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CASE STUDY

Government

Facility at a glance

Name
Northwest Service Center

Location
Dallas, TX USA

Facility size
93,000 ft² multi-use facility

Issue
Design a new fleet services facility that meets city-mandated "green" requirements

Solution
Balance seasonal heating and cooling loads with Daikin Vision® air handling units and AGZ air-cooled scroll compressor chiller

Northwest Service Center, Dallas, anticipates LEED® Gold using energy recovery wheels and VAV control

Daikin Vision air handlers provide 100% outside air exchange

In Dallas, all roads lead to green. The city's fleet of over 1,200 service vehicles is the largest in the nation to run primarily on compressed natural gas (CNG) as part of an effort to make the city a greener place to live and work. In addition, the new maintenance and operations facility that services the fleet—the Northwest Service Center—is designed to meet city-mandated "green" requirements. Those requirements challenged the facility's designers to develop an HVAC system that provides safe and adequate ventilation for a vehicle maintenance and operation facility while also meeting LEED Silver guidelines established largely for office buildings.

The answer lay in a careful balance of seasonal heating and cooling loads, and in a ventilation system designed around Daikin Vision air handling units, energy recovery wheels and variable air volume (VAV) control. The project was so successful that the Northwest Service Center is anticipating not Silver, but Gold certification for its green efforts., utilizing the LEED v2.1 NC and Campus Setting requirements.

Industrial-strength challenge

In 2003 the Dallas City Council mandated that all new facilities owned and operated by the city achieve LEED Silver certification as a fundamental program requirement. One of the biggest challenges for the Northwest Service Center project was to design an energy-efficient industrial complex using LEED guidelines modeled on commercial office building energy consumption. Located on a 17-acre brownfield redevelopment site, the Center provides space for city building services, vehicle maintenance, and the sanitation and streets divisions. While it includes 16,000 ft² of office space for the streets and sanitation departments, the site is primarily industrial space: 42,000 ft² for fleet vehicle maintenance; 10,000 ft² for vehicle fueling and washing; and 25,000 ft² for covered storage.

LEED-NC (New Construction) certification is structured on gains in energy cost savings compared to a typical office building as defined by ASHRAE 90.1 standards (see sidebar on page 4: Green Design and LEED). At present, LEED certification programs do not take into consideration the unique requirements of industrial applications. For example, while air conditioning is the largest energy consumer in a typical commercial office building, the Northwest Service Center has a relatively small cooling requirement: only the 16,000 square foot offices are cooled.

"Industrial buildings typically don't have a huge air conditioning load like an office building, so it's harder to figure out ways to get efficiencies when you don't have those big loads to drop down from," said Charlie Aldredge, vice president and project manager, Huitt-Zollars Engineering, Inc., Fort Worth, and a member of the Northwest Service Center project design team. In the Center, the largest source of energy consumption would come from a requirement for 100 percent outdoor makeup air exchangers in the vehicle service area to ensure adequate and safe air exchange for occupants. That is where the engineers would have to gain the efficiencies they needed to meet the LEED requirement. And since the area is not air conditioned, they would need to gain those efficiencies from winter heating loads rather than summer cooling.

Since the vehicle service center is not air conditioned, efficiency gains to meet LEED requirements are achieved by reducing winter heating loads rather than summer cooling loads.

Energy recovery wheels save energy in the service center

To meet the 100 percent outdoor air exchange requirement in the vehicle service area, three large Daikin Vision air handling units were installed. These can pull in outside air at a total exchange rate of approximately 40,000 cfm (two units at 15,000 cfm and one unit at 10,000 cfm). In comparison, a typical office building pulls in 10 to 20 percent outside air. Additional safety measures in the building include a gas detection system and emergency exhaust systems.

To achieve the required energy efficiencies in the service area, Sergey Aleksanyan, PE at Huitt-Zollars, the mechanical engineer of record, specified energy recovery wheels for each Vision unit. These capture energy from the heated exhaust air stream and transfer it to the cool outside air being pulled into the space (see sidebar on page 3: How Do Energy Recovery Wheels Work?). Up to 75 percent of the energy from the exhaust air stream can be recovered.

