WHITEPAPER

GREEN IMPACT IN THE WHITE SPACE

The Data Center:
Your Greatest Point of Leverage for Both Cost Savings and Carbon Reduction

Along with a transition to "digital everything" the most important business trend of our age is the quest for carbon neutral.

This is part of a larger focus on Environmental, Social, and Governance (ESG) from customers, board members, and employees. The area of ESG that is most popular among stakeholders is the environmental portion. Who doesn't want clean air, clean water, and a future that isn't a constant heatwave?

This is particularly true in the technology industry. Tech firms are most likely to have employees very interested in sustainability issues, which leads to (generally positive) pressure from board members, executives, and customers to adopt green-friendly initiatives.

The Quest for Carbon Neutral: the most prominent sustainability trend in business is the setting of carbon reduction goals. Many organizations have made splashy announcements about aggressive sustainability goals. But an unfortunate reality for many organizations is that they are four years into a "Zero Carbon by 2030" type pledge yet have

made only marginal advancements to achieve that goal. As they look to increase their velocity toward sustainability many people look to their left, look to their right, and wonder how the work environment they are sitting in can be made more environmentally friendly.

Green Buildings: The Environmentally Ideal Workplace

Driven by a blend of responsibility and both employee and customer interest, the business community's focus on being gentler on the planet than it has been in the past has turned toward their workplace. The concept of a "green building" has come to the forefront over the past few years and policies and practices of our offices, distribution centers, plants, and factories have evolved as a result.

Defining the Green Building: A green building is a structure that is either strategically planned to be as sustainable as possible in its construction, or it is an existing building that takes as many steps as possible to become more sustainable in its operations.

Reducing energy, reducing carbon emitted in both operations and sourcing, wise and limited use of water, utilizing recycled materials, lay the foundations for the concept of a green building. Discouraging driving, development of green spaces and plant/tree growth, handling refuse properly, and numerous other elements can be factors in creating and maintaining a green building.

Environmental Compliance: Numerous certifications from various organizations have been introduced over the last 20 years, and more are emerging all the time. According to the Yale University Office of Sustainability the four most widely adopted are:

1. **LEED** (Leadership in Energy and Environmental Design)
2. **WELL Building Certification**
3. **Living Building Challenge**
1. **Energy Star Building Certification**

Many certifications encourage a wide range of green-friendly activities and projects. Having bike rooms to encourage cycling to work, green roof projects with gardens that absorb carbon dioxide and sunlight while releasing oxygen into the environment, recycling, utilizing low-carbon concrete and other structural materials, utilization of smart lighting systems, and many other action items can help an organization earn points on their checklist towards achievement of many of these certifications.

The Power of Power Reduction: While these actions are laudable, and stacking best practices can lead to results, much of this is just nibbling around the edges of true sustainability. A significant amount of scientific discovery and technological development to reach the point where large-scale energy consumers can be powered entirely by solar (especially when its cloudy) and wind (particularly on still days when the windmills aren't turning).

There is still nothing that a facility can do to impact our environment positively that comes close to a significant reduction in electrical usage. And when energy reduction is meaningfully reduced it benefits those in an organization responsible for the financial stewardship of the company as well.

And where do companies utilize more energy usage than anywhere else? ***In their data center.***

The Greatest Green Leverage Point: Energy Efficiency in Data Center White Space

Data centers utilize a bit less than 2% of all energy worldwide. Servers and uninterrupted power supply (UPS) units consume large amounts of energy. While this used to be seen as controversial by some, the rapid advancement of our digital economy makes data centers a necessity.

Unlike a decade ago (remember the New York Times data center energy usage series and the phrase "power pigs"?) data centers are seen as a necessity even by environmentalists, who are not looking for reasons to give up their smart phones, online shopping, streaming, technology-loaded vehicles, and all the conveniences and efficiencies that technology has introduced into our modern life. Data centers are no longer evil, they are an established necessity, but it is also necessary to make them more efficient.

