cisco Meraki

WHITEPAPER

Six Ways for IT Leaders to Reduce Their Carbon Footprint

Executive summary

The need to address the climate crisis is an incredibly urgent one. It's a critical initiative for governments, businesses, and citizens alike. As the world becomes more connected, technologies like cloud, AI, and wireless create new opportunities to champion a sustainable future. Cisco Meraki has a culture of pushing boundaries and innovating to make IT more intuitive, faster, and smarter for our customers. We believe applying these same principles to the climate crisis can enable our customers to leverage digital innovations that are good for business and for the environment.

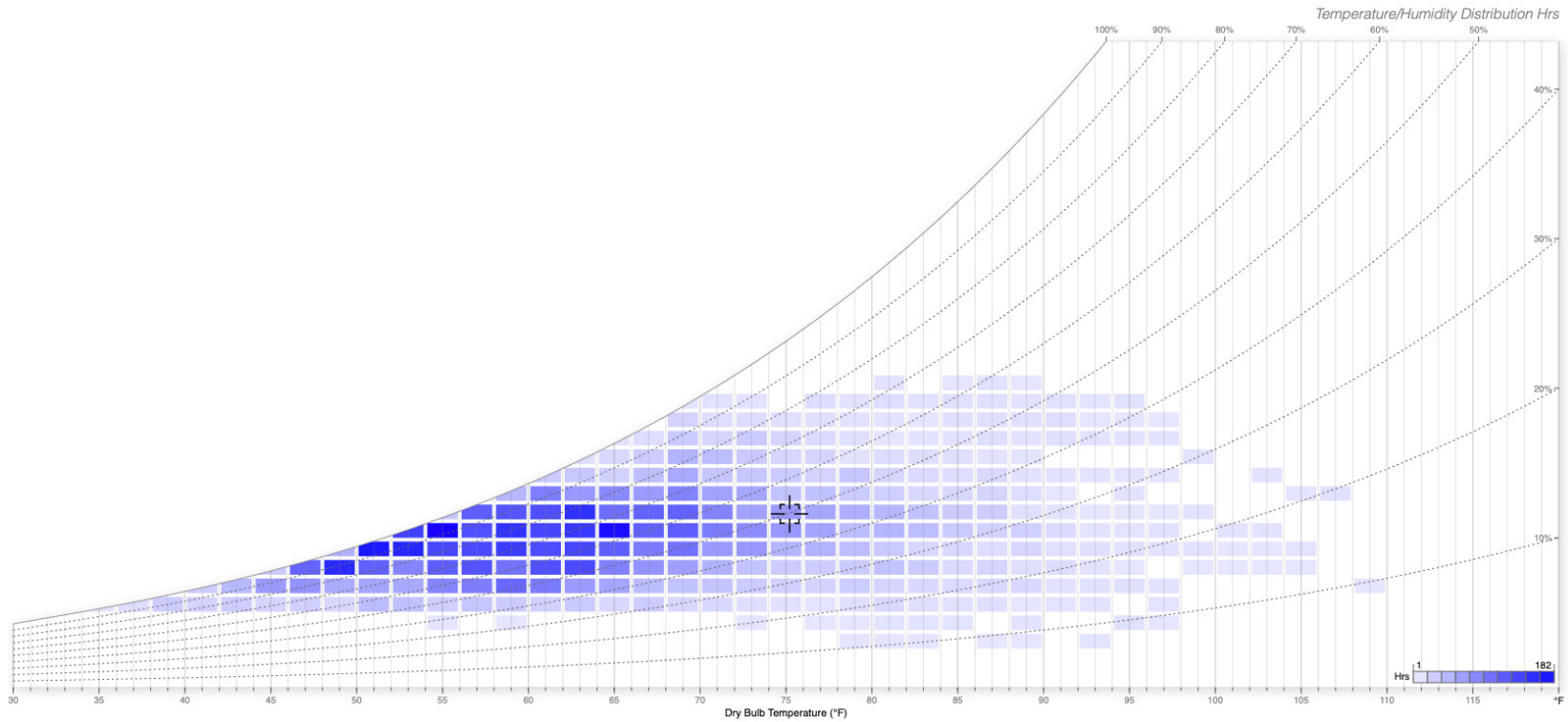
As more organizations set goals for achieving carbon neutrality and using 100% renewable energy in the coming decades, increased emphasis has been placed on improving energy efficiency in data centers. This whitepaper covers a variety of best practices that organizations can adopt to increase data center efficiency while reducing their power usage and carbon footprint. Practices discussed include free cooling, hot aisle containment, ASHRAE guidelines, environmental sensors, psychrometric charts, and PUE monitoring. Implementing these tactics can help organizations decrease their energy consumption and associated carbon emissions by 20-50%.

