Smart Energy Districts
Case Study

QDG ENGINEERING CONNECTIONS

A Smart Energy District is essentially just a new model for energy generation and delivery across multiple buildings, particularly in a campus-style environment. These districts use central energy plants – which deliver steam, condenser water and chilled water across multiple buildings – in conjunction with the latest distributed energy and digital technologies.

But that description doesn't really do them justice. Smart Energy Districts are driving energy and cost savings almost everyplace they're implemented. They can reduce operating costs, pay for themselves more quickly than traditional energy generation technologies, increase both energy reliability and energy efficiency, and reduce CO2 emissions by as much as 40%.

How a Smart Energy District Turned a Florida Town Green

Energy conservation and efficiency get more and more important with each passing day, from both an environmental and economic perspective. Smart Energy Districts are showing how a carefully planned combination of energy distribution and design sense can yield significant gains on both fronts.

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How can they do that? Using a central cooling plant makes it easier to balance loads across all buildings, which can lead to noticeable efficiency improvements all by itself. Most of these plants use centrifugal chillers, which are inherently more efficient to operate. Not only that, centralizing cooling plant operations will also contribute to noise reduction and centralization, as the noise involved in energy generation moves from individual building plants to the central chiller plant location.

By contrast, forcing each building on a campus to house its own HVAC equipment is more expensive both to set up initially and to maintain over the long term.

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The Historic Green Village at Anna Maria Island, FL

Planned from the beginning to be the first Net Zero Energy campus in the US, the Historic Green Village at Anna Maria uses Smart Energy District ideas and technology to generate more energy than it consumes, harvest rainwater and stormwater, and contribute to a cleaner future by encouraging a range of sustainable transportation choices. This commitment began at the design stage: All buildings in the Village are designed to meet LEED Platinum level certification requirements, the most stringent level of certification from the US Green Building Council (USGBC).

Reaching this Net Zero Energy goal required integrating several different technologies and approaches, including:

Solar Technology: The Historic Green Village has Solar PV panels on each building, with a single point of common coupling to the utility. This micro-grid allows extra electricity being generated at one building to flow to its neighbor. When more electricity is generated across the entire site than is being consumed by the campus, the extra electricity is exported to the utility to supply adjacent properties on the Island.

In addition to solar PV, the Village's Rosedale Café and residences have solar thermal panels that generate hot water. During the first full month of operation, the PV system generated 6,972 kWh of electricity.

Geothermal: At least half of a buildings' energy use is for heating and cooling. The Historic Green Village has a geothermal heating and cooling system that takes advantage of the relatively constant temperature of the earth to maintain indoor thermal comfort, by using geothermal heat pumps to extract heat from the earth during the winter and use the earth as a heat sink when cooling is required.

Energy Efficient Buildings: The most cost-effective means to creating a Net Zero Energy campus is to ensure that the buildings and equipment meet the highest energy efficiency standards. In a typical office, heating, cooling, and lighting comprise about 90% of the energy usage. In Florida's hot, humid climate, an energy-saving strategy seeks to maximize natural daylight while minimizing excessive solar heat gain.

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High Performance Envelope: The initial design focus for energy savings in the Village was creating a well-insulated building envelope: the roof, walls and windows. This envelope should simultaneously reject heat and let in natural light. Each building has an EPA Cool Roof, with insulation levels that exceed State code (R-30 vs. R-19 for the roof; and R-19 vs. R13 for the walls). Spectrally-selective windows, specifically developed for hot climates, actively reflect heat energy, resulting in a major reduction of the solar heat gain through the window without significant loss of visible light transmitted through the glass.

Lighting: Lighting generally accounts for 20% of energy use in commercial buildings. All lighting fixtures in the Historic Green Village use LED lamps, which use 80% less energy than the typical MR16 halogen lamp (the typical lighting choice for retail environments). In the Village's Rosedale Café, for example, lighting accounts for less than 4% of electricity consumed.

Minimization of Other Plug Loads: Electrical devices such as TVs, computers, printers, copiers and refrigerators not only use energy but also generate heat, thus increasing cooling costs. These plug loads usually account for about 6% of the electrical use in a typical office setting. Using automatic shutoff timers and thermal blankets on the appliances in the Café helped bring down electricity demand in off hours.

A Smart Network: Each building has an e-Monitor that monitors and transmits real-time data on building energy use for lighting, heating and cooling, refrigeration, and various other "plug" loads, as well as the amount of renewable energy generated on-site. This data has been an invaluable tool in targeting how to effectively reduce energy demand. It highlights when equipment is unnecessarily left on after hours, or when a thermostat is improperly programmed.

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Of course, energy efficiency isn't free. Actually building this Smart Energy District involved significant capital outlay in the beginning. Renovation costs for the Cafe and the Sears Cottage totaled nearly $500,000, with the geothermal system, power distribution and PV panels adding another $400,000. During the first full month of operation, the Village's total load was 7,812 kWh. Florida Power & Light delivered 3780 kWh, and the Village itself exported 2,940 kWh, falling 840 kWh short for their first full month of operations.

However, as the Village's operators learned more about their energy needs, capacities and use patterns, they were able to use this knowledge to drive improved energy efficiencies, achieving their Net Zero Energy goals immediately after turnover to the owner.