Datacenter Efficiency Program

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Abstract

Worldwide, datacenter energy consumption is skyrocketing and datacenter energy efficiency is gaining more attention than ever. This report discusses the Puget Sound Energy (PSE) datacenter program that CLEAResult manages, focusing on an enterprise datacenter as a case study. The PSE program focuses on motivating energy efficiency for a wide variety of datacenter customers, ranging from server closets to enterprise datacenters. CLEAResult utilizes a customer relationship management (CRM) tool to track projects from outreach, audit, implementation, measurement and verification (M&V) to final incentive payments. This presentation sheds light on program design and project implementation. An enterprise datacenter project was used to demonstrate the engineering process from energy audit to project implementation to final M&V. Comprehensive measures including uninterruptible power supply (UPS), datacenter cooling, and airflow optimization were identified and implemented to deliver energy savings beyond best practices. A two-phase approach was used to implement all measures without interrupting 24/7 operation. Phase I measures include water-side economizing, chiller plant optimization, and air handling unit (AHU) static pressure reset. After Phase I, an M&V procedure was conducted to verify energy savings of over 6 GWh/yr. Due to limited economizing hours, phase II measures will be implemented in early 2015. These measures include air distribution optimization, hot aisle containment, chilled water loop optimization, and the addition of chilled water rooftop units. Energy savings from Phase II is projected at 3 GWh/yr. The power usage effectiveness (PUE) decreased from 1.7 to 1.4 (after Phase I) and 1.3 (after Phase II), which is significantly beyond the Energy Star standard.

Introduction

Datacenters are mission critical facilities that provide information storage and processing for businesses and institutions of all sizes. Datacenters can be found anywhere from school districts to health care facilities to large standalone enterprise datacenters. A typical datacenter consists of servers as well as the cooling equipment and power supply needed to support the space. The main energy users in a typical datacenter include IT servers, uninterruptible power supply (UPS), and heating ventilation and air conditioning (HVAC).

Worldwide, datacenter energy use is skyrocketing. Across the U.S., datacenters account for over $7.4 billion in annual energy costs and roughly 2% of total national electric use. In order to curb this energy consumption CLEAResult has developed a utility offering that has resulted in demonstrated datacenter energy savings. CLEAResult has delivered this program throughout the country, with both successes and challenges. The challenges provide an opportunity for learning and growth; and through these challenges CLEAResult learned and summarized the elements of an efficient and successful datacenter utility program. The following paper will describe the dedicated team, the utility program offering, and an example of a successfully implemented datacenter project.

The Team

The implementer's team is the most important component of the datacenter program offering. By their nature, high availability and reduced downtime is datacenter's first priority. Emerson 2013 estimates the cost of an unplanned outage is $7,900/minute with an average recovery time of 119 minutes. This equates to $901,500 in total cost per unplanned outage. Expectedly, datacenters are highly risk-averse environments. Encouraging energy efficient upgrades can be a challenge from the beginning. But, on the other hand, datacenters are extremely energy intensive and thus have a great opportunity for energy savings. The Uptime Institute 2013 describes that, cost management, especially operation cost, is one of the top three priorities in a datacenter. High operating costs are primarily associated with IT and cooling loads.

CLEAResult has built a Datacenter Practice Area with dedicated resources that specialize in working with this sophisticated group of customers. The Datacenter Practice Area includes a team of datacenter energy efficiency experts who understand the datacenter business and the issues critical facility managers deal with. This includes dedicated engineering, outreach, project management, and program management resources. It is critical to have a team that is adept at working with both IT and HVAC staff to communicate the benefits of datacenter energy efficiency and motivate customers to take action.

Datacenter Program

Datacenters consume a significant amount of energy, and energy utilities strive to provide valuable energy efficiency services for this segment. However, the datacenter complexity and high risk aversion make datacenter energy efficiency a major challenge. CLEAResult provides a turn-key solution for utilities in the datacenter area from outreach to final incentive payment, and thus utility clients can achieve energy savings in a cost-effective way and serve their datacenter customers better.

