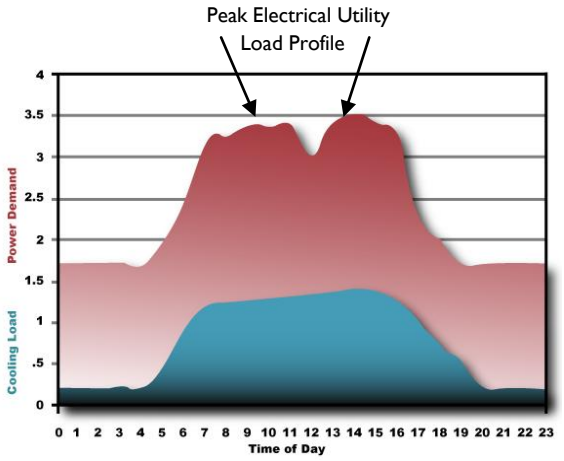
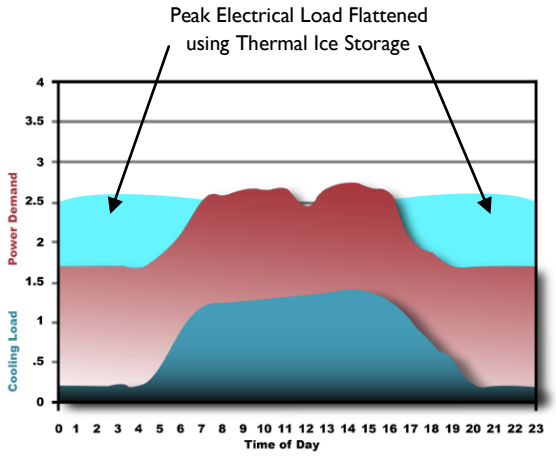
GREEN PIECE

EVAPCO's Newsletter on Environmental Sustainability

November 6, 2009
GP #8

Cut the Tip off the ENERGYberg:
Thermal Ice Storage and the LEED®v3 Green Building Rating System





Green Piece #8 specifically addresses **Thermal Ice Storage** and its LEED® credit opportunities. In addition to energy cost savings credits in Energy and Atmosphere, there are categories in Water Efficiency and Indoor Environmental Quality for schools that may have the potential to earn additional credits.

Take the initiative and go for those hard to obtain credits that push the LEED® rating from Gold to Platinum! Ice thermal storage provides an energy efficient cooling system that is economically responsible to the end-user and diminishes the demand on the utility's electrical infrastructure. The benefits of ice storage include:

- Reduced greenhouse gas emissions and source fuel required to generate electricity.
- Lower energy costs made possible by shifting power usage to night time when rates are lower.
- Smaller chillers required for partial ice storage systems-*resulting in lower refrigerant charge on site.*
- Quiet building operation with a full ice storage system-*towers and chillers turned off during the day.*
- Zero water consumption when Thermal Ice Storage is combined with air-cooled chillers.

Water Efficiency

Credit Category	Title	LEED NC	LEED for Schools	LEED Core & Shell	EVAPCO Product Contribution
WE Credit 4	Process Water Use Reduction	NA	1 Point	NA	EVAPCO Thermal Ice Storage with Extra-Pak® Ice Coils and Air Cooled Chillers.[1]

Energy & Atmosphere

EA Credit 1	Optimize Energy Performance	1-19 Points	1-19 Points	3-21 Points	EVAPCO Thermal Ice Storage with Extra-Pak® Ice Coils help earn credits in this category by reducing energy costs – ice is made during off-peak power rates.[2]
EA Credit 4	Enhanced Refrigerant Management	2 Points	1 Point	2 Points	Partial ice storage systems utilize 40% smaller chillers compared to conventional chilled water plants, therefore holding a smaller refrigerant charge.[3]

Indoor Environmental Quality-Schools Only

IEQ Prerequisite 3	Minimum Acoustical Performance	N/A	Required	N/A	Design a full storage system to provide chilled water during school hours and special events, allowing the school to turn off their chillers and cooling towers.[4]
IEQ Credit 9	Enhanced Acoustical Performance	N/A	1 Point	N/A	Design a full storage system to provide chilled water during school hours and special events, allowing the school to turn off their chillers and cooling towers.[4]

Innovation in Design

ID Credit 1	Innovation in Design	1-5 Points	1-4 Points	1-5 Points	Thermal Ice Storage reduces carbon emissions, peak demand and the need for new power plants.[5]

