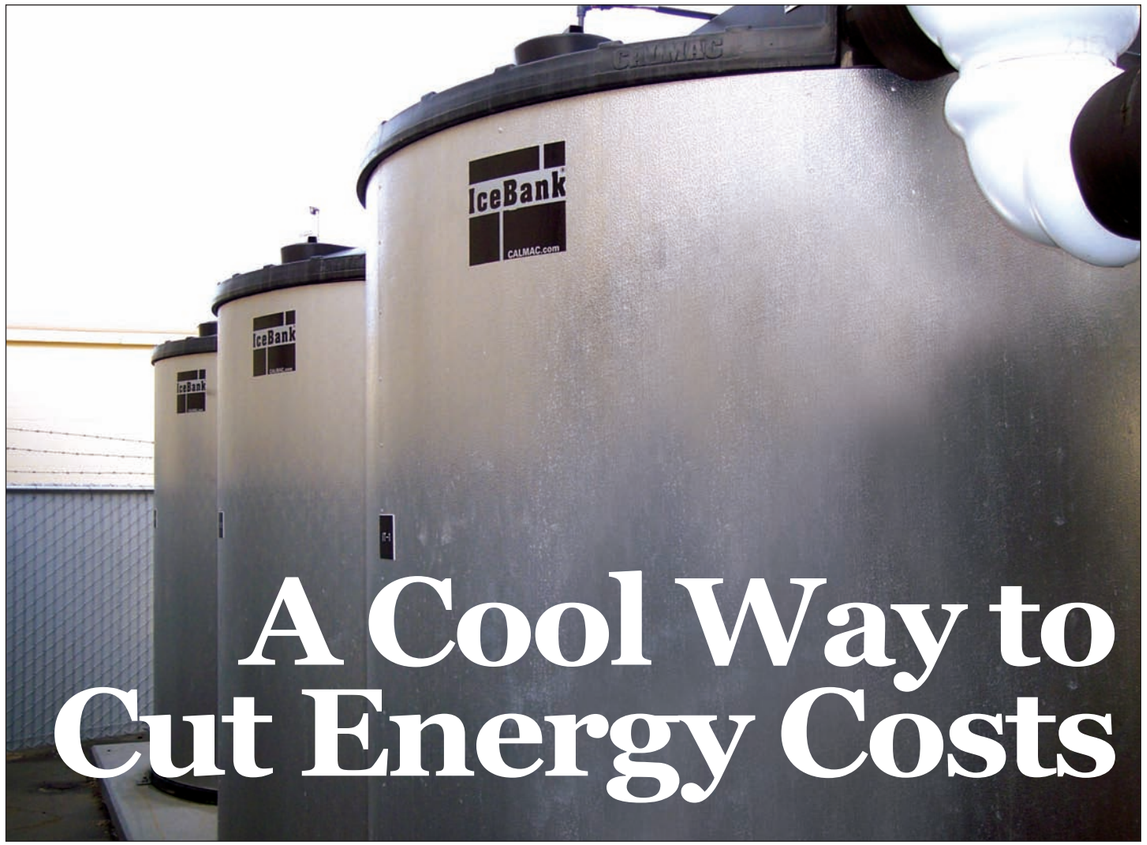

A Cool Way to Cut Energy Costs

THERMAL ENERGY STORAGE SHIFTS ELECTRICITY DEMAND TO OFF HOURS TO GIVE THE GRID A BREAK DURING PEAK TIMES

CALMAC IceBank® tanks at the award-winning Encinitas Civic Center. These three energy storage tanks help reduce the center's energy costs by 74 percent.

COURTESY OF THE ENCINITAS CIVIC CENTER

Story by Chris Warren

As part of a recent energy retrofit for the City of Encinitas' Civic Center, designers and engineers considered several eco-minded options that would reduce the center's energy consumption while lowering costs — and then employed them all.

Installing photovoltaic panels on the building's rooftop was considered and incorporated. Ditto, skylights and light tubes.