Customer Engagement

The first step is engaging a customer. The implementation team must engage customers throughout utility programs in a variety of different ways. One way is through the utility itself. The utility may already know their datacenter customers or have a list of key accounts to target. This is a good place to start. The implementer may also work through the utility's customer list targeting schools, government, hospitals, financial institutions, central offices, and telecom facilities, which often house datacenters. Outside of the utility, the presence at trade shows and datacenter/energy conferences puts the team in direct contact with customers that the utility may not be aware of. Finally, from working with datacenter programs throughout the US, the implementer has a network of trade allies that the team will leverage to find local customers who may be interested in energy saving projects. A different implementation team may be able to draw from their specific business areas to find a variety of different customers that support datacenters. This diverse approach to identifying and recruiting datacenter customers leads to a variety of small, medium, and large customers integrated into the utility program.

Customer Qualification

Once a customer is identified and engaged in the utility program, the next step is a site walk through. This walk through is used to gauge several variables that will help guide interactions with the customer throughout the process. The implementer can use this opportunity to evaluate both the datacenter system and the people at this facility to determine if this customer is a good fit for the program. The goal is to identify cost-effective measures and find customers who are likely to implement energy conservation measures in their datacenter. Site factors that might come into play include datacenter size, efficiency, potential energy savings opportunities, and quick paybacks. When it comes to evaluating the customer, this requires a little more tact. At this point the implementation team can determine customer interest/motivation, ongoing energy initiatives, available budget, and risk aversion. Based on the site and personnel opportunities, this customer may or may not be a good candidate for the datacenter program. These factors will also impact how the implementer interacts with the customer. For example, if a customer has an ongoing energy management strategy, such as compliance with the International Organization for Standardization (ISO) 50001:2011 *Energy Management System*, the implementer can tailor interactions to meet the customer's existing processes.

This process results in several benefits. First, it filters out customers who are unlikely to implement energy conservation measures or customers who do not have reasonable energy savings opportunities. This saves the datacenter program time and money. Second, those customers that do move forward in the process will be treated to customized energy analysis and project management. The implementation team can then dedicate the resources to provide the detailed audit and implementation services that this customer needs to move forward with an energy conservation project.

Customizing the Datacenter Audit Process

Each mission critical facility requires a customized approach when identifying and quantifying energy savings opportunities. This approach will vary depending each customer's unique system, personnel, and organization. However, implementing a customized approach in the program is not always easy. A variety of factors must be taken into account in order to address customer's specific needs. Factors that might impact the involvement with a customer include: datacenter size, available capital/budget cycle, customer motivation and preferences, existing customer energy initiatives, risk aversion, and energy savings potential. Typically an initial walkthrough is performed to screen customers and provide direction on the variables outlined above.

For certain customers, it is essential to provide a detailed, ASHRAE Level II energy audit, which includes a thorough investigation of all energy using equipment, temperature and amperage logging, as well as comprehensive engineering calculations to support all identified energy conservation measures. This type of study might focus on a more comprehensive capital or controls upgrade. For a customer with substantial savings potential and motivation, this report may be exactly what they need to fully understand the scope of the project and communicate opportunities to their upper management team. In order to motivate implementation, internal buy in is necessary. The case study at the end of this study describes a customer and project that went through this more thorough audit process.

For other customers, a more targeted report may be appropriate. This type of report includes analysis supported by spot readings, onsite data collection, and minimal data logging.

These studies might target low/no cost measures or capital measures that are straightforward and easy to implement. These reports are typically concise and easy to understand. They are ideal for customers who are smaller, have opportunities that could be implemented quickly, or are already efficient and could benefit from operations and maintenance measures.

Regardless of which approach is taken, the customer receives an audit report that details the existing systems, a baseline of energy usage, and a list of energy conservation measures. The energy conservation measures include savings potential, estimated project cost, projected utility incentive, and the cost effectiveness. This audit process aligns well with the ISO 50000 series, including ISO 50002:2014 *Energy Audits*, which focuses on the energy audit itself. Customizing the datacenter process results in an audit report that is actionable and meets the customer's needs regardless of datacenter size or efficiency.

