



KAISER PERMANENTE DATA CENTER: CONTINUOUS AND INNOVATIVE ENERGY EFFICIENCY IMPROVEMENTS

Healthcare provider Kaiser Permanente owns and operates data centers that host corporate service applications for over 200,000 employees. Like any other large organization, these applications include tools for administration, communications, finance and accounting, procurement, legal, and human resources use. Kaiser Permanente data centers also provide continuous availability so that the organization can provide real time, technology-enabled healthcare for over 9,000,000 members.

In healthcare settings, a data center supports life critical systems. As a result, a data center must maximize security, resiliency, and availability. Kaiser Permanente is also determined to make their data centers energy-efficient as part of its environmental stewardship for the communities it serves. This is not surprising for a company that:

- Was ranked as the number one “Top Green-IT Organization” by *ComputerWorld* in 2011.
- Earned 29 environmental excellence awards from *Practice Greenhealth*¹ in 2013.

Kaiser Permanente’s 160,000 square-foot premier data center has been recognized for making many improvements to its energy efficiency since 2008, including:

- Earned **ENERGY STAR Data Center Certification** in 2010 – making Kaiser Permanente the first health care provider to earn that recognition.
- Won the first place award in Facilities Innovation² at the Uptime Institute’s 2011 Green Enterprise IT Symposium for its development and implementation of computer room functional efficiency (CRFE) metric.
- Received **Platinum Certification for Existing Building Operations & Maintenance** from the US Green Building Council’s Leadership in Energy and Environmental Design (LEED) program – the first (and currently only) data center in the world to earn this prestigious award.

This case study will examine the efficiency measures implemented by Kaiser Permanente’s data center facilities team. It includes measures initially implemented during their raised floor optimization (RFO) program, the adjustments made using their unique computer room functional efficiency (CRFE) metric, and efforts to optimize cooling during a 40,000 square-foot/4 MW data center expansion.

¹The national membership organization for hospitals and health systems committed to environmentally responsible operations and care.

²This award is the Uptime Institute’s highest honor, and recognizes projects that significantly improve efficiency in data centers.

“Kaiser Permanente is focused on providing healthcare services in a way that protects the environment and the health of our communities now and in the future. Our entire organization actively looks for ways to reduce our carbon footprint. In our data centers, we’ve challenged both our design and operations teams to raise the bar on system performance and operations excellence. This is not just a hobby for us; it’s a way of life.”

-Steve Press,

Vice President of Data Center Solutions

Visit energystar.gov/lowcarbonit for more information.

RAISED FLOOR OPTIMIZATION

As early as 2008, Kaiser Permanente's data center facilities team realized that the accepted industry standard measurement methods were not granular enough to clearly evaluate the cooling for IT spaces. Upon careful inspection, they noticed that there was always excessive air circulation with minimal heat rejection in the organization's data centers. The team launched the Raised Floor Optimization (RFO) program to maximize heat rejection while minimizing air circulation. At the data center, the team implemented the following projects:

- Retrofitted 31 existing computer room air handler (CRAH) units from constant speed fans to electronically commutated (EC) variable speed fans allowing the cooling system to match the load, minimizing the excess of air circulated.
- Added 57 new CRAH units with the EC upgrade as the data center's IT load increased, matching the existing cooling scheme.
- Installed SynapSense wireless sensors. They installed 489 wireless metering nodes in the IT space at roughly—or one on every third rack. The wireless nodes measured:
 - Temperature at the top, middle, and bottom of the cabinet on the hot and cold aisle sides, and below the raised floor under the cabinet.
 - Humidity above the floor.
- They also installed 96 pressure sensors above and below the raised floor and 90 additional temperature sensors were placed on the return air to the CRAH units.
- Isolation and sealing of leaks and bypass air through all equipment on the raised floor. This effort involved:
 - Cold aisle containment that typically included flexible curtains on one end and sliding doors on the other end. The cold aisle is covered overhead with panels, which automatically shrink and fallout from the high temperature during a fire so that a separate fire suppression system for the cold aisle was not necessary.
 - Working with a boat cover company, the team custom-made 40 CRAH covers that would not only prevent bypass air, but also could be quickly removed (through a system of bungee cords and hooks) when the standby CRAH units were needed. The covers, which were not offered by any data center equipment manufacturers at the time, eliminated nearly 14,500 CFM of bypass air through the damper less CRAH units.
 - PlenaForm®, which partitions off unoccupied raised floor space with underfloor baffles. The team installed PlenaForm around power distribution units and remote power panel (RPP) pedestals. In addition, they installed blanking panels inside equipment cabinets. The two measures eliminated over 53,000 CFM of bypass air.

According to a study conducted by Pacific Gas & Electric (PG&E), this project saved enough energy annually to cover the cost of the improvements in 4.5 years. Though the IT load increased over the implementation period making the impact of the installation more pronounced, conservative estimates confirmed the benefits of the installation had easily surpassed the original ROI projections.

