AIRSYS

CASE STUDY

How Free Cooling Reduced the HVAC Energy Use at a Data Center Site In Helena, MT by 60%

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Project Summary

In a land well known for the thriving streams and the outdoor grandeur of the rustic surroundings, Montana, or Big Sky Country, will always remain a special place. Although data centers are not a part of the beautiful views, they have now become a necessity in the land's ecosystem that relies on network data. The AIRSYS Field Services team traveled up to Helena, MT to assist a longtime client troubleshoot a facility in town that was experiencing high energy usage. While walking the site and getting acclimated to the current systems at the data center, the team was able to analyze the issues and provide a viable design to not only save them money in operational costs, but allow the team the option add more network equipment in the future. The technical team at AIRSYS gathered a year of verifiable utility data that showed an annual savings of $8,400 in electricity usage that is directly attributable to the installation of the AIRSYS HVAC equipment.

One notable engineering feature that dramatically reduced the HVAC energy use was largely due in part to Free Cooling. Free cooling is a method of allowing low external air temperatures to bypass the mechanical cooling stage and exchange its heat with lower outdoor air temperature. This bypass process of free cooling can reduce energy, lower maintenance costs and reduce overall operational costs.

The data collected represents a 20% reduction in the total site electricity and a 60% reduction in energy usage for the HVAC equipment by upgrading to the energy efficient AIRSYS UNICOOL units and controls with the Free Cooling economizer feature.

The 20% reduction in site energy is a direct result of the reduction in HVAC energy. This HVAC energy reduction is estimated to be from 35% to 85% after 12 months from the installation of the new HVAC equipment. The first 35% reduction is primarily from the more efficient mechanical cooling the UNICOOL systems now deliver. The additional 50% is primarily from the use of direct fresh air free cooling.

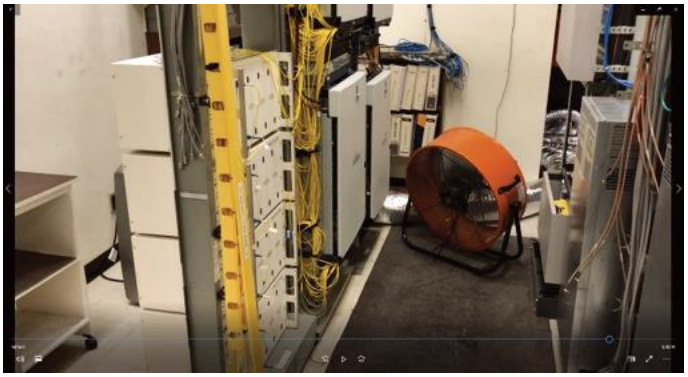
Preexisting Conditions On Site

In the spring of 2018, engineers and facility management personnel contacted AIRSYS about a site located in Helena MT, that was experiencing high energy usage and an inability to consistently meet temperature set points. The majority of the HVAC legacy systems were at their end of life. The site was continuously in and out of high temperature alarm conditions, causing a strain on the daily operations team. With about a 10 ton IT load on site, the 15 Tons of operational HVAC equipment were not able to keep up with the cooling demands.

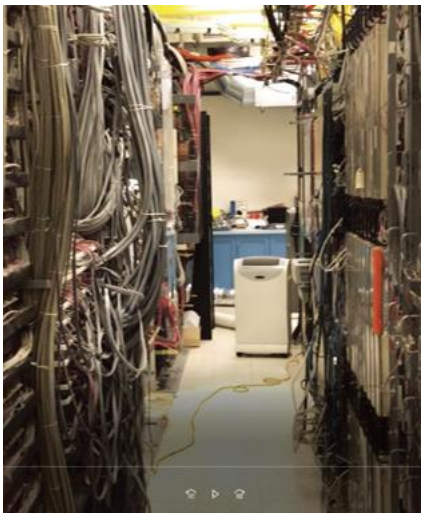
Existing HVAC Equipment	Design Tonnage	Operational Tons
One operational 5 Ton 1993 Liebert Packaged CRAC Unit	5	5
Two 5 Ton 1999 Liebert WPUs	10	5
One 5 Ton (fairly new) Lennox RTU	5	5

The large existing space only had approximately 30% of the floor space occupied with IT racks, so a majority of the space was open. In addition to the 15 tons of active cooling, advanced duct work was used to try and deliver cold air wherever it was most needed. Circulating fans and portable coolers were also used to manage the room temperature in and around the network equipment.