Motivating Implementation/Customer Support

The purpose of an audit report is not just to identify energy conservation measures. It is to motivate a customer to install those measures. The best way to motivate a risk-averse customer, like a datacenter, to take action is to provide all the support and information they need through the entire process. This support starts at the onset of the walkthrough, but really kicks off at audit delivery. The implementer should work with the utility client to deliver the report to the customer, taking time to discuss each measure and its costs and benefits with the customer. A good understanding of each measure and its potential pros and cons in a datacenter environment is crucial.

The goal after the meeting is to move forward with measures that interest the customer, which is not always straightforward. Energy efficiency projects can be burdensome to datacenter customers and to contractors. For this reason, expertise working with a variety of customers, utilities, and contractors is critical. For each customer, there will be a unique relationship dynamic that must be addressed. The program team should be prepared to provide support to the customer when they work with: internal teams, external stake holders, contractors, and the utility. At a minimum, be prepared to work with both the datacenter facility team and the datacenter IT team to set expectations, provide clarity on the project, and ease all risk-averse concerns. It is important that the implementation team also provides technical communication about the measures and the benefits, which often extend beyond energy efficiency to include: expanded capacity, increased reliability, and increased redundancy. It is important to engage the customer when selecting a specific system design. A customer is more likely to implement a project if they are involved in the process. That is why it is important to work with customers to investigate alternative energy efficiency projects that are of interest. This might involve completing custom calculations for a specific model of equipment that interests the customer or modifying the proposed solution to better meet the customer's special needs.

When a customer decides to move forward, the implementer can also help the customer install the projects. This might include eliciting quotes or putting them in touch with vendors they prefer. It is especially important to stay flexible throughout the implementation process. Oftentimes customers may be more open to implementing measures as part of a phased approach. A phased implementation approach allows the customer flexibility so that the energy projects can better align with budget and time constraints. Customers may or may not be equipped with internal project management staff. So, it can be helpful to provide project management services as needed throughout the installation. Project management services might include:

- Eliciting quotes and working with vendors
- Reviewing construction plans
- Coordinating with contractors, architects, internal/external stake holders
- Assisting with compliance with local ordinances and building codes
- Providing technical support to ensure construction occurs per design
- Performing post installation commissioning
- Ensuring that proper training on equipment is provided by installer

This is a typical process, but by no means an exhaustive list of project management services. Each project will be different and require a slightly modified approach. For example, at one project, CLEAResult even helped orchestrate the sale of existing UPS equipment to a nearby datacenter. This improved the payback associated with the project while also finding a home for an unneeded UPS.

On-site technical support throughout the implementation process ensures that measures are installed to meet design specifications, optimizing the energy savings. A firm like CLEAResult's ongoing involvement with the customer ensures both customer and utility satisfaction. In the past, CLEAResult encountered a situation where a customer decided to move forward with the proposed energy conservation measure, but did not want to utilize continuous implementation support throughout the construction process. Instead, they wanted to work directly with a contractor to install the project. In this project, the measure resulted in significantly less energy savings. The contractor specified equipment that had a lower first cost but did not meet the design intent. Due to this oversight, a cooling tower was specified that allowed for significantly fewer free cooling hours for the customer. This contractor's first priority was completing the project within budgets, not reducing long term energy savings. Since this event, CLEAResult strives hard to explain the benefits of implementer involvement in the construction process.

This hands-on approach to customer engagement and project implementation results in customers who are empowered to reduce energy use at their datacenter. These customers will experience energy savings and, in applicable territories, receive incentive checks, increasing satisfaction with the utility.

Measurement and Verification Process

When a customer decides to move forward with a measure, it is important to work with them and the utility to measure the actual amount of energy savings. This is crucial for a successfully implemented program. However, determining actual energy savings can be difficult in a datacenter. A datacenter can be a dynamic environment with energy consumption that varies based on IT load, outdoor air temperature, as well as other factors specific to the customer. The implementer should coordinate with the customer and the utility to determine the best way to measure and verify the project energy savings while complying with the International Performance Measurement and Verification Protocol (IPMVP). This approach will vary based on customer site, project scope, project size, and specific utility requirements. The implementer should customize the measurement and verification process and verify energy saving for each implemented project.