Keeping things cool for free

Data centers and server rooms require a substantial amount of energy to reliably operate business-critical IT equipment. However, less than half of the total energy is used to power IT hardware. The majority of the energy is used by the HVAC system to regulate airflow and protect IT equipment from extreme temperature and humidity. Using traditional mechanical refrigeration from the HVAC system is an energy-intensive process, but significant energy savings and carbon reductions are possible any time the data center can be cooled and humidified through alternative means.

Fortunately, many times throughout the year, cool outdoor ambient air and water can serve as a natural alternative to mechanical refrigeration through a process known as free cooling. Free cooling uses a machine called an economizer to source naturally cool air or water from the outside to control interior environment levels.

The number of days per year that free cooling can be leveraged will vary depending on the latitude, elevation, local climate, etc of the location. Research has shown that incorporating an economizer and free cooling can reduce cooling costs by 60%. Weather data from specific geographic locations can be plotted on a psychrometric chart to help estimate the number of hours per year that free cooling can be leveraged.



A psychrometric chart showing the frequency of ambient temperature and humidty values per year for a given location.

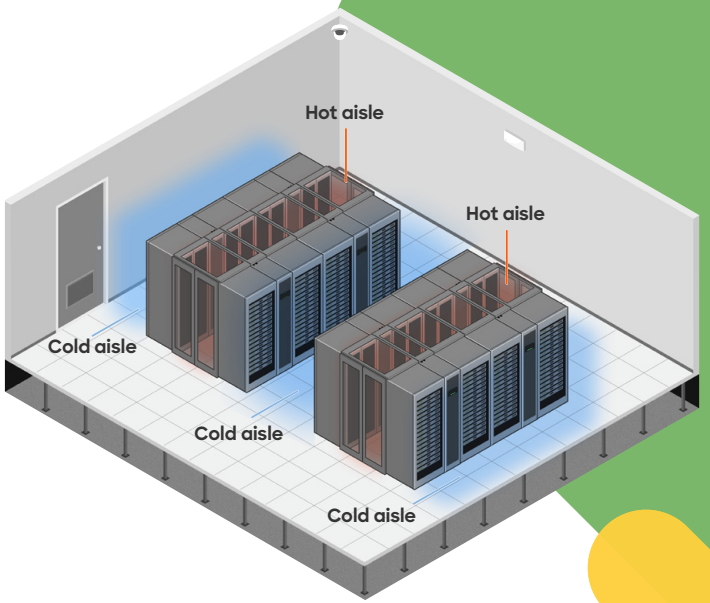
A common best practice is to place temperature and humidity sensors inside the data center and outside the building to help automate the building management system and determine when the economizer can leverage free cooling or if mechanical refrigeration is required.

A global advertising company and Meraki customer reduced their annual energy cost at one of their campuses from $183,600 to $134,000–a savings of 27% after implementing Meraki MT sensors and a free cooling economizer. Read the Total Economic Impact™ study of Cisco Meraki MT sensors, conducted by Forrester Consulting, to learn more.

Contain the hot air

Inside data centers, cold supply air is drawn over top of IT equipment while hot air is exhausted out the back. A significant problem can occur if hot exhaust air from one rack mixes with the cold supply air of another rack. When this happens, the room must be over-cooled to prevent the IT equipment from overheating, ultimately leading to wasted energy. Hot aisle containment systems offer a simple solution to prevent the hot and cold air from mixing.