But perhaps the pièce de résistance is a thermal energy storage solution that keeps the building cool using hardly any electricity during the day. Thermal energy storage works at night by temporarily storing energy — in this case in the form of ice — in large IceBank® storage tanks so the energy can be used during peak energy demand periods.

Already, the system has won local green accolades, earning a San Diego Energy Efficiency award. During the next 25 years, the project will save taxpayers an estimated $4 million in energy costs.

"Every time I look at that rooftop," said Encinitas Mayor Maggie Houlihan when she learned about the award, "I see a cash register with deposits coming down from the sun."

Top: High-efficiency air handlers that use the chilled water stored by the CALMAC system.

PHOTO BY JUSTIN MILLER/ XNERGY

Below: Energy savings abound, with Trane supplying a smaller chiller, paired up with three CALMAC ice storage tanks, to help shift energy usage from on-peak to off-peak and to avoid overloading the electrical grid.

PHOTO COURTESY OF CALMAC

Inside the civic center's three IceBank tanks, a glycol-water mixture circulates through coil tubing at night to freeze water stored inside. During the day, the frozen water melts to cool the water that circulates in the building. Powerful fans blow air past the chilled water in order to cool the building.

Douglas Poffinbarger II, managing principal of Oceanside, Calif.-based PE Consulting Inc., said a thermal energy storage solution made sense for the project. The technology is more popular in parts of the country where electric rates are high — like Southern California.

"Most of the country's utilities have the same problem," Poffinbarger said. "Everybody is working during the day." And that's when the most strain is placed on power grids.

Although renewable energy saving technologies like solar energy and natural lighting are getting more attention now, thermal energy storage is an important part of the green energy equation, Poffinbarger said.

"Solar energy is a 'plug and play' technology," he said. "Thermal storage is more 'belt and suspenders' engineering. It's a little more customized."

Thermal energy storage is typically used in larger buildings that use chilled water cooler systems, so the system isn't always a viable option for smaller structures, Poffinbarger said.

"It's also important to have a client that is interested in taking a holistic approach to saving energy," he added.

IAMPO Director of Special Services Dave Viola noted that thermal energy storage could be very helpful in attaining the IAPMO board of director's goal of reducing overall energy and water consumption in buildings by a minimum of 10 percent.

"Thermal storage cooling is an excellent strategy for building owners to consider," Viola said. "Besides the lower energy costs

Opposite Page: The CALMAC tanks enabled the facility to utilize a smaller solar PV system to offset their dependence on the traditional electricity grid.

PHOTO BY JUSTIN MILLER/ XNERGY

associated with shifting the cooling load to a time of day with more economical rates, the technology is green.

"Night time charging for the next day's cooling load also occurs during the most efficient operating time — at night. The net result," Viola said, "is a smaller Trane chiller, less energy and refrigerant usage, and lower greenhouse gas emissions."

Terry Andrews, Western regional sales manager for CALMAC Manufacturing Corp., the firm that manufactured the three IceBank tanks used in the civic center thermal energy storage system, explains how the system works.

'air handlers.' The air handlers consist of chilled water coils and a fan that blows air through the coils. "This is the cool air that we feel in the building," Andrews said.

Conventional cooling continues until the peak electric rate period. For San Diego Gas & Electric, this is from 11 a.m. to 6 p.m. in the summer. Around 11 a.m., conventional cooling with the chiller ends. The warm fluid returning from the building is now sent through the ice tank coils and the fluid comes out cold. From 11 a.m. to 6 p.m., the IceBank tanks cool the building — not the chiller. In the cooler winter months, the IceBank tanks will be able to meet the building's cooling requirements for longer periods of time.

Above: The Encinitas Civic Center.

PHOTO COURTESY OF THE ENCINITAS CIVIC CENTER

"Thermal storage requires less energy to produce cool air during the more expensive daytime electric rate periods, since we're turning off the compressor that is normally used to produce chilled fluid," Andrews said.