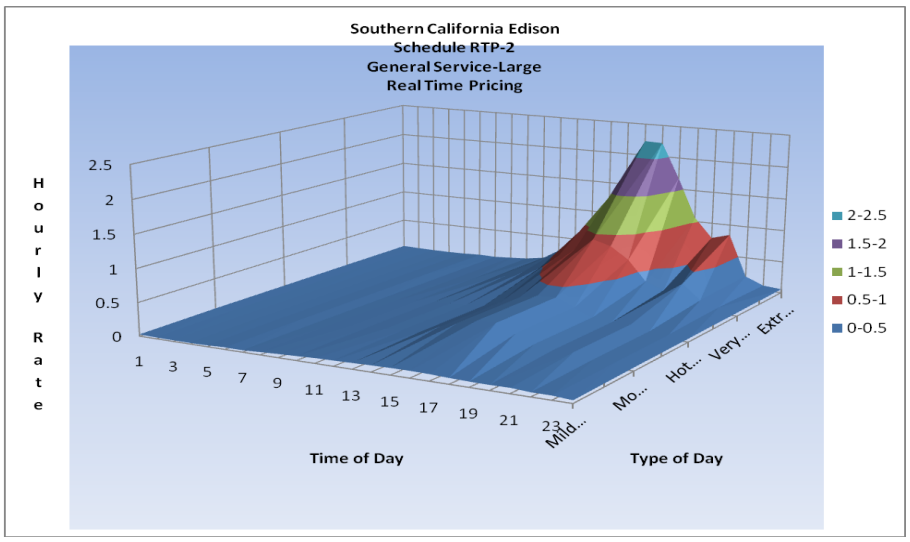
Foot Notes:

1. EVAPCO Thermal Ice Storage Systems that utilize air cooled chillers to build ice will reduce water and energy used for air conditioning schools. If the design consultant prefers to use air-cooled chillers, Thermal Ice Storage will provide the end-user, not only with significant water savings, but with incremental energy savings when compared to a conventional system design with air cooled chillers. Energy is saved by operating the chiller at night to build ice when dry bulb temperatures are typically 20˚F to 30˚F lower than during the day.

2. "*The primary benefit of thermal storage is its ability to substantially reduce total operating costs, particularly for systems using electricity as the primary energy source. Thermal storage systems reduce the demand for expensive on-peak electric power, substituting less expensive nighttime power to do the same job.*" ASHRAE Handbook-2008 HVAC Systems and Equipment

   To receive Energy & Atmosphere points in the Optimize Energy Performance credit category, LEED® guidelines specify increasing percentages of energy cost savings in the proposed building design when compared to a baseline building. For an Optimize Energy credit, the HVAC system design must show a 12% energy cost savings for new buildings and an 8% energy cost savings for existing buildings, using the performance rating method in Appendix G of ASHRAE Standard 90.1-2007. This energy cost savings calculation must be supported using a computer simulation model such as E-Quest, DOE-2, Visual DOE-4 or DOE Energy Plus.

   For example, Figure 1 below is a current rate graph (September 2009) for Southern California Edison (SCE) using the Real Time Pricing (RTP-2) schedule for customers with a demand greater than 500kW. On days defined as "Very Hot Summer Weekday" (91˚F to 94 ˚F day time temperature), the average cost of electricity is 42.4 cents/kWh. However, on those same days the average night time cost of electricity is 5.6 cents/kWh…. **a 7.5 to 1 energy cost differential!**



Data for Graph Courtesy of Southern California Edison

Figure 1- Typical Rate Structure Beneficial to Thermal Ice Storage

2 continued)

Thermal ice storage reduces peak electrical cost therefore reducing the overall electric cost for the entire building. This electrical cost saving is recognized by the USGBC and the LEED rating system. Energy and Atmosphere Credit 1 has up to 21 points available for energy cost saving strategies based on the energy cost budget method as defined by ASHRAE 90.1.

Energy and Atmosphere, Optimize Energy Performance Credit 1

OPTIMIZE ENERGY PERFORMANCE

	NC	SCHOOLS	CS
Credit	EA Credit 1	EA Credit 1	EA Credit 1
Points	1-19 points	1-19 points	3-21 points

Intent

To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Requirements

NC, SCHOOLS & CS

Select 1 of the 3 compliance path options described below. Project teams documenting achievement using any of the 3 options are assumed to be in compliance with EA Prerequisite 2: Minimum Energy Performance.