Hot aisle containment systems use a physical barrier to guide hot exhaust airflow back to the AC return. By preventing the hot exhaust air from mixing with cold supply air, data centers can increase cooling efficiency and energy savings and enable predictable temperatures for IT equipment. Hot aisle containment systems alone can reduce cooling costs by 10-35%. Meraki temperature and humidity sensors can be placed in the hot and cold aisles of every rack to ensure air is not mixing or developing hot spots in a particular location.



Sealing off the hot and cold aisles with rigid containment systems offers the greatest benefits in terms of energy efficiency, however, significant savings can still be achieved by separating the hot and cold aisles with low-cost plastic curtains, similar to those found in a supermarket or commercial refrigerator. For example, Google invested $25,000 in plastic curtains, air return extensions, and a new air conditioner controller, and returned an energy savings of $67,000 per year without any operational downtime.

Turn up the heat to reduce spend

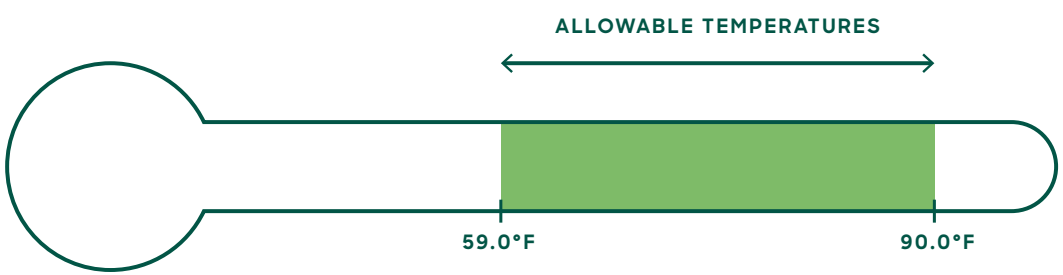
Traditionally, data centers have been over-cooled in an effort to mitigate the risk of extreme temperature levels that could damage IT equipment or take down the network. While excessive cooling does a great job of ensuring network availability, it is extremely inefficient. Organizations have an opportunity to reduce their cooling costs and carbon emissions by following industry guidelines and safely increasing the temperature of their facility.

Initial guidance from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) was to keep data centers between 20°C and 25°C (68°F and 77°F). In 2008, after years of research, ASHRAE determined that IT equipment could safely operate between 15°C and 32°C (59°F and 90°F), without decreasing reliability. Some data center equipment can operate at even higher temperatures depending on the equipment class.

By adhering to the newer ASHRAE guidelines, organizations can effectively reduce the demand for mechanical cooling, increase the annual hours of free cooling, and ultimately decrease energy consumption and carbon emissions. Research has shown that every 1°F increase in temperature can save 4% to 5% in energy costs. According to a study conducted by Google, the simple act of raising the temperature from 22°C/72°F to 27°C/81°F in a single 200kW networking room could save tens of thousands of dollars annually in energy costs.

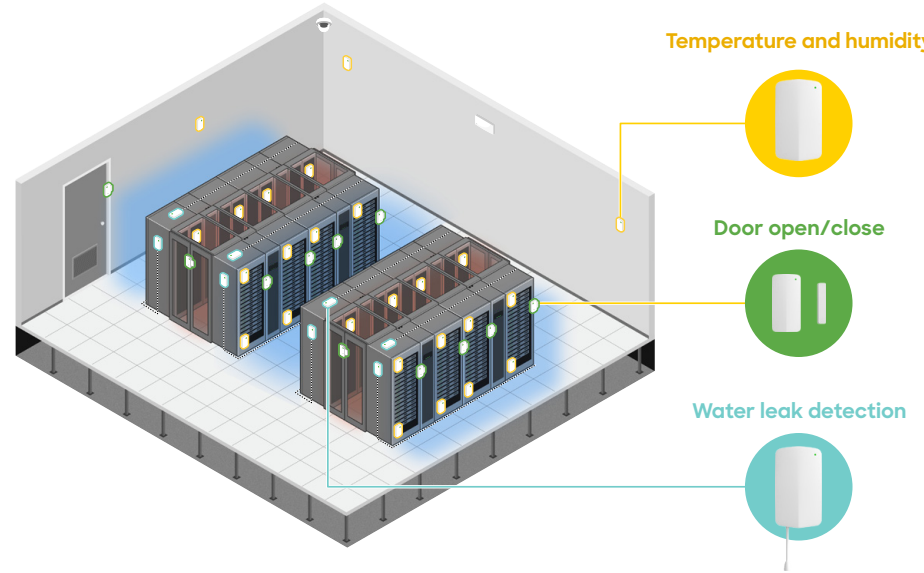
Raising the room temperature does create a risk of hot spots forming in the facility and affecting equipment reliability. As a best practice, Meraki temperature and humidity sensors can help mitigate this risk by monitoring equipment inlet and exhaust temperature levels. Hot spots identified from the sensors can indicate issues with air flow restrictions or the mixing of hot and cold air.