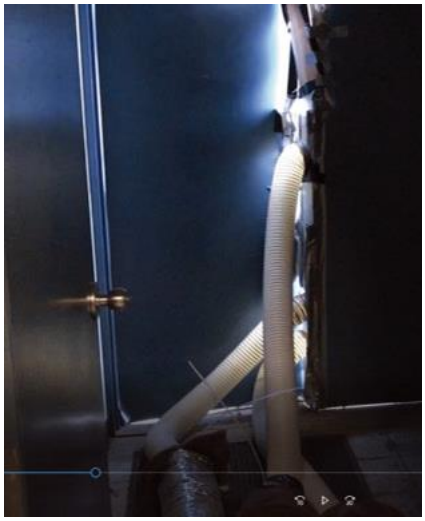
Liebert 5 Ton Wall Pack Units



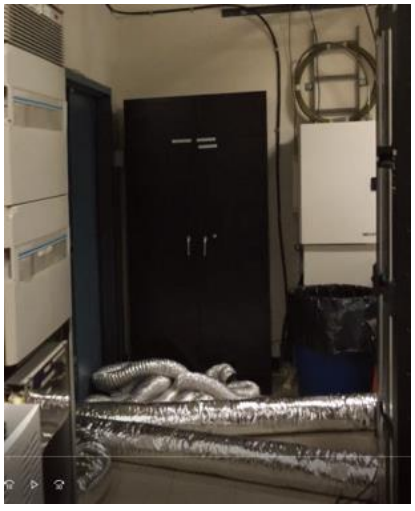
Industrial Floor Fan for added ventilation



Portable Air Conditioner Unit



Exhaust air ducting for the IT racks



Supply air ducting for the IT racks

HVAC Upgrade Details

During the design stage it was critical to address the general replacement of the legacy HVAC equipment, as well as the challenge of getting air flow to the critical rows in such a large open space. AIRSYS chose to deploy the newest UNICOOL variable capacity Wall Pack Units (WPU) in order to address the air flow challenge and provide plenty of total capacity to ensure a minimum of +1.0 protection for the site.

The new systems deployed were the following AIRSYS UNICOOL models:

- Qty. (3) 11V1T3 // Top Supply 2-4 ton UNICOOL variable capacity WPUs with integrated free cooling (economizers).
- Qty. (2) 28V1B5 // Bottom Supply 5-10 Ton UNICOOL variable capacity WPUs with integrated free cooling.
- Qty. (1) ASMUC.6 // AIRSYS Multi-Unit controller that can manage 6 UNICOOL WPUs and 4 zones.

A total MAX capacity of approximately 32 Tons of cooling. This new design allowed the client the ability to double the IT load in the future at this facility without requiring any additional HVAC capacity.

NOTE: While all the Liebert HVAC units were removed from the site the Lennox RTU remained for several reasons:

1. It remains a working asset that has not reached end of life.
2. It would have been a significant additional cost to remove and dispose of the RTU.
3. The client requested we keep the Lennox unit to preserve their current insurance policy.

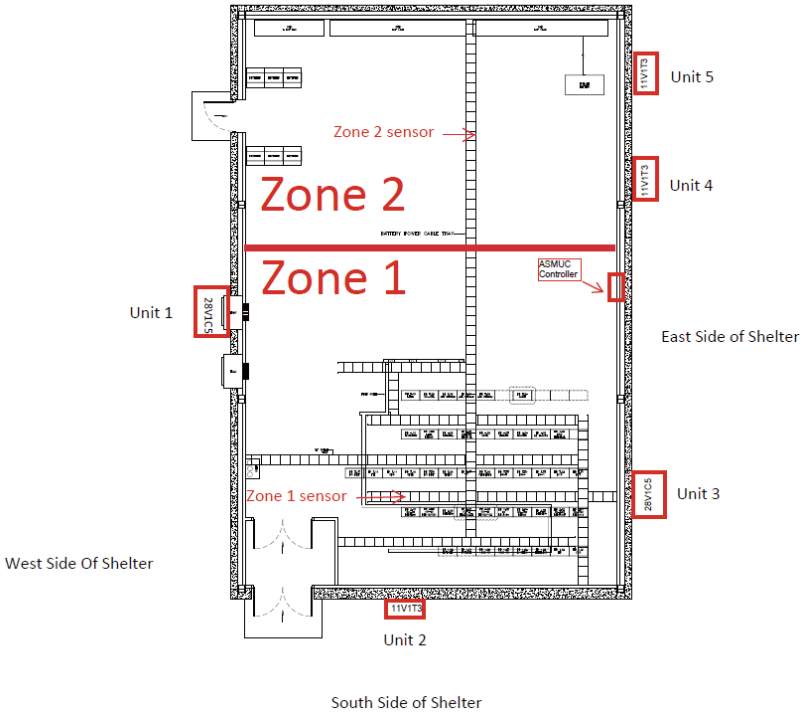
NOTE: The Lennox Roof Top Unit (RTU) in the image above was reset to turn on at 80°F while the new AIRSYS System has a setpoint of 74.5°F thereby keeping the RTU from turning on at all, so we can measure the performance of the new AIRSYS equipment without any interference from the Lennox RTU.