CALMAC got involved with the civic center retrofit when Carlsbad-based Xnergy, an engineering, construction and alternative energy firm, proposed the project to the Encinitas City Council and picked CALMAC to help provide cooling to the civic center. Due to CALMAC's three IceBank tanks, the civic center's greatest cost savings were derived from shifting electrical demand to off-peak hours.

At night the chiller charges the IceBank tanks by cooling a heat transfer fluid — a glycol solution that serves as antifreeze — which circulates through coils inside the IceBank tank until the water surrounding the coils in the tank is frozen. "Now, we have low-cost stored energy in the form of ice," Andrews said.

"The next day, the chiller operates normally by cooling the fluid that is sent to the building's

Justin Miller, director of business development with Xnergy, said another plus is that the IceBank system doesn't require much maintenance. "The only real thing is to maintain the glycol solution annually and add water treatment to the IceBank tanks about every other year," he said.

"The ancillary equipment that works in conjunction with the system — chiller, air handlers, pumps, etc. — have routine preventive maintenance procedures on a quarterly basis," Miller said.

Andrews said thermal storage systems like the one in Encinitas can also lower maintenance costs. "We're only freezing and melting tap water," he said "and routine maintenance on the chiller can be performed during normal working hours when the IceBank tanks are meeting the building loads." On larger thermal storage installations, other mechanical components (chillers, pumps, 'cooling towers') are often downsized, which will help reduce maintenance costs, as well.

BANK ON IT

IceBank energy storage tanks store renewable energy for comfort use during peak demand periods. Reducing daytime demand for electricity can cut cooling costs as much as 20 percent to 40 percent. Source energy and emissions also are reduced, and construction of new power plants and transmission lines can be postponed or eliminated.

SOURCE: CALMAC Corp.

ENVIRONMENTAL BENEFITS FOR THE CITY OF ENCINITAS CIVIC CENTER:

According to PE Consulting, the environmental benefits from the City of Encinitas retrofit — which included the addition of skylights, and a 96 kW solar photovoltaic system designed into the new roof — are:

- Annual Energy Savings: 218 kW; 345,634kWh, 999 Therms
- Annual Emissions Savings: 312,019 lbs CO_2 (GHG); 578 lbs NOx (smog); 650 lbs SO_2 (acid rain)
- Equivalent to planting 465 trees each year
- Equivalent to not driving 341,301 miles in a car annually
- Equivalent to powering 31 large homes with renewable energy

USEFUL INFO

WHY THERMAL ENERGY STORAGE SOLUTIONS?

1. TO LOWER COOLING COSTS
During the day, electric rates are much higher than they are at night, so turning off chillers in large buildings can mean significant savings on electric bills.

2. TO REDUCE PEAK DEMAND
In California and most states — with the exception of business hours, when energy consumption peaks — there is enough electricity being generated. Because CALMAC's thermal energy storage system powers on at night, it reduces the load to utility grids, making it possible for utilities to get more out of their existing electrical infrastructure.

3. TO SAVE SOURCE ENERGY
At night, utilities can operate their most efficient power plants. During hot days, they have to operate more of their plants, including their older, least efficient and most polluting plants. Electricity produced and delivered at night uses less source energy — fuel like natural gas or coal. This is important because the 'old school' method of measuring energy usage focuses only on the meter at the building. But real energy usage includes energy used at the power plant (source fuel) to generate the electricity.

4. TO HELP MAKE RENEWABLE ENERGY VIABLE
When replacing fossil fuels with renewable energy, the storage component or the dispatch ability of the energy is missing. In other words, fossil fuels are forms of stored energy that are converted to electricity. Renewable forms of energy (solar, wind) lack this stored component; they are instantaneous. However, when paired with a form of energy storage (such as ice storage) the renewable energy can be stored for a time when it is most needed. Thus, thermal energy storage augments smart grids to take advantage of renewable energy and existing forms or generation.

SOURCE: CALMAC Corp.