"Our solution for meeting the energy requirement was to gain winter efficiencies to offset the lack of a cooling load," said Aleksanyan. "The exhaust air energy is used for preheating the makeup air. The rotary wheels recover energy from the exhaust air and return it to the supply air." In addition to achieving LEED points for energy efficiency, this solution will earn the Center an additional LEED point for innovation because energy recovery wheels are not considered standard design.

VAV and high-efficiency chiller save energy in offices

To achieve additional efficiencies, the office area is conditioned by two Daikin Vision air handling units with variable air volume (VAV) controls, energy recovery wheels and hot water heating. The VAV controls provide energy efficiency by matching airflow volume to load requirements: the motor runs at a lower amp draw under part load, thereby using energy only as needed to meet conditions. The energy recovery wheels lower heating and cooling costs by pre-treating the outside air using building exhaust air. A high-efficiency Daikin Model AGZ air-cooled, scroll compressor chiller (130 tons) provides chilled water for cooling. The fact that the chiller operates using an HCFC-free refrigerant (R 407C) gained the project an additional LEED point.

According to Rachael Green, LEED director for Mitchell Enterprises LD, the build project's general contractor, "Energy model data shows that energy costs for the total project will be 67 percent of those for a typical LEED-NC building. That's a 33 percent savings, and enough to get four LEED points for optimizing energy. The Daikin high efficiency chiller, VAV control, and innovative energy wheels—along with other factors such as high-efficiency boilers, domestic hot water demand reduction, good insulation and windows, and lighting efficiencies—all contributed to the total energy savings." That puts the Northwest Service Center on track to exceed the Silver requirement with an expected 44 LEED points—enough to achieve LEED Gold certification later this year.

One of three large Daikin Vision air handling units installed for the vehicle service are

"Silver, I thought, would be very tough to get when we first started because of the largely industrial nature of these buildings," said Bobby Williams, chief estimator for RMF Contractors who installed the air conditioning and plumbing systems. "If we get a LEED Gold rating, then you know everyone has done exceptional work."

"From roof color to glass selection—it's not just equipment—it all has to work in harmony to get the maximum energy reduction," said Williams. "We could put the most efficient equipment in the world in the building, but if they put a black roof on a building in Texas, or use uninsulated glass or inefficient light fixtures, you're not going to see the benefit of that efficient equipment."

Charlie Aldredge credits a design-build contract structure for producing a building with systems working in harmony, as well as for creating a cross-discipline team making decisions together.

"Getting these guys in the same room to talk and work through things was very helpful," said Aldredge. "I don't think that we would have succeeded with LEED, and I don't think the schedule would have been anything like it turned out to be, if we had not been able to have those open conversations. You can get costs down with a plan-and-specification process, but you'll sacrifice the schedule because of the paper trail going back and forth from the subcontractor to his general contractor to the design team professionals, and so on."

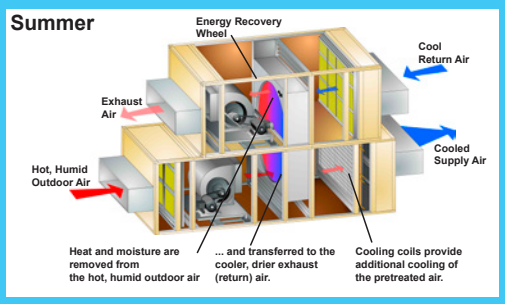
How Do Energy Recovery Wheels Work?

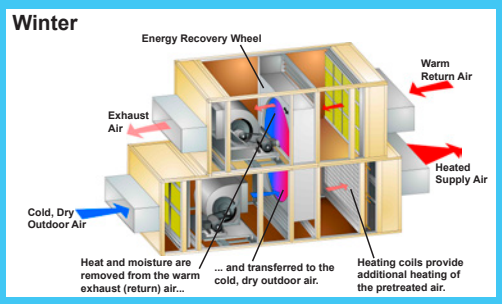
Energy recovery wheels reduce energy costs by transferring heat and moisture from one air stream to another. In the winter, they capture heat and humidity in the exhaust air stream and transfer it to the incoming fresh air. This saves much of the cost of heating and humidifying the incoming cold, dry air. Energy recovery wheels can recover 75 percent of the energy from an exhaust air stream and can cut winter humidification energy costs by up to 60 percent.