RECOMMENDED SERVER INLET TEMPERATURES



Monitor and automate energy savings with environmental sensors

Organizations require a way to monitor and automate the data center environment so that all processes are optimized for energy efficiency and maximum equipment reliability. Meraki temperature, humidity, water leakage, and door sensors provide rich contextual environmental data to help technicians proactively identify problems or automate cooling based on IT loads.



Meraki MT sensors are easy to install and integrate into any environment. By placing the sensors strategically, IT teams can remove the complexity from monitoring temperature and humidity while reducing the risk of equipment failure with ASHRAE guidelines. Alerts can be sent to key stakeholders any time sensor data falls outside the guidelines so issues are quickly remediated.

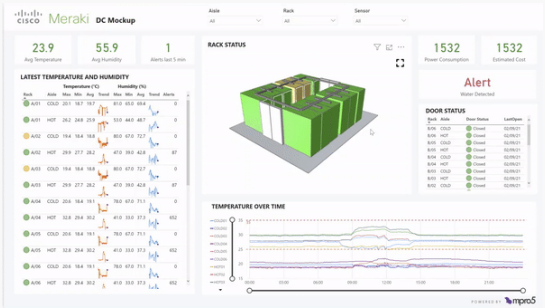
Assuming that hot aisle containment protocols are being followed, a minimum of three temperature/humidity sensors are required per rack to ensure proper thermal regulation; one at the bottom of the cold aisle, one at the top of the cold aisle, and one at the top of the hot aisle. For more precise monitoring, ASHRAE recommends up to six temperature/humidity sensors per rack, placed at the bottom, middle, and top of both the hot and cold aisles.

MERAKI MT SENSORS

Temperature and humidity sensor data can be plotted on Meraki energy savings charts to identify if the temperature can be increased, while remaining compliant with ASHRAE guidelines, to achieve additional energy savings. Sensor data can also be consumed by the building management system to determine when free cooling can be used to save energy or if mechanical cooling is necessary for equipment reliability. Greater energy savings and reduced carbon emissions are possible any time sensor data indicates that free cooling can be used.

In addition to temperature and humidity sensors, door sensors can be placed on each rack to make sure the cabinet remains closed. This is extremely important for systems with in-row cooling. Water leak detection sensors can also help prevent catastrophic damage to IT equipment by making sure there are no leaks coming from the HVAC system.

PARTNER SOLUTION



Meraki ecosystem partners can help integrate sensor data with other systems to deliver custom business outcomes.

