Tech Topic: Commercial solar thermal

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Time to strike?

LEED credits among many reasons to consider a commercial solar thermal system.

Low fuel prices nationwide have made the investment in renewable energy sources – solar thermal among them – difficult to justify.

Yet, prices for fossil fuels are gradually increasing again and won't remain low forever. Also, there's a determined minority of engineers, developers, architects and building owners who prefer renewable energy by choice, eager to pursue United States Green Building Council LEED credits.

Assuming there *is* interest in developing solar thermal capability for a commercial and/or multifamily project – whether new construction or retrofit – a few key considerations quickly emerge:

- Size/heating capacity of solar thermal system (will it merely assist or meet peak use demand?);
- Size of thermal storage; and
- System backup.

These typically become the most important questions, though the issue of backup [heat] or ample storage of heated water is most frequently ignored – at least initially.

According to **Carl Pinto**, Bradford White's marketing director, it's natural to veto a larger expense to fund larger thermal storage of solar-heated water when numbers are first examined. Yet, when the system is up and running for some time, it later becomes apparent additional storage would be useful. Typically, the cost for larger storage is best when the system is installed.

Consider additional storage needs early when designing a commercial solar thermal system because the cost for larger storage is best during installation.

Bigger picture

For commercial facilities, 20% to 60% of energy is used for water heating; percentage varies greatly, determined by the nature of the facility. College dorms, with large shower and bath areas, and car or truck wash facilities, are at the high end of that scale. Office facilities are at the lower end.

"Payback" for investment in solar thermal systems is determined by many factors, the largest of which is volume of hot water used.

"Investment in solar thermal capability for private commercial and industrial projects is driven chiefly by return on investment," Pinto says. "Although solar thermal may still hit a nerve with developers as being the right thing to do for the sustainability of our natural resources, the ROI has to make sense."

According to **Mark Betterly**, national sales manager for Niles Steel Tank, solar thermal and photovoltaic systems continue to become more affordable; the price for this technology is being steadily reduced.

"If solar thermal systems remain affordable, I would expect to see renewed interest from developers, engineers and building owners when energy costs stabilize," he says. "They're moving in that direction now."

Storage makes sense

Tank size varies, but on average most solar thermal systems require about 750 gal. of storage with one or more coils inside. The number of coils correlates to the number of sources of heat used, such as solar thermal, geothermal, fossil-fuel equipment (such as a backup boiler) or different needs for the heated water, such as domestic water or space heat.

Backup heating systems clearly offer an insurance package for rainy days, cloudy weeks and evening heat generation – especially if thermal storage doesn't exist.

Backup heat typically is standard with residential solar thermal water heater systems, but it is even more critical in commercial applications because a lack of an alternate/traditional (perhaps fossil fuel) heat source may mean down time and loss of revenue.

Photo courtesy of Bradford White

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The Marine Company 9 firehouse in New York City (background) features nine solar panels with 22 evacuated tubes. The solar thermal array provides domestic hot water and space heat.

Without hot water, a car wash loses effectiveness or – by law – a restaurant must close. Food safety regulations require specific dish washing temperatures *must be* met. And, just imagine the impact of a hotel, at full occupancy, without hot water.

Size matters

Commercial and military projects have such varying hot water demands that it's hard to determine if there's a "rule of thumb" when sizing a storage tank.

Building load is only a part of the equation. Solar thermal systems have a long recovery period, so capturing as much heat during the heating hours is critical. The building draw may only be 300 gal. of hot water, but the solar designer may opt to add three times that as a buffer for non-solar heating hours.

"There are still a few projects being designed with large-volume solar tanks," Betterly says.

This fire's under control

An example of solar thermal heat, with sufficient storage for hot water, is a facility recently constructed for the Fire Department of New York Marine Company 9. The waterside station is home to the new fireboat, Firefighter II.

At 140 ft. long, 500 tons and $27 million, it's the country's biggest fireboat. If there's a fire to put out, the vessel can pump up to 50,000 gpm.

To complement the new ship, a new Marine Company 9 firehouse barracks was constructed, allowing for quicker access to any needs in New York Harbor. The 8,000-sq.-ft. firehouse is on the cutting edge of design and sustainability.

Located at the former Navy Homeport in Stapleton along Staten Island's northern shore, the facility is designed in the spirit of classic fire houses. More important than the actual aesthetic appeal of the building, however, are the project goals of sustainability, durability and affordable maintenance. A "green" roof, two solar arrays and a tight building envelope reduce the facility's carbon footprint.

The larger of the two solar arrays is a solar thermal system, comprised of nine panels, each with 22 evacuated tubes. The solar thermal array – which provides domestic hot water and space heat – covers 450 sq. ft. of the roof. The array is capable of producing nearly 400 MBH, although New York weather makes actual heat output subject to variation.

The other array is a 4.5 kW photovoltaic system, set with the task of providing power for system controls and circulators.

BTU distribution

According to **Roman Liberstein**, director of operations at Midtown HVAC Enterprises, which was tapped to install some of the mechanical systems, glycol lines run from the solar thermal arrays to a 475-gal. tank produced by Niles Steel Tank. The heavily insulated tank has four separate coils inside.

"The first coil is for the glycol from the solar-thermal array," Liberstein says. "It keeps the tank at its target temp of 180° F. The second coil supplies the building's space heat, and the third and fourth coils provide heat to the two hybrid tanks."

In the case of the large tank at Marine Company 9's new firehouse, once the four coils were hooked up and the tank was filled, it was

The Marine 9 firehouse has a 475-gal. Niles Steel Tank installed where glycol lines run from the solar thermal arrays to the heavily-insulated tank.

permanently sealed. Not only does the tank act as a thermal target and storage system, it acts as a massive four-way heat exchanger.

Domestic water

Olympic Plumbing & Heating Services in Cambria Heights, N.Y., assumed responsibility for the domestic portion of the system. Two 80 gal. solar/electric hybrid Bradford White water heaters were installed to supply the kitchen, four showers and outdoor hot water needs at the fire station.

"Two of the coils in the big Niles tank are dedicated to supplying domestic hot water through the use of heat exchangers as pre-heaters for the standing electric water heaters," says **Demetrios Velentzas**, plumbing foreman at Olympic. "There are times when the solar-thermal array meets all the needs for the domestic water system. Other times, when it isn't sunny, or the space heating component of the system is placing a large demand on the tank, the solar-heated coil inside the water heaters isn't enough. That's when the electric element in the hybrid tanks turns on to meet the demand."

One of the coils inside the big NST tank is dedicated to providing supplemental space heat for the firehouse. A heat exchanger transfers energy to four hydronic coils within the building's duct system. Throughout the building, hydro-air units between 20,000 Btu/hr. and 130 MBH are used in various areas. Rooftop heat pumps supply the extra heat that the solar array can't.

As the Marine 9 project, commercial solar thermal systems require a lot of planning and commitment, but can be an ideal design route for an engineer. **pme**

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