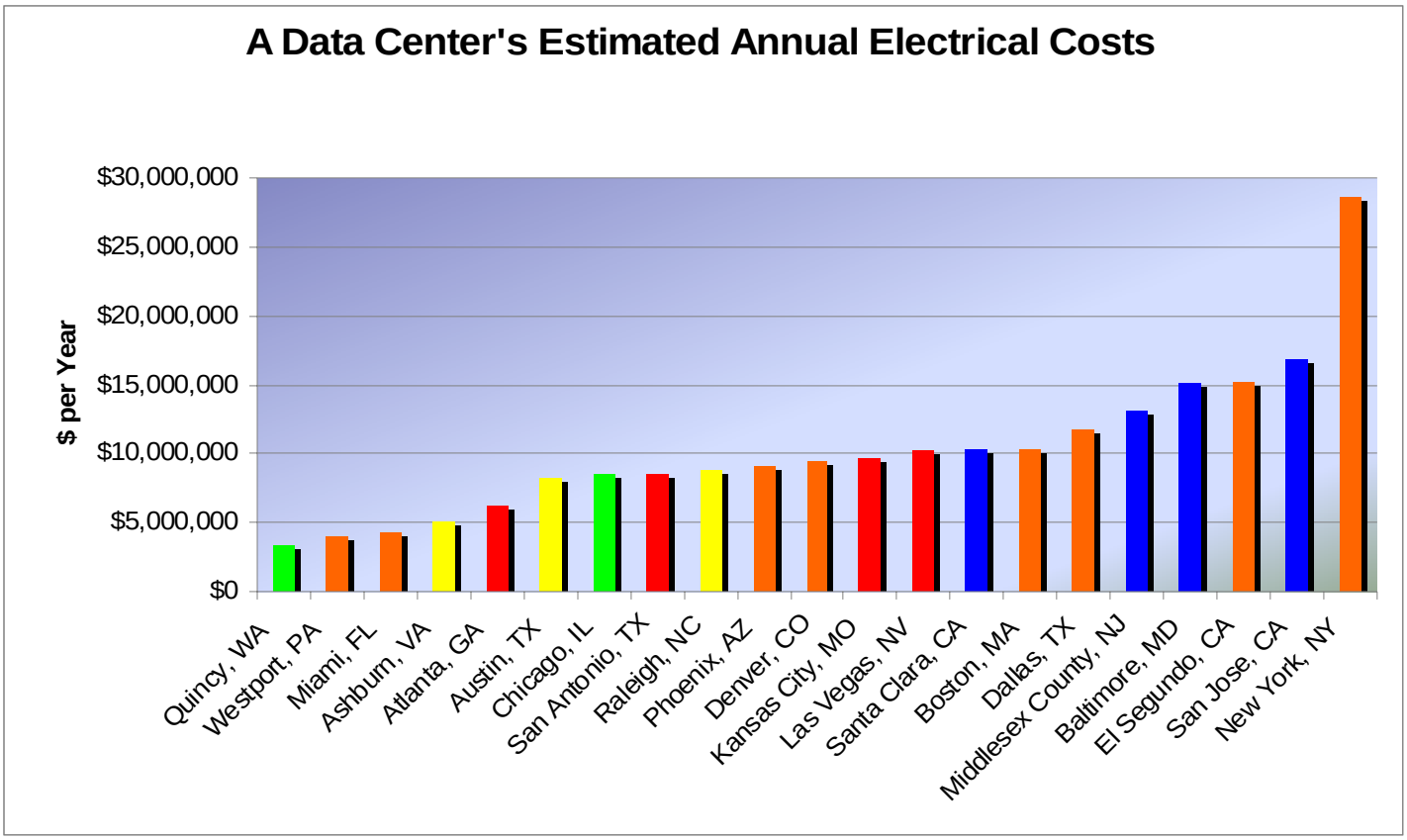
Data centers located in the first group of the chart (green) will produce the least amount of carbon while the ones at the end of the chart (red) produce the most. As the graph indicates, building a data center in Quincy or Chicago offers the best way to reduce the amount of carbon dioxide generated by the facility's operations.



Details of the Hypothetical Example

The methodology followed began by multiplying the total kWh used by the servers in our hypothetical data center by the amount of CO_2 produced per kWh (lbs CO_2/kWh) as generated by a local utility company in each of the 21 cities. The amount of CO_2 that a utility company produces was calculated by averaging the amount CO_2 produced from its various fuel sources. When fossil fuels are combusted at a power plant to produce electricity, CO_2 is produced as a by-product. The average amount of CO_2 produced from oil is 1.8 lbs CO_2/kWh, from natural gas is 1.32 lbs CO_2/kWh, and from coal is 2.1 lbs CO_2/kWh. Hydroelectric, nuclear, and renewable power essentially produce zero CO_2. The breakdown of how a utility company produces its power—its power mix—was then used to calculate a weighted average for how much CO_2 is produced for that particular utility company. If the utility company purchases power from multiple suppliers and the fuel mix used to generate the power could not be found, a national average of 1.4 lbs CO_2/kWh was used. The power-mix percentages used are rough estimates and can fluctuate. In some areas, multiple power companies are available and customers can choose which utility supplies them with electricity.