Front entrance with the Lennox Roof Top Unit (RTU) installed in the middle of the structure

Northeast Elevation

Northwest Elevation

Mechanical Plan Design



Drawing of the proposed layout for HVAC upgrades comprised of five units

UNICOOL Model 11V1T3 // Top supply // 2-4ton Variable capacity WPUs.

NOTE : Top supply was used to take advantage of existing ductwork without modification to the existing hole patterns in the building or to the existing ductwork.

UNICOOL Model 28V1B5 // Bottom supply // 5-10 ton variable capacity WPU.

Satellite Image

Southeast Elevation

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HVAC Electricity Reduction

In order to capture HVAC energy consumption and calculation how that electricity consumption has changed before and after the install, utility bills for the site from Sep 2016 through Dec 2019 were used which includes:

- Monthly kWh used
- Number of days in each month
- Average monthly utility rate

The heat load on site may fluctuate month to month. In order to calculate for this, the load of the site is being monitored remotely.

- DC Plant load (all network equipment is powered through a -48 Volt plant)

With the following data points listed below, we can determine the average daily energy usage in each month, calibrate for change in loads and calculate the HVAC energy change before and after the completion of install (Aug 2018). Also calculated is the average daily data, the change in DC loads and the year over year change in HVAC energy consumption that we have tabulated below.

Average kWH/Day

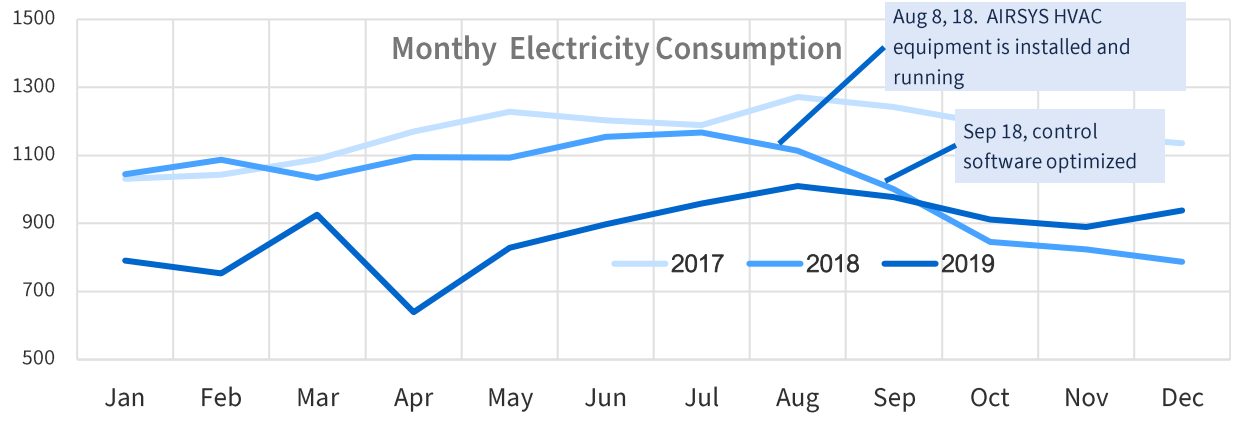
	Januray	February	March	April	May	June	July	August	September	October	November	December
2016	-	-	-	-	-	-	-	-	1340	1328	1284	1164
2017	1031	1044	1089	1170	1228	1204	1189	1272	1243	1192	1158	1136
2018	1045	1087	1035	1096	1094	1154	1168	1114	1001	847	824	787
2019	791	753	926	639	829	897	959	1010	978	912	890	939

Year Over Year % Change in DC Load

	Januray	February	March	April	May	June	July	August	September	October	November	December
2017-2016	-	-	-	-	-	-	-	-	7.1%	7.1%	-10.5%	-7.9%
2018-2017	-7.9%	-9.2%	-9.2%	-10.1%	-10.1%	-10.1%	-10.1%	-10.1%	-11.8%	-11.8%	-2.0%	-2.0%
2019-2018	-2.0%	-2.0%	-3.4%	-3.4%	-3.4%	-3.4%	7.6%	-0.4%	1.6%	1.6%	17.3%	17.3%