Data Center Professionals Should Be Proud: There is also the understanding that the data center sector has been very responsive and has successfully achieved data center reduction. The Berkley National Laboratory study that led to the New York Times expose on profligate energy usage was revisited a decade later and the improvements were massive.

Quite simply, there is tremendous opportunity in your data center white space. This is particularly true if your data center was not built in the past five years. If your company operates a data center there is a very good chance that it is your greatest leverage point for sustainability.

Aligning the C-Suite: Massive Cost Savings are Available: There is frequently tension in an organization when it comes to the pursuit of sustainability. Everyone wants to do it, but as organizational resources are not unlimited, it isn't always seen as a wise financial move to invest resources into green initiatives that do not serve the business in an immediate and obvious way. While a CEO, CFO, and COO may roll their eyes if a Chief Sustainability Officer wants to turn valuable space in an office environment into a bike room, the cost savings that is readily attainable by becoming more energy efficient in the data center brings everybody together.

The Balance Sheet Meets the Quest for Carbon Neutral: Now that we have determined that reducing data center energy usage might be the most critical way for our organizations to reduced energy usage, save money, and get closer to carbon neutral, let's talk about some specific ways we can get there in your data center.

8 KEY STEPS TO

Reduce Carbon and Cost in Your Data Center's White Space

At Subzero Engineering, it is our business to bring together multiple engineering disciplines (mechanical, environmental, electrical, etc.) to make our data center white space more energy efficient.

The result of our work is less carbon and less cost.

But not everything you can do to obtain data center energy savings, and the subsequent cost reductions, requires an engagement with an engineering firm like ours. Engaging in some basics, the blocking and tackling of data center sustainability, can get you on the path to energy reduction and cost savings.

Step One: *Align Your Organization Toward Data Center Sustainability*

Any organization achieves more when a goal is set by the leadership and followed through with a steadfastness that includes their direct involvement.

Many companies make grand sustainability pledges, but it soon becomes apparent that the leaders of the organization aren't really committed to them. The half-heartedness of the efforts is obvious throughout the organization and what may have begun with a grand pronouncement but fizzles into mediocre results.

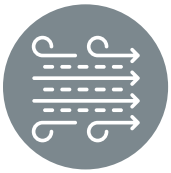
Earlier we spoke about how C-Suite alignment is achievable with data center efficiency initiatives due to the cost. Why not show that alignment with important roles for visible executives leading the charge toward a green data center?

Two management roles with companies should be aligned on data center cost savings, and those are the chief information officer and chief financial officer. These are typically people that carry a lot

of respect and power within a company. The CIO frequently oversees the fastest-growing group in the org chart. As the person who signs the checks and determines the financial direction of the company, the CFO will always command people's attention.

A data center energy reduction initiative within the company that has both the CFO and CIO playing a role is difficult to ignore and will greatly benefit both positions. The CFO loves to see greater budgetary efficiency while the CIO is typically in the pole position for budget increases that can be justified by cost savings within the data center.

Maybe the CIO an CFO in your organization have too much on their plate and it makes sense for others to be the face of a data center sustainability initiative. But some portion of your top leadership needs to be involved, visible, and vocal to drive the greening of the data center to become an important initiative within your organization.



Step Two: *Leverage Cool Outside Air Whenever Possible*

The easiest way to decrease electricity use is to rely more on air from outside your data center when appropriate and less on mechanical cooling and air conditioning. Free air cooling, air-side economization, water-side economization are all strategies that can be impactful in all but the warmest climates. Many data centers that could be using these measures are not. While those in Arizona, Texas, and Georgia may think that their hot summers make outside air usage untenable, in fact, there are thousands of hours that these strategies can be utilized.

If you last built a data center a decade ago you may be surprised at the new opportunities to utilize outside air. There are new technologies, new strategies, and new servers that are designed to withstand significantly higher temperatures. Those higher set points are a critical advantage that may not have existed last time you went through a process like this.