Learn more at apps.meraki.io

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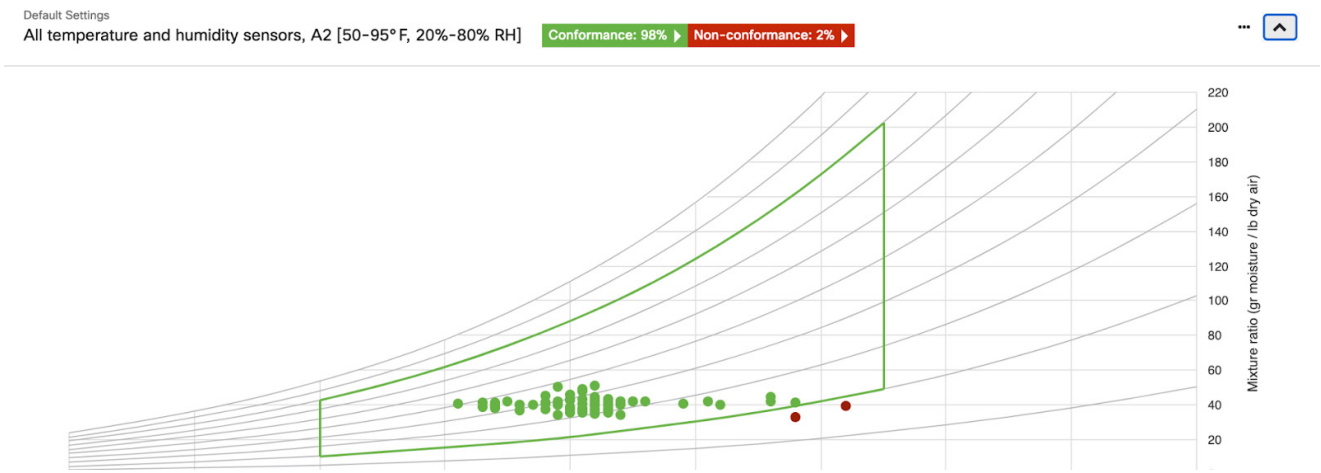
Visible energy savings: meet the psychrometric chart



Environmental sensor data alone does not provide enough information for organizations to assess real-time operating conditions or make informed decisions on improving data center efficiency. Meraki energy savings charts solve this issue by combining a psychrometric chart with ASHRAE guidelines to help determine the environmental efficiency of a data center or server room.

The psychrometric chart plots temperature against humidity to assess the thermodynamic properties of air. Psychrometric charts alone can be a great tool to help estimate the number of hours per year that free cooling can be leveraged by plotting weather data from a specific geographic location on the chart.

The Meraki energy savings chart overlays an envelope defined by ASHRAE guidelines on top of a psychrometric chart to show the ideal environmental conditions inside a data center or server room. Meraki temperature and humidity sensor data is plotted on the chart to determine if specific locations are in conformance with ASHRAE guidelines.

Technicians can safely increase the temperature of the data center and decrease their overall energy costs as long as the sensor data conforms to ASHRAE guidelines. Conversely, non-conforming sensor readings can reveal hot spots, identify issues with air flow, or indicate that the temperature or humidity levels in the room need to be adjusted. Data analysis from energy savings charts can also help influence the building management system logic to optimize use of the free cooling economizer to save additional energy and carbon emissions.

You've done the work, now lower the PUE

Power usage effectiveness (PUE) is a ratio of the total data center facility energy to the amount of energy delivered to IT equipment. Energy data is typically acquired from power meters connected to servers, storage, switches, and other IT equipment, in addition to air handlers, chillers, pumps, humidifiers, and other cooling infrastructure. Data centers become more efficient as the PUE ratio approaches 1, however the average data center has a PUE ratio of 1.67.

PUE is an excellent metric to determine how efficient a data center is operating and can be directly correlated to energy costs and associated carbon emissions. Decreasing the amount of energy required by the cooling infrastructure is one of the best ways to decrease PUE. Organizations should monitor PUE over time as they implement some of the energy-saving tactics defined in this whitepaper to understand how each improvement affects energy consumption.

$$PUE = \frac{\text{Total Facility Power}}{\text{IT Equipment Energy}}$$

As an example, BNY Mellon, a global financial services company, decreased their PUE from 2 to 1.52 after installing a hot aisle containment system and increasing the temperature and humidity levels inside one of their data centers according to ASHRAE guidelines. The net result was 24 million kWh, or $1.7 million, saved over the course of the project.

An energy-efficient future

As more organizations voluntarily make climate action pledges and move toward sustainable practices, they can look to their IT infrastructure and data centers to help them meet their carbon neutrality goals. The best practices outlined in this whitepaper offer simple and readily available ways to actively implement sustainability in powering, building, and cooling data centers.

Whether the motivation is out of concern for the climate or a company's bottom line, there is an opportunity for technology to help lead the way. With intuitive technologies like IoT-enabled sensors, Meraki can help you optimize your IT experiences and approach sustainability from a business perspective.

Meraki

To learn more, visit Meraki.com

Ready to take the next step toward sustainability?
Email our IoT sales team to discuss further:
merakiiot@cisco.com