Working with Trade Allies

Vendors and contractors are one of the keys to a successful datacenter utility program. When vendors and contractors realize a utility energy efficiency program as an opportunity to expand their business, they can be among the most important champions. For example, trade allies can help to identify customers who are interested in making a change in their datacenter. Or, they might know of a customer who has recently undergone a major virtualization effort — that means that this customer likely has too much cooling equipment and an opportunity for HVAC related energy savings. However, when a utility program is in its infancy, the implementer may run into a variety of issues with contractors. Examples include:

- They perceive the program as burdensome
- They are not accustomed to selling projects that emphasize energy efficiency
- Energy efficiency is seen as a barrier to their main business, selling and installing new equipment
- They are protective of their customer lists and unwilling to communicate with their customers about the benefits of the utility program

It is important to work directly, one on one, with trade allies in the beginning. During the meeting, a variety of topics can be discussed. The first step is reviewing the utility program and incentives available for customers. The next step is listening. The trade ally discusses a typical project that he would undergo with an energy savings component. At that point, the conversation shifts to a description of potential incentives associated with that project. Finally, it is important to close by highlighting the benefits the utility program. This might include:

- Potential for inclusion on a short list of program approved contractors/trade allies that will be available to prospective customers
- Opportunities for incentives paid directly to contractor
- Possibility of reengaging stalled projects in the contractor's backlog
- Opportunities for the implementer to identify new business for the trade ally through energy conservation projects

The final step to ensuring contractor engagement is keeping the utility process as simple as possible. In order to do this, the implementer must shift the program burden from trade allies to internal teams as much as possible. This encourages them to contact the program as they find other customers with energy saving opportunities.

Working directly with trade allies and vendors also presents potential problems for the implementer. On one hand, it is important to develop relationships with all local trade allies (contractors and vendors) in order to expand the reach of the program. However, it is also crucial to stay vendor neutral in the interest of the customer and the utility program.

Through the process outlined above, it is important to use communication and organization to encourage trade allies to see utility datacenter programs as potential business opportunities and treat the implementers as a part of their team. This results in more energy saving projects.

Case Study

The following case study includes the evaluation and upgrade of an enterprise class datacenter located in Puget Sound Energy (PSE) service territory. An enterprise datacenter rents space and IT equipment for multiple users. This datacenter was identified as part of the PSE datacenter energy efficiency program. CLEAResult performed the initial audit in 2012. That audit resulted in a two phase energy efficiency upgrade. Phase I has been completed, and Phase II is currently ongoing.

Observed Conditions

This customer operates a large datacenter with a total IT load of more than 1.5 MW. The facility is primarily datacenter space with a small portion of office space. The datacenter includes one big room that houses IT servers and switches, one mechanical room that houses chillers and pumps, and another room that houses uninterruptable power supplies (UPSs). In the datacenter spaces, servers are configured into “hot” and “cold” aisles, while there is little containment.

In the datacenter cool air is supplied to the servers by more than 12 large air handling units (AHUs) which distribute air through over 100 variable air volume (VAV) boxes. All AHUs are equipped with variable frequency drives (VFDs). During the site visit only 70% of AHUs were operating at 80% speed and the system was designed to maintain a static pressure of over one inches of water. Each AHU was equipped with a 35 kW electrical steam humidifier. During the site visit, it was noted that the AHUs were bringing in a large amount of outside air all year long, since the AHU outdoor air damper was set to a minimum position of 15%. The initial design proposed the use of the AHUs as air side economizers in the cool months. Due to the low moisture content of the air when outdoor air temperatures are low, the humidifiers are required to operate during most of the economizing season. These electrical humidifiers are not energy efficient. In fact, the total humidifier demand could exceed the cooling demand of the chiller plant. Therefore, it was actually less efficient to operate the air side economizer than it was to use mechanical cooling during very cold days. Air is distributed throughout the datacenter through an overhead supply and return plenum. Due to the close proximity of the supply and return grilles, the cold air was not effectively reaching the servers. Instead, some cool air was being “short circuited” directly back to the return grille.