Leverage your consulting and engineering resources, both within your company and both established and new outside advisors, to learn about the new ways you can utilize outside air to cool your data center. Every breath of outside air your data center takes in is temperate air delivered with less need for mechanized cooling.

Step Three: *Engage in Rack Hygiene to Plug the Leaks*

Leaks are a problem in many walks of life. A leak in your hot water cooler at home can lead to unexpected water damage not noticed until it was too late. Many poker players have leaks in their game that keep them from winning. Political careers can be made and destroyed by media leaks.

But the most damaging leaks financially are likely those of the power-wasting variety in data centers. Even data centers built in the past few years that are designed and operated to do many of the large things well have at least small leaks of air that over the course of hours, days, and months add up to a massive amount of power spent on cooling that is lost into the outside atmosphere.

Rack hygiene areas of analysis include checking rails for points that should be sealed, reducing and

eliminating any opening you can find, and doing a thorough overview underneath your racks, as floor tuning and floor sealing offers energy-saving benefits to a great many data centers that we analyze.

Those are just a few of the physical places where leaks typically occur but there may be leaks in your strategy as well. Low efficiency servers should be replaced, zombie servers should be eliminated, and virtualization should take place where sensible and appropriate, as applications that are due to be virtualized typically currently reside on inefficient servers.

There are almost certainly some form of leaks in your data center, and in your thermal management strategy. Find them, plug them, and enjoy the rewards of reduced energy consumption and the resultant lower costs.

Step Four: *Consider De-Emphasizing PUE as a Metric*

Measurements are key to evaluation goal setting, and performance in any area of business, and are especially important in data centers. A metric that has come into favor in the industry in the past decade is PUE, or Power Usage Effectiveness. PUE is the total amount of power used in a data center divided by the total amount of power used to run the IT equipment within it. Though servers are getting more efficient all the time, they use a lot of power, and the goal is to have the data center infrastructure running so efficiently that the PUE is very low, as close to 1.00 as possible.

Actual PUEs in data centers range from well over 2.0 in legacy, inefficient data centers, to 1.10 or so in some of the most state-of-the-art, large scale data centers containing the latest, most-energy-efficient servers, storage arrays, and telecom equipment.

You'll hear of data center developers saying that they've designed a data center to have a PUE of 1.15 or some other aggressive number. The suggestion is that it is the fault of the operator if the PUE design number is not achieved.

PUEs are typically self-reported by data centers and generated with data that is proprietary to the company, so when data center professionals gather you'll hear of jokes that they're operating at a PUE of 0.98 or some other mathematically impossible number. That highlights one weakness of PUE evaluation, but there are others.

An impressive PUE is largely dependent upon having a data center at or near capacity. If a data center is

underutilized the PUE will always be higher (less impressive) than a facility that is full. The PUE will be higher if the servers and other equipment are not the latest generation, which is almost always out of the DCO team's hands. If the company is stretching out server life for an extra year it will not reflect well on PUE. Additionally, properly measuring each segment of power usage can be very difficult to do accurately without the proper measuring tools, and what those tools are may be different than what the tech media buzz is.

PUE can be a useful measurement tool. But it is a metric that is difficult to measure, is overly influenced by budgetary decisions outside of the data center staff and is frequently abused by marketers and others seeking to impress with a non-verifiable, but impressive sounding metric.

Step Five: *Use Containment as an Efficiency Bedrock*

A significant "efficiency bandit" in data centers is the mixing of hot and cold air, leading to lukewarm air that can cause two significant issues.

1. Temperatures so high they damage equipment. Or more commonly...
2. Cooling inefficiencies that result from air conditioning systems having to work hard to cool a roomful of lukewarm air.

The blending of disparate air temperatures is an issue best solved by utilizing a containment strategy. This optimizes airflow, cooling the areas that require lower temperatures. Containment involves keeping the cold and hot air separate. Containment arranges for cold air to flow to where it is needed to be effective and avoids the need to cool the entire data center as though it is a giant refrigerator.