Year Over Year Comparison of Average kWH/Day - Calibrated for DC Load Change

	January	February	March	April	May	June	July	August	September	October	November	December
2018-2017	-	-	-	-	-	-	-	-	-123	-246	-318	-333
2019-2018	-238.0	-318.7	-77.6	-434.6	-237.2	-226.8	-281.5	-100.0	-	-	-	-

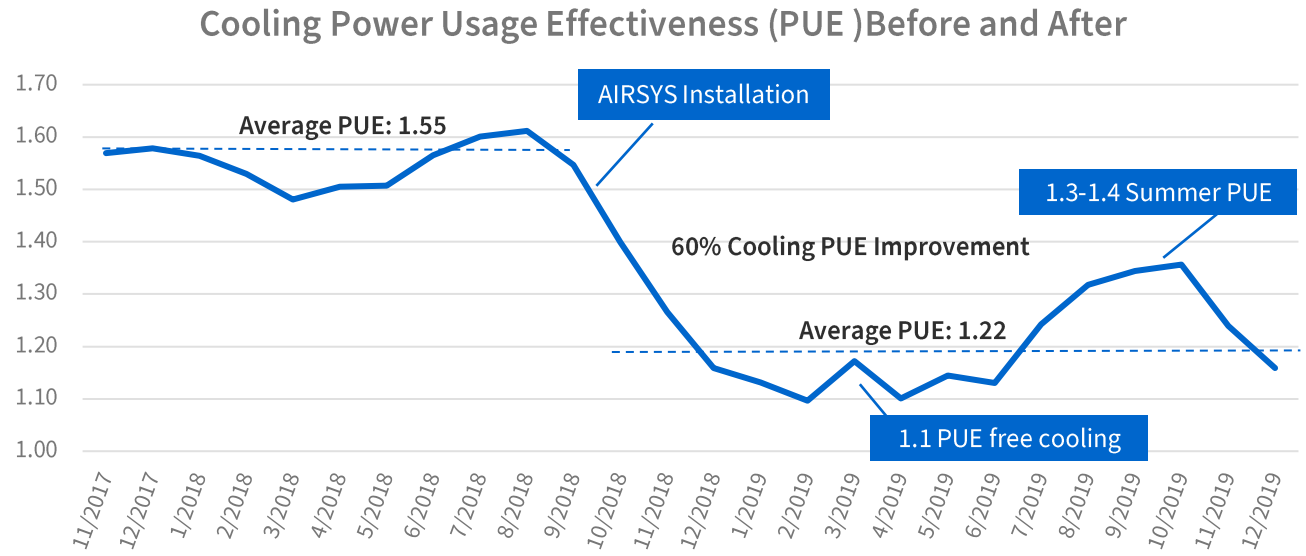


Aggregating 12 months of change in energy consumption

Annual Energy Savings: **89,230 kWh/yr. ($8,457/yr.)**

Change in Power Usage Effectiveness (PUE)

The Power Usage Effectiveness (PUE) is the ratio between total energy usage of the data center versus energy usage of the IT equipment. A PUE closer to 1.0 usually means that most of the energy is being dedicated to serving the IT equipment, thus resulting in a more energy efficient data center. Conversely, a PUE much lower than 1.0 means a lot more energy is being consumed to maintain the data center. In general, cooling and other environmental variables dominate the energy usage other than IT equipment and a reduction in HVAC energy is critical for getting the PUE closer to 1.0. By comparing the site and HVAC energy data before and after the installation of the upgraded HAVC equipment, we can determine the new PUE on site. The graph below illustrates the PUE before and after the HVAC equipment upgrade.



Interior shot of Unit 3 grills

Exterior Shot of Unit 3: AIRSYS UNICOOL Model: 28V1B5MR410BAC

Conclusion

The installation of the five new UNICOOL Inverter Driven systems with Free Cooling has accomplished a number of positive attributes for the site. The client now has a sufficient enough amount of capacity and airflow to maintain the environment without portable coolers or floor fans, greatly reducing energy consumed by those inefficient systems.

Secondly, the savings on electricity alone should be substantial due to the Free Cooling feature. By adding Free Cooling, the site can maintain the set temperature, without the need for mechanical cooling, for at least three solid winter months from December - February and at a high percentage for five of the remaining nine months. Additionally, in the warmer months of June - September we expect to see significant hours of Free Cooling as well during cooler times of the day. Thirdly, there is now a sufficient enough amount of existing HVAC capacity to allow the team to double the IT load in the future and still maintain a +1.0 protection. The team is extremely satisfied with the new results and the site is now a model for future sites to follow in their vast portfolio of data centers.

South Side of Helena Data Center

South Side of Helena Data Center

East Side of Helena Data Center

East Side of Helena Data Center

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BALANCE THE ENVIRONMENT.

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