Below is a chart of the average annual cost of running the example datacenter in the same 21 cities. The amount of electricity consumed by the servers in a year was multiplied by the average cost per kWh found for the chosen utility companies. Given the assumptions of the hypothetical data center model, locating a data center in Quincy can reduce a utility bill by about 90 percent as compared with New York City, which corresponds to a savings of at least $25 million a year, underscoring the notion that reducing carbon emissions doesn't necessarily mean increasing costs.



Above and Beyond

Beyond location and power sourcing, many technology experts are exploring how facility design can improve cost and energy efficiency in data centers. The large, well-known technology giants urge businesses to take a system-wide view, looking at the power, the networking gear, and the processes surrounding how data is used and accessed.

Strategic, well-planned data centers are not only cropping up in "green" locations, they are becoming less siloed. Connectivity and virtualization technologies are enabling tech-savvy companies to deploy fewer but more powerful servers with service-oriented network architectures that allow businesses to share services and information across organizational boundaries, to collaborate more effectively and allow customers and partners to be able to enjoy more productive and rewarding interaction. The results: Quality and availability of information and applications improves dramatically, driving the efficiency and productivity of the business. In addition, network equipment is consolidated, enabling additional savings in capital expenditures and energy consumption.

A 2006 McKinsey survey supports this view: Sixty-four percent of respondents planned to implement service-oriented architectures in the coming year. This suggests an evolving view of IT architectures that enables a standardized platform for secure interactivity and connectivity among internal staff and external partners and suppliers. Similarly, in a study conducted by Accenture in 2005, 85 percent of senior executives at all levels of governments across 13 countries in Europe, North America, the Asia Pacific region, and Africa said they believe that shared services are playing or will play a role in supporting their organizations' strategic goals.

Yet another approach favored by data-center-reliant businesses is to examine the energy efficiency of equipment and how it is laid out within a data center. For instance, using energy-efficient equipment not only reins in the amount of power drawn by the servers, but also reduces the amount of heat that needs to be removed by the HVAC equipment. Every kilowatt not used by the server is one less kilowatt of heat that the cooling systems must remove. Businesses can increase the efficiency of servers by enabling CPUs' power-saving features. Servers are often in an idle state, but they still consume electricity. The power-saving features regulate energy consumption by reducing a CPU's clock speed and voltage to the core whenever the computational power isn't needed. This can realize an additional energy savings of 10 to 40 percent when the server is idle. *Computerworld* reports that under a congressional mandate, the Environmental Protection Agency is teaming with Lawrence Berkeley National Laboratory to examine the promotion of energy-efficient servers. It is believed that an Energy Star specification could be in place by year end.

Having facilities that enable flexible configurations to allow proper air flow and equipment cooling—front to back versus side to side—can also contribute to modulating energy consumption. For example, a side-by-side chassis can accommodate added ports but requires more energy to regulate the temperature. With the front-to-back airflow model, which is specified by The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Technical Committee 9.9, data centers are set up with alternating rows of hot air/cold air. The equipment, which requires an air inlet in the front to facilitate the airflow, generally pulls air in at 70 to 75 degrees Fahrenheit and exhausts it at 80 to 95 degrees.

How to Start Planning

Building or collocating a data center has its challenges for sure, but achieving a greener, more cost-effective facility does not impose additional obstacles. Following are some guidelines to keep in mind.

- Conduct an internal assessment, involving your operations, finance, and technology stakeholders, to determine current and future data center needs, including size, power density, and level of redundancy.
- Be flexible in your data center location requirements, if possible, as the cost of power and the environmental impact can vary widely. Local utilities can help in assessing what the particular power mix and electrical costs would be. The effect of various climate on mechanical system efficiencies should also be considered.
- Minimize energy costs and environmental impact by choosing energy-efficient equipment, basing the purchasing decision on life cycle rather than first costs of equipment; designing flexible and high-performance facilities, incorporating commissioning into the construction budget and process; and deploying smart energy solutions such as occupancy and lighting sensors to reduce waste.

Finding the right facilities and technology expertise can diminish the complexity of undertaking a data center significantly. Base Partners, for instance, offers advisory services, as well as services that include acquiring, developing, and designing customizable data centers. Its partners include experts in technology, engineering, sustainable building practices, and other critical areas required to ensure a secure, state-of-the-art data center.

About Base Partners

Base Partners, Inc. is a global leading force in the rapid delivery of customized, sustainable, next-generation, mission-critical data center facilities.

The Base Partners Team has worked together over the past eight years, creating or advising on the development, build out, and management of 70 data centers, comprising over two million square feet around the world. The company's skill set results from their industry experience in development, design, construction, and brokerage services.

The partners have completed transactions in such diverse markets as London, Frankfurt, Brooklyn, Staten Island, Dallas, Santa Clara, San Jose, Thousand Oaks, Tokyo and Hong Kong.

To learn more about planning and building a greener, more cost-effective data center, contact Base Partners at 415.292.7700 or info@basepartnersinc.com.

You can also visit us on the Web at www.basepartnersinc.com

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About Glumac

Glumac is a full-service consulting engineering firm specializing in cost-effective, sustainable design of commercial, institutional, healthcare, and advanced technology facilities worldwide. With seven offices on the West coast, we are well positioned to serve our clients. In addition to its primary focus on mechanical, electrical and plumbing (MEP) consulting engineering services, Glumac offers extensive sustainable design, lighting design, technology integration, and building commissioning services that complement and enhance our core capabilities. Glumac administers comprehensive building services engineering as a single coordinated package to our clients.

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