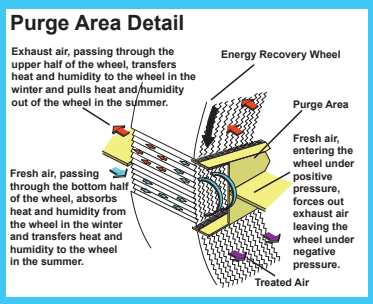
In the summer, energy recovery wheels work in reverse: they capture heat and humidity in the incoming fresh air stream and transfer it to the exhaust air stream. This saves much of the cost of cooling and dehumidifying the incoming air stream. Energy recovery wheels can cool outdoor air down to about 67 degrees F, significantly reducing the load on conventional cooling equipment.

Heat and moisture are captured in the energy wheel's corrugated desiccant material. The wheel rotates between the incoming and exhaust air streams where variances in pressure and temperature cause heat and moisture to move from one air stream to the other. Only heat and moisture transfer through the energy recovery wheel. Air is purged from the wheel before entering the other air stream.

For example, the Vision air handlers in the Northwest Service Center vehicle maintenance area exhaust 100% of the air in the facility. In the winter, their energy recovery wheels capture heat in the exhaust air stream before it leaves the building and transfer it to the incoming air stream. Contaminants carried in the air stream are exhausted outside.







LEED challenges and benefits

Other LEED accomplishments on this project include a 68 percent wastewater generation reduction, 56 percent recycled content in materials, 99% construction and demolition materials recycled, and over 90 percent locally-produced materials. Indoor air quality requirements were achieved through installation of indoor air quality monitoring systems and control of indoor chemical and pollutant sources, including low VOC materials such as mastics, insulation, sealants, glues, carpets, and millwork.

"Designing the facility to LEED requirements was a tough challenge," said Jack Ireland, director, Equipment and Building Services, City of Dallas, commenting on the rigorous process changes required to meet LEED certification. "But in the long run the city will see the savings in energy consumption, in water consumption, and hopefully in less employee illness and absenteeism from better indoor air quality—not only for the shop workers, but for the office workers as well."

And that extra effort helps city officials achieve their overall goal of turning Dallas into a city of green.

Green Design and LEED: Creating Synergies

The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary standard, established by the U.S. Green Building Council in 1999, and widely recognized as a third-party verification system and guideline for measuring what constitutes a green building. LEED describes its goal as helping professionals across the country to improve the quality of buildings and their impact on the environment.

A LEED-certified building means it has achieved at least a minimum standard as judged in six categories: sustainable sites; water efficiency; energy and atmosphere; materials and resources; indoor environmental quality; and innovation and design process. Points are awarded in each category, depending on how the facility meets each category's requirements. A building must receive a minimum of 26 points for LEED certification; up to 69 points are possible. There are four levels of LEED certification: Certified (26-32 points); Silver (33-38 points); Gold (39-51 points); and Platinum (52-69 points).

Synergy is the key to accumulating the most points: understanding how each system affects the others and where to get the most tradeoff between credits. For example, decreasing the indoor lighting required in a space (by adding more natural daylight) helps reduce the size and operating cost of the air-conditioning system required. Less lighting means less heat gain, which means less energy is required to cool the space.

The Energy and Atmosphere category—one third of potential LEED points—directly addresses the HVAC system and its impact on the environment. This includes the amount of energy the HVAC system consumes, the environmental impact of generating that energy, and the ozone depletion potential of the refrigerant used in the equipment.

Once a building has met three prerequisites (for fundamental building systems commissioning, minimum energy performance and fundamental refrigerant management), LEED-New Construction provides up to 10 points for the percentage of energy performance increase beyond the minimum required in the prerequisite, as shown in the table.

Energy Reduction	Points
15%	1
20%	2
25%	3
30%	4
35%	5
40%	6
45%	7
50%	8
55%	9
60%	10