Chilled water was delivered to the AHUs through a central chilled water plant. There are a series of cooling coils that distribute the chilled water throughout the AHUs. However, it was noted onsite that the cooling coils were piped backwards during the initial installation. That backward piping reduces the cooling coil efficiency substantially. There were a total of three water cooled chillers with variable frequency drives (VFDs). The chilled water loop is a constant primary and variable secondary loop. For each chiller, there is a dedicated constant primary chilled water pump and a variable secondary chilled water pump. Heat was rejected through three open loop cooling towers, which were equipped with variable speed fan and three VFD condenser water pumps. During the site visit the chilled water setpoint was 48°F and the condenser water minimum setpoint was 81°F.

As noted above, the total IT load is distributed through a total of 4 UPSs, each of which has 4 internal modules. The UPSs provide 2N redundancy to protect IT loads. The total capacity of the 4 UPSs is 10 MW and the average operating efficiency is 81%. The IT load was distributed evenly among all of the UPS modules. The UPSs are located in a dedicated room that is cooled through three direct expansion (DX) computer room air conditioning units (CRACs) that reject heat through air-cooled condensers on the roof.

<u>Proposed Upgrades</u>

The following section discusses the measures that were proposed and implemented at this enterprise datacenter. Phase I of implementation has been completed, and Phase II of implementation is scheduled for 2015.

Phase I Implementation

Phase I of implementation included a multifaceted approach to reduce mechanical cooling, fan, and humidification loads. The end result was a system that reduced energy usage by more than 6 million kWh per year after a comprehensive M&V analysis.

The following table provides a summary of the actions taken during the first phase of project implementation for this enterprise level datacenter. Following the table, detailed descriptions of the installed measures can be found.

Table 1. Description of Implemented Measures – Phase I

Stage	Existing Conditions	Implemented Conditions
1	70% of the AHU fans are operating; 30% are not operating	All AHU fans are operating in order to increase effective cooling coil size; speed is controlled based on Stage 3
1	AHU chilled water coils are piped backwards	AHU chilled water coils are piped correctly
1	Chilled water temperature is 48°F	Chilled water temperature is 51°F
1	Minimum condenser water temperature is 81°F	Minimum condenser water temperature is 68°F
2	Minimum outdoor air damper position is 15%	Demand control ventilation is added, significantly reducing humidification load
2	Outdoor air economizer provides “free” cooling, but huge humidification load	Outdoor air economizer is disabled, significantly reducing humidification load
3	70% of the AHU fans are running at 80% speed; 30% are not operating. Fan speed is based on static pressure setpoint of 1.25” of water	All of the AHU fans are operating at reduced fan speed; fans are controlled based on VAV box positions. Static pressure is reduced to 0.5’’ of water.
4	No waterside economization	Heat exchanger with a 2°F approach is added to existing cooling tower to provide free cooling whenever 49°F leaving water can be generated

The first stage of the Phase 1 energy efficient upgrade included system modifications that allowed for more efficient operation of the existing chiller when in mechanical cooling mode. As noted above, the chilled water temperature at the time of the initial audit was 48°F. As part of this initiative, the original chilled water coils, which were piped in a parallel flow arrangement, were changed to a more efficient counter-flow configuration. This improved the cooling coil heat transfer efficiency and AHU cooling capacities. In addition, because all AHUs were equipped with VFDs and only 70% of AHUs were used in the baseline, the implementer recommended operating all AHUs to take advantage of more cooling coils and operate them in lower speed to reduce total fan energy use. By re-piping the cooling coils and operating more AHUs, the customer was able to increase the chilled water temperature from 48°F to 51°F without changing the supply air temperature. Furthermore, the minimum condenser water temperature was reduced from 81°F to 68°F. The original condenser water setpoint of 81°F was based on an extremely conservative design. The existing VFD chillers are new and equipped to operate at a much lower condenser water temperature of 68°F. Since chiller efficiency varies greatly depending on their lift, increasing the chilled water temperature and decreasing the condenser water temperature resulted in a significantly more efficient chilled water system.

