

Technology

DPS Campus One of First Net Zero K-12 Schools in the U.S.

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In August of 2010, Denver Public Schools celebrated the opening of the Evie Garrett Dennis Campus in the Green Valley Ranch neighborhood of far northeast Denver. While visitors and dignitaries celebrated the green features of the four building, 180,000-square-foot campus, what most people did not realize was that the school was one of the first K-12 schools in the nation to target net zero energy use as a goal.



Installation of the geothermal system. Piping buried beneath the earth exchanges heat between the earth and building to provide year-round heating and cooling. *Photo - M.E. GROUP*

The foundation for the net zero goal was outlined in an eco-charrette, held at the offices of project developer Oakwood Homes. Comprising the entire design-build team as well as other interested parties from National Renewable Energy Laboratory and the Governor's Energy Office, the charrette laid the foundation for the approaches necessary to achieving net zero energy use.



The campus includes four distinct buildings comprising three academic buildings and a central Student Union. *Photo - Mike Rogers*

While many different definitions of net zero have been used in the industry, the team decided that achieving net zero meant producing as much energy on the site through renewable energy as it consumes over the course of the year. Since energy in the form of both electricity and gas would be used, the renewable energy source needed to offset both.

Knowing that funding of a renewable energy source could be challenging, the team focused on building a low-energy school that could accommodate the future

installation of a photovoltaic array with minimal disruption. This concept was referred to as "solar ready." However, while construction was under way, Denver Public Schools signed a power purchase agreement to install photovoltaic systems throughout the district. As a result, the Evie Garrett Dennis Campus installed a 288 kilowatt roof-mounted array in the fall of 2010. This array was estimated to be enough to make two of the buildings net zero. The remaining two buildings are constructed to achieve net zero in the future through a combination of roof-and-ground-mounted photovoltaic systems.

Working on a fast-paced design schedule that included producing all of the construction drawings using



Daylighting is used throughout the campus to promote a healthy learning environment as well as reduce lighting power.

building information modeling (BIM), the team quickly analyzed the energy use of different concepts with energy modeling software and ran daylighting analyses with advanced simulation models. These models were critical for making the quick decisions necessary to adhere to the project schedule. Acting as the general contractor and design-build leader, Saunders Construction provided the quick cost estimating necessary to determine the cost benefit of different sustainability strategies.

Ultimately, the project made use of a number of sustainable strategies to achieve low energy use. Special attention was paid to the construction of the walls to achieve an effective R-value of 22 to 25 in all areas, with low rates of infiltration from the use of closed cell spray foam insulation. Daylight harvesting was implemented in most of the building to reduce lighting power consumption.

Natural ventilation schemes were implemented to take advantage of the mild climate conditions often experienced during the spring and fall, but when mechanical heating and cooling is required, it is provided by a

geoexchange field and ground-source heat pumps. Energy recovery ventilators save energy as well, and provide fresh air to spaces based on carbon dioxide sensor levels.

As a result of these strategies, the energy use intensity of the campus was projected to be 28 kBtu/sf/yr. After the first year of operation, the campus has operated at 32 kBtu/sf/yr (not including the photovoltaic contribution).

It has been observed that during the last year the building has had greater hours of occupancy than originally modeled, particularly during the summer. Also, through the commissioning process, several items were addressed that were not operating as intended, and corrective measures to these items should bring the building more in alignment with the original models. Ultimately, this illustrates the importance of the commissioning process and ongoing verification of energy use.

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Project Team:
Developer: HC Development / Oakwood Homes
Contractor: Saunders Construction
Architect: DLR Group
MEP Engineer/Energy Modeling: M.E. GROUP/ design+green
Structural Engineer: Martin/Martin
Landscape: Vogel & Associates



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In 2011, the two buildings targeting net zero energy have been tracking in line with the production of the photovoltaic array. While achieving net zero requires a full year of energy use, and the photovoltaic system has not been operational a full year yet, the buildings appear to be tracking towards achieving this ambitious goal.