With containment air exits the air conditioning system and cools the IT infrastructure. That air is significantly warmer as it exits the servers and is delivered directly back to the cooling infrastructure. By not letting the two temperatures mix the cool air is more effective in lessening the temperature of the IT equipment, and less energy is required to effectively cool the data center.

Through containment cooling takes place where required, avoiding the waste of expensive energy and resulting in a significant reduction of your carbon footprint. There are many different methods of containment and one of them should be foundational to your data center thermal management strategy.

Step Six: *If You're Get CRACking on Strategy Improvements*

Let's get this out of the way, computer room air conditioning (CRAC) units are expensive to buy, and installation is no bargain either. If your CRAC units are working there probably isn't a significant appetite within most budgets to upgrade them. But older, less-efficient CRAC units are an impediment in many data centers to an acceptable level of energy efficiency.

Newer CRAC units frequently pay for themselves rather quickly. Digital scroll CRAC units (DSCRACs) are worth the upgrade, as they can make a CRAC unit as energy efficient as a CRAH (computer room air handler). DSCRACs are capable of ramping down

the speed of the compressor when appropriate. This provides meaningful efficiency that quickly translates into cost savings that repays your investment in the equipment.

Many older data centers suffer from the same poor strategy, one that is an efficiency killer. A CRAC controlled by return air is typical in legacy data centers and is a certain sign of an environment that is energy Inefficient.

Typically, a data center manager will think that the containment just isn't tight enough when he actually just needs to shut off the cooling units. This will solve the problem of having units running and 80 degree set points that lead to the room being flooded with air at temperatures approaching that amount.

The outdated strategy of basing cooling on the technology of return air is still in vogue in a surprising number of data centers and suggests that an updating of strategy is in order.

Step Seven: *Utilize CFD; The First Step in Data Center Energy Efficiency*

Nothing provides a higher likelihood of optimizing a data center than to engage in modeling the airflow prior during the design and development of a facility. Modeling using computational fluid dynamics (CFD) leverages software-based tools for predicting energy efficiency and performance.

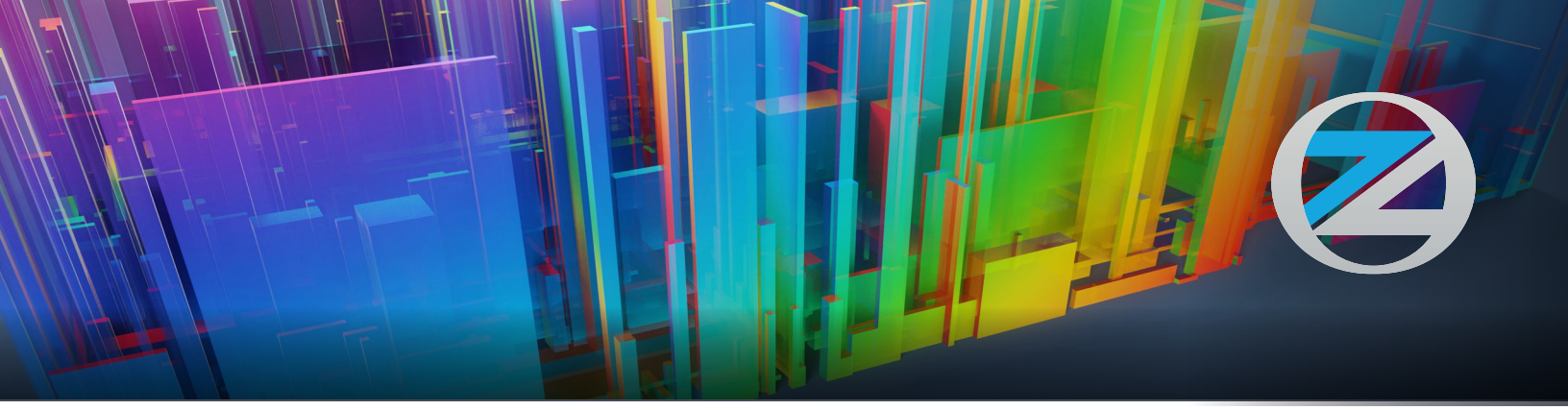
CFD helps you determine how efficient your data center design is today, and how changes to the current blueprint will impact temperature and energy usage. CFD can help you determine where you may be cooling too aggressively, wasting energy resources as a result, by modeling what things would look like if an area was allowed to be slightly warmer. It can also isolate potential trouble spots, enabling you to modify your design to come closer to achieving your goals.

