TARGET "EXPECTS MORE AND PAYS LESS" FOR ITS DATA CENTERS

TARGET'S COMMITMENT TO ENERGY EFFICIENCY

Target's data centers are a critical part of the company's business and infrastructure. As with many mission-critical data centers, improving their energy efficiency is not always the highest priority. Ted Hight, Target's lead engineering consultant, said Target's early efficiency efforts included "basic blocking and tackling, which involved creating hot and cold aisles, blanking plates in racks, and blocking holes in tiles under the racks."

As a part of its commitment to sustainability, Target set a goal of increasing its percentage of ENERGY STAR-certified buildings from nine percent in 2009 to 75 percent in 2016.[1] To help meet its environmental goals and improve data center operations, Target's Technology Center Engineering Team conducted a series of cost-effective energy-efficiency upgrades on two 45,000-square-foot[2] data centers in Minnesota: Target's Brooklyn Park facility, which was built in 2001, and its Elk River facility, which was built in 2007.

Scott Hovet, data center engineer, described the shift in attitude: "Our team developed a passion for managing our cooling technologies as mission-critical delivery, not settling for simple cooling of our IT infrastructure. Therefore, energy efficiency became a byproduct of precise technology management, which led us to perform an efficiency audit on the entire data center." **As a result of the efficiency upgrades, Target was the first company to have two data centers earn the ENERGY STAR building certification.**

> *"At Target, we always are looking for ways to improve our operations. With this project, the goal was to improve reliability through advanced management. The byproduct of improving our cooling management was improved energy efficiency. Once we saw the associated energy efficiencies, we conducted an assessment of the entire data center, with the highest priority requirement of the project being maintaining our level of power and cooling reliability."*
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> - Paul Peoples, senior group manager of Infrastructure, Target

DATA CENTER EFFICIENCY MEASURES

The Brooklyn Park and Elk River data centers house 3.4 MW of IT load, which powers more than 6,900 computing devices and can support up to 9.7 total MW of IT load. Cooling for the data centers is provided by 12 650- to 675-ton chillers that feed 102 computer room air handlers (CRAHs), ranging in size from 20 to 30 tons. Target's efficiency audit determined which retrofits provided the best return on investment. With the assistance of its trade allies, a mechanical engineering firm, and incentives from Xcel Energy, Target took the following actions:

- **Installed variable frequency drives (VFDs) on CRAHs, air handling units (AHUs), and exhaust fans.**
  - VFDs allow fans to run at lower speeds by controlling the frequency of the electrical power supplied to the fan motor. Fan power consumption is proportional to the cube of fan speed, so a decrease in fan speed can lead to extraordinary reductions in fan energy use.
  - Before VFD installation, exhaust fans and AHUs were redundant and rotated on a weekly basis. After VFD installation, both technologies were run at reduced fans speeds, leading to significantly lower energy use. Fan speed was reduced by as much as 78 percent in some instances, resulting in a 99 percent reduction in power use. CRAH and AHU motor sizes ranged from 7.5, 10, and 15 horsepower (HP). Exhaust fans (used in battery rooms, chiller rooms, etc.) were 1.5 HP.

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[1] *Learn more about Target's sustainability commitment: http://hereforgood.target.com/learn-more/goals-and-progress*

[2] *The data center has 45,000 square feet of white space. Other areas of the buildings are devoted to electrical/mechanical plant, storage and office space.*

- **Reduced temperatures on generator heaters.**
  - Standby generators are typically specified with jacket and oil warmers that use electricity to maintain the system in standby mode at all times. The manufacturer indicated that the temperature of the generator heaters could be lowered because each was located within conditioned space.
  - Target reduced temperatures from 140 to 110 degrees Fahrenheit, resulting in a 4 kW decrease in the power consumption at each of these 16 heaters.
- **Installed timers and efficient lighting.**
  - Timers were installed to turn lights on at 6:00 a.m. and off at 4:30 p.m.
  - Inefficient lighting was replaced with efficient lighting throughout the building (e.g., conversion of T-12s to T-8s, high-beam metal halides to high-output T-8s).
- **Turned off unloaded transformers.**
  - Two unloaded, 300 kilo volt-ampere (kVA) power distribution units (PDUs) were taken offline at the Elk River data facility, where the computing load was not yet completely built out.

For a variety of reasons, several evaluated measures were not implemented:

- Energy-efficiency improvement options for water side economizers were found to have a high simple payback of 8.5 years and would have required costly retrofitting of chiller equipment.
- Temperature and humidity adjustments were deemed unnecessary because supply temperatures to equipment had already been adjusted to 74-75 degrees Fahrenheit in previous upgrades. Also, humidity sensors had already been switched from relative humidity (which varies with temperature) to dew point (which does not) to minimize unnecessary humidification.

RESULTS

As shown in Table 1, Target's data center retrofits led to more than 5.8 million kWh annually and, on average, paid back in 1.4 years, including utility rebates.[3] The installation of VFDs accounted for 79 percent of the savings realized by the efficiency upgrades. The annual carbon emission reduction achieved through these efforts is the equivalent of taking 800 cars off the road. It is important to note that powering down the unloaded transformers and reducing the temperature of generator jacket heaters incurred virtually no cost for installed equipment and labor.

Table 1: Payback for Measures Installed

Measure Description	Measure Quantity	Annual Savings (kWh)	Payback (Years)
Installed VFDs on AHUs, CRAHs and exhaust fans; rebalanced instead of rotated	117	4,578,469	1.7
Reduced temperatures on generator heaters	16	630,720	0.0
Installed timers and efficient lighting	N/A	349,813	0.8
Powered down unloaded transformer	2	261,875	0.0
Total Annual Savings/Average Payback		**5,820,877**	**1.4**

These measures led to 25 percent overall power savings on the mechanical loads. The ENERGY STAR rating system scored the Brooklyn Park data center with a 91 in 2012. This means the data center was more efficient than 91 percent of the data centers in the United States. The Elk River data center received the same upgrades but was not completely built out at the time of the scoring. It received a 77 in 2012.

LESSONS LEARNED

- **Top-down commitment is needed.** A key to this effort's success was that Target's leadership was open to new ideas and concepts. Senior executives understood that data center energy-efficiency improvements aligned with Target's sustainability and energy-saving goals and, therefore, encouraged integration of these initiatives and options throughout Target's business model (e.g. Target's goal of having 75 percent of its buildings ENERGY STAR qualified by 2016).
- **Data center efficiency does not necessitate large expenditures on new equipment.** Target was able to realize significant savings by retiring two unloaded transformers and lowering the jacket heater temperature settings on generators. These two efforts did not require any up-front costs.
- **With a redundant system, VFD savings can be huge.** Target was able to take advantage of the savings potential of VFDs due to its redundant systems. In the past, single-speed, redundant exhaust fans and AHUs were rotated on a weekly basis. By using the two redundant, variable-speed fans simultaneously—at significantly lower speeds—to accomplish the same job, enormous savings were realized.

[3] *Also, since this analysis was completed, Target has installed chimneys on the cooling units, and all new CRAHs installed will be controlled by supply-side air monitoring.*