The second stage of the Phase 1 upgrade included upgrades that reduce the total humidification and cooling loads in the datacenter. As noted in the prior sections, the existing system maintained a minimum outdoor air damper position of approximately 15%, regardless of the outdoor air conditions. In the summer, that causes an unneeded cooling load. In the winter, this system typically utilized air side economization to provide "free" cooling. However, due to the low moisture content of the air, the humidifiers were forced to run when the "free" cooling was enabled. These existing humidifiers were very inefficient; in fact, they may have had a higher demand than the entire chiller plant. The implementer recommended disabling the air side economizer and adding demand control ventilation to maintain adequate indoor air quality. These measures allowed the customer to reduce the amount of outdoor air being brought into the space. This reduced the cooling load during the summer, when outdoor air temperatures are above the supply air temperature, and it reduced the humidification load in the cold winter, when outdoor air absolute moisture content is less than the datacenter humidity setpoint.

The third stage of the Phase 1 upgrade included measures that reduced the AHU supply fan energy use. A high AHU static pressure setpoint was used in the baseline, and thus most VAV boxes were throttled significantly to provide proper cool air to the datacenter. AHU supply fans wasted significant energy to generate unnecessarily high pressure airflow. The implementer recommended reducing the static pressure setpoint and taking advantage of existing supply fan VFDs by monitoring all VAV box positions.

The final stage of the Phase 1 upgrade included modifications that allowed for free cooling through the existing cooling towers for 60% of the year. As part of this measure the implementer recommended the installation of new heat exchangers so that the cool water coming from the existing cooling towers could be used directly to generate chilled water for the AHUs. As noted above, the chilled water temperature was raised to 51°F as part of the first portion of this measure. The higher the chilled water temperature, the more free cooling hours available through the cooling towers. The water-side economizing system included a heat exchanger with a 2°F approach. That means that when the cooling tower is able to generate 49°F leaving water, the cooling system can provide 51°F water to the AHUs without any mechanical cooling.

Due to the large energy savings potential, after the Phase I had been completed, two IPMVP approaches (Option C and Option B) were conducted to verify the actual energy savings. This Phase I has resulted in over 6 million kWh/year or $450,000 of energy savings. The PSE program paid incentives to cover 70% of the total project cost. The total project has a simple payback of less than 1 year after utility incentives.

Phase II Plan

Phase II of implementation is currently underway and includes an approach to reduce mechanical cooling load in the UPS room and UPS losses. The following table provides a summary of the actions taken during the second phase of project implementation. Following the table, detailed descriptions of the installed measures can be found.

Table 2. Description of Measures Being Implemented – Phase II

Stage	Existing Conditions (Post-Phase I)	Conditions Being Implemented
1	Servers are oriented into hot and cold aisles but no containment is installed. Cold air is being “short circuited” from the supply to return grill without reaching the servers	Servers are contained with plastic curtains and blanking panels. Supply and return air paths are isolated using hot-aisle containment
1	Supply chilled water temperature is 51°F	Supply chilled water temperature is 58°F
1	Free cooling occurs below about 40°F (wet-bulb)	Free cooling occurs below about 47°F (wet-bulb)
2	(3) DX CRAC units provide mechanical cooling to the UPS room all the time	New chilled water AHUs provide cooling to UPS room. Free cooling from central plant can be used
3	4 UPSs with 4 modules each, providing 2N redundancy with abundant capacity	1 module is disabled in each UPS. 4 UPSs with 3 modules each, providing 2N redundancy and sufficient capacity
3	Existing UPS efficiency is 80%, generating significant heat in the UPS room	UPS efficiency increases to 85%, generating much less heat
4	Existing cooling towers have sump heaters that turn on whenever outside dry bulb temperature is less than 74°F	Cooling towers sump heaters turn on whenever outside dry bulb temperature is less than 40°F
4	Chilled water pipes are insulated, but more than 10 lines of heat tape are energized all the time because of a broker controller.	All heat tape is disabled

First, as part of the Phase 2 upgrade, the implementer recommends airflow modifications that will further allow increasing the chilled water temperature, thereby increasing chiller efficiency and free cooling hours available. As part of this step, the implementer proposes airflow modifications including full hot aisle containment. Containment is an excellent approach to managing airflow in a datacenter to prevent the mixing of hot and cold air. It is best to direct cool air where it is needed, the front of the servers, rather than allowing it to mix with the hot return air. Through isolation, hot aisle containment allows the facility to increase the hot aisle temperature up to 90°F while still maintaining server inlet temperatures of less than 70°F. This is well within the ASHRAE TC 9.9 recommendations for critical facility operating conditions. Increasing the supply and return air temperatures allows the datacenter to increase the supply water temperature, which has two main benefits. First, in mechanical cooling mode, an increased supply water temperature reduces the lift of the chiller, thereby increasing chiller cooling efficiency. Second, an increased chilled water temperature allows for additional hours of economization. So, adding containment will allow the facility to operate the chiller plant for fewer hours per year, while also ensuring that when the chiller is in mechanical cooling mode, it is as efficient as possible.

Second, the implementer proposes modifications to the UPS room cooling. There are four UPSs in the room, and they generate a large amount of heat constantly because of relatively low UPS efficiencies. Three 30-ton DX CRAC units operate all the time to keep the UPS room cool. 100% mechanical cooling is used consistently. Since a water-side economizer is available from the central plant, the implementer proposes replacing the existing DX CRAC units with two chilled water air handling units on the roof to cool the UPS room.

Third, the implementer recommends modifications to the existing UPS operation to reduce both its cooling load and internal UPS losses while still maintaining 2N redundancy. There are a total of 4 UPSs, each of which has 4 modules. Each UPS has a capacity of 2.5 MW, for a total capacity of 10 MW. Currently the UPSs are operating at 80% efficiency. The implementer recommends disabling one module in each of the four UPSs. This will reduce the total available UPS capacity to 7.5 MW, which is still within the requirements for 2N redundancy. This will improve the UPS load factor and operating efficiency which will result in a lower UPS loss. By reducing the UPS loss, this customer will also reduce the heat generated in the UPS room, resulting in HVAC energy savings.

Finally, the implementer identified some operations and maintenance (O&M) measures to further reduce energy consumptions in the datacenter. There are three cooling towers on the roof. Two of them have sump heaters for freeze protection. Each cooling tower has two sump heaters, which can draw 36 kW at a full load. Those heaters turn on whenever the outside dry bulb temperature is 74°F or below. Significant energy is wasted for unnecessary heating when the ambient air is well above freezing. The implementer recommends lowering the sump heater set point to 40°F. There are almost 7,300 hours per year between 40°F and 74°F at this location, and thus a significant amount of energy can be saved by reducing the temperature setpoint for the sump heaters. The other O&M opportunity pertains to heat tape. There are more than 10 lines of heat tape on chilled water pipes on the roof, and only one controller dictates the operation of the heat tape. The controller is broken, therefore all heat tape draws electricity 24/7, generating waste heat. This heat is transferred to the chilled water loop resulting in unnecessary cooling loads. The result is simultaneous heating and cooling. The chilled water pipes are well insulated. Additionally, these pipes transport water that is warmer than 50°F continuously. There is no need for heat tape at all, and thus the implementer recommends disabling all heat tape.

Significant energy savings are projected in Phase II. An IPMVP option B approach will be conducted to verify the actual energy savings after Phase II is completed. The projected savings is 3 million kWh/year or $220,000 of energy savings. The PSE datacenter program will pay incentives based on final actual energy savings and actual project cost. The projected simple payback of Phase II is less than 3 year after utility incentives.

Conclusion

Datacenters present a huge opportunity for energy savings. However, it is difficult for utilities and implementers to successfully engage these customers in energy efficiency programs. This challenge is a product of the datacenter market itself; datacenter customers operate complex and unique systems and are a highly risk averse clientele. This paper sheds light on a turn-key solution for utilities' datacenter program design and implementation. Several factors can lead to a successful datacenter program for implementers such as CLEAResult. First, a dedicated team of energy efficiency experts is important to streamline all the process and build trust with the customers. Second, building a network of trade allies can help program outreach. Third, continuous onsite implementation support from implementers can increase customer and utility satisfaction and ensure measures are installed to meet or even exceed design specifications. Finally, implementer flexibility is the key so that the energy projects can better align with customer budget and time constraints; often a phased approach can help push more large-scale measures forward. An enterprise datacenter project in the PSE datacenter program was used to demonstrate the engineering process and the phased approach.

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