COMPUTER ROOM FUNCTIONAL EFFICIENCY

The data center facilities team wanted to understand and quantify the improvements gained from implementing energy-efficient projects. To do so, they pulled data from the wireless sensor network which by then had been integrated with the data center's Automatic Logic Controls (ALC) energy management system (EMS). More specifically, the team identified the different stages of the air circulation/heat rejection cycle and used the ALC data to evaluate temperature quality degradation throughout the cycle and across the environment. This data was collected into a metric called computer room functional efficiency (CRFE). The CRFE processed data provided operators the tools to optimize the heat removal cycle efficiency with unprecedented precision. The team was able to not only quantify the benefits from previous large-scale efforts, but also analyze hard data and extract necessary information to make small adjustments, such as additional decreases in fan speeds, taking more CRAH units offline, and taking out additional perforated tiles. The CRFE metric helped the team:

- Precisely identify problem spots
- Validate and quantify the benefits of measures they had implemented

By optimizing efficiency through CRFE, Kaiser Permanente estimated that when they combined the cost of reduced energy use with the utility company incentive that the project had paid for itself in under two years.

Visit energystar.gov/lowcarbonit for more information.

SUSTAINABILITY AS A HABIT AND DATA CENTER EXPANSION

Energy efficiency, environmental awareness, and sustainability are more than lofty goals for Kaiser Permanente, they have become habits. Most recently, their now ingrained way of life was evident in an expansion of the data center which included the addition of 40,000 square feet of computing space on the second floor and the replacement of the entire mechanical plant. Specific environmentally conscious improvements included:

- **Chilled water plant design:** The chiller plant was more than twenty years old, so the team replaced it with an all new variable volume primary loop system that includes variable speed drive chillers, chilled water pumps, condenser water pumps and cooling tower fans.³ Upon replacement, the average energy demand of the chiller plant decreased by 200 kilowatts – resulting in over 1.7M kilowatt hours of annual energy savings.
- **Air-side and water-side economizers:** The new second floor addition to the data center uses 100 percent outside air during the majority of the year. Two new large waterside economizers can now be run in parallel with the chillers or in stand-alone mode, eliminating the need for chiller operation when the right conditions are present.
- **Water conservation:** Water discharged from the cooling towers no longer goes down the drain at the data center. The water is now routed to collection tanks, where it is used to meet irrigation needs across the site. Any excess water that the collection tanks are unable to store overflows to a retention pond, where it naturally and safely filters back into the water table.
- **Multi-mode uninterruptible power source (UPS) systems:** New UPS systems have the ability to run in a highly efficient “line interactive” mode or the traditional (and safer) “double conversion” mode.⁴
- **Waste heat recovery:** Warm or hot exhaust air from the UPS rooms is now routed to the generator room next door to eliminate the need to operate a boiler/heater to temper the generator rooms, and to decrease the power draw for the diesel engine block heaters.
- **Lighting:** Installation of new light emitting diode (LED) lighting and occupancy sensors reduces energy consumption and heat generation.
- **Hot aisle containment:** The team deployed fully-enclosed return air chimneys tied to a drop ceiling return plenum back to the Air Handling Units and eliminating air recirculation through the compute space.

PROJECT LESSONS

Kaiser Permanente’s efforts demonstrate three essential components of a successful data center energy efficiency retrofit:

- **Leadership commitment:** Kaiser Permanente demonstrated its leadership and commitment to sustainability by supporting the efforts at the data center at the highest levels of management. The retrofit at the data center complemented the company’s ongoing sustainability efforts.
- **Life cycle cost analysis:** During the bidding process for the chiller plant, life cycle cost analysis led to winning bids being 40 percent to 50 percent more affordable than the most expensive bids. Incorporating the value of annual energy savings led Kaiser Permanente to make the correct long-term decisions.
- **Monitoring network:** The wireless temperature/humidity/pressure sensor network, integrated with their energy management system, allowed Facilities staff to directly monitor the cooling system and make adjustments to optimize efficiency while assuring IT staff that cooling levels are appropriate.

³The old system was three 500-ton R-11 Carrier chillers with no variable speed capability and one York 500 ton chiller with variable speed. The new system is five 875-ton York variable speed units.

⁴Since August 2012, EPA listed ENERGY STAR certified UPSs, including multi-mode UPSs – see www.energystar.gov/products

ABOUT KAISER PERMANENTE

Kaiser Permanente Kaiser Permanente is recognized as one of America's leading health care providers and not-for-profit health plans. Founded in 1945, our mission is to provide high-quality, affordable health care and to improve the health of our members and the communities we serve. We currently serve approximately 9.1 million members in eight states and the District of Columbia. Care for members and patients is focused on their total health and guided by their personal physicians, specialists and team of caregivers. Our expert medical teams are supported by industry-leading technology and tools for health promotion, disease prevention, care delivery and chronic disease management. For more information, go to: kp.org/share.

ABOUT EPA ENERGY STAR'S LOW CARBON IT EFFORT

Organizations can save money and energy in the IT space by:

- Purchasing ENERGY STAR certified IT products: computers, servers, data storage, uninterruptible power supplies, and small networking equipment.
- Learning how to quickly and easily activate sleep settings on computers so they automatically enter a low-power sleep mode.
- Benchmarking their data center's energy efficiency performance versus hundreds of other data centers across the country using the Portfolio Manager tool. Data centers in the top 25% earn ENERGY STAR building certification.
- Read user-friendly, non-technical descriptions of data center efficiency techniques by reviewing the ENERGY STAR's Top Twelve Ways to Decrease the Energy Consumption of Your Data Center website.
- Review case studies on outstanding data center retrofit efficiency efforts by Low Carbon IT Champions.