CFD very accurately answers questions like:

- ***What if we put more cooling resources over here?***
- ***What if we add containment in this area?***
- ***What would this change to the design do to the heat load?***
- ***Would this adjustment have a positive impact?***

It allows you to analyze in advance any permutation or combination of factors that you are considering in the design, development, and execution of your data center, enabling you to settle on a strategy that best suits your goals and reduces your energy consumption.

Those questions are all answered with a high degree



of accuracy when CFD is part of the development process. CFD allows you to forecast with precision how a data center reacts to certain conditions, which enables you to develop and execute a strategy for cooling as optimally as possible.

When CFD is properly utilized a data center is left with a strategy for circulating air at the proper temperatures for optimal performance and energy consumption. CFD is a tool that allows you to avoid having too much cold bypass air, a situational that is unnecessary and wasteful, and also can eliminate having too little cool air circulating through, or circulating in the wrong places, potentially creating an environment that's too hot, resulting in excessive cooling costs and in some cases even damaging data center equipment.

Not utilizing a proven, data-driven software tool greatly lessens the chances your new data center will be efficient, sustainable, and green. CFD should be a part of any data center construction or expansion.

Step Eight: *Green Data Centers Execute Thermal Management with Monitoring*

An existing data center, even one that has used the powerful tool of Computational Fluid Dynamics in being built or refreshed, needs a comprehensive thermal management program. While CFD is a very powerful tool and can provide as accurate a view as possible into the future performance of the design, not all variables are known in a data center before it becomes operational.

Servers and other IT infrastructure may not perform to expectations. During the construction process a new generation of servers may be introduced that generates less heat. Technology may improve with the latest versions installed in the data center.

In some instances, due to changing business needs, the power density of the data center may be different than anticipated. Sometimes circumstances lead to a different optimal temperature or humidity point within a data center. Organizational IT infrastructure goals may have changed. Truly, the number of factors that can impact the thermal performance of a data center are innumerable.

That's where monitoring comes in. Monitoring allows for visibility into the actual performance of the airflow, cooling, and containment strategies of a data center, permitting adjustments to reach a true level of optimization.

The next generation of monitoring has arrived with more accurate measurements and data. Outputs are enhanced with visual graphic elements that allow for immediate evaluation. We're just scratching the surface on the power of state-of-the-art

monitoring, offering features that were never available with legacy data center infrastructure management (DCIM).

As important as CFD is to the building or retrofitting of a data center, monitoring is of equal importance in its operational performance. No data center can truly be green without a comprehensive monitoring program using the latest technologies.

Seize the Green Opportunity in *Your* White Space

People in nearly every industry have the desire to reduce emissions, lessen energy spend, and capture the dual benefits of sustainability, the beneficial reduction in cost and satisfaction of being responsible stewards of resources. But most are frustrated, because there is only so much they can do.

Not so for those of us that touch the data center. We all have extraordinary leverage to deliver all of the benefits of energy conservation; the cost savings, the lessening of emissions, being first with solutions that will be modeled by other industries, and the impact and legacy of our work generating both the hard and soft benefits of sustainability.

SubZero engineering can help you do all of those things.
If you are interested in analysis on how to turn your data center into a green data center, Subzero Engineering would welcome the conversation.

To arrange for a virtual meeting, scan the QR code below, or visit the Contact page on our website.