OPTION 1. Whole Building Energy Simulation (1-19 points for NC and Schools, 3-21 points for CS)

Demonstrate a percentage improvement in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda[1]) using a computer simulation model for the whole building project. The minimum energy cost savings percentage for each point threshold is as follows:

New Buildings	Existing Building Renovations	Points (NC & Schools)	Points (CS)
12%	8%	1	3
14%	10%	2	4
16%	12%	3	5
18%	14%	4	6
20%	16%	5	7

Figure 2

There are other tangible material cost and energy saving benefits of a Thermal Ice Storage system. For example, an ice storage system design using chilled water at 36˚F and an 18˚F delta t compared to a standard chiller system with a 45˚F chilled water temperature and 10˚F delta t, will have smaller pumps, piping, air handling cooling coils and ductwork!

3. Ice storage systems may be sized for full or partial storage. A partial storage system is defined as "A cool storage sizing strategy in which only a portion of the on-peak cooling load is met from thermal storage, with the rest being met by operating the chilling equipment." (ASHRAE-2008 HVAC Systems and Equipment Chapter 50 Thermal Storage).

A partial storage system will typically require a chiller that is 10-40% smaller in size than a conventional chilled water system. Smaller chillers equate to lower refrigerant charges, resulting in less impact to the environment from potential leakage during the operating span of the equipment.

4. In another LEED® for Schools strategy, using a full storage ice system sized for complete on-peak cooling capacity would allow a school to run silent during the day or special off hour event by melting ice without turning on noisy chillers and condenser cooling equipment. The only components of the chilled water cooling plant that would operate during the day are the small chilled water pumps.

   Ice storage will enable HVAC system designers to use lower temperature air and water to size smaller air handlers with reduced HP fan motors and slower duct velocities resulting in lower sound levels, a requirement of IEQ Prerequisite 3 and IEQ Credit 9 shown below:

   IEQ Prerequisite 3

"Achieve a maximum background noise level from heating, ventilating and air conditioning (HVAC) systems in classrooms and other core learning spaces of 45 dBA."

IEQ Credit 9:

"Reduce background noise level to 40 dBA or less from heating, ventilating and air conditioning (HVAC) systems in classrooms and other core learning spaces."

5. Thermal ice storage systems have received positive recognition and LEED® points from the USGBC for its ability to reduce green house gas emissions as a result of lower energy use at the power plant. It has been well documented that power plants run more efficiently and electricity is easier to distribute to the grid at night due to lower ambient temperatures.

In order to receive the LEED® Innovation Point, according to the USGBC's latest Credit Interpretation Request dated 2/23/2005, the ice storage system must be sized to shift 5% of the total building energy use. In addition, the designer must prove that there is a reduction in air emissions compared to a standard chilled water system.

There are two studies available that quantify air emission reductions by shifting electrical demand to off peak: one by the California Energy Commission (CEC) completed in February 1996 (P500-95-005) and a Florida Light and Power (FPL) Study presented at the 2008 ASHRAE Summer Meeting in Salt Lake City (Seminar 69).

The CEC study evaluated the two largest electricity suppliers in California: Pacific Gas & Electric (PG&E) and Southern California Edison (SCE). The fuel source energy savings depends on air conditioning usage patterns, the design and operating strategy for the thermal storage system-Full or Partial and the source of the electricity supplied (i.e. Hydro, Coal, Natural Gas or Nuclear).

In the study, Thermal Energy Storage systems in the regions served by PG&E and SCE shifted 40-80% of the annual kWh's of electricity used for A/C from Day to Night. The result was an 8 to 43% reduction in source fuel use. Since the fuel source was reduced, it also has the added benefit of reducing greenhouses gas emissions.

In the FPL study, it was shown in their evaluation of its power and Thermal Energy Storage (ice and chilled water) plants in their portfolio, that by shifting power to off peak, it reduced CO2 output by .43 lbs per kWh shifted, based on 500 tons per peak day per average installation

FPL was able to achieve this level of carbon reduction because Thermal Ice Storage allowed them to shift from Oil and Gas fired power plants (34% efficient) to more efficient Combined Cycle plants using natural gas (50% efficient).

The benefits to the environment and energy costs are significant with Thermal Ice Storage. Incorporate Thermal Ice Storage ice into the chilled water plant design on your next LEED® project.

EVAPCO will present the benefits of ice storage at GreenBuild 2009 in Phoenix. Our Thermal Ice Storage systems are designed for commercial HVAC, industrial cooling and district energy projects using our Extra-Pak® Ice Coils for internal or external melt applications.

EVAPCO Thermal Ice Storage Installation

To learn more about EVAPCO's Thermal Ice Storage systems go to http://www.evapco.com/ice-video.asp to view the Thermal Ice Storage video and to download our Bulletin 401F-Ice Coils. For information on how to incorporate Thermal Ice Storage into your new or existing system design contact me at EVAPCO or send an e-mail to ice@evapco.com.

Keep it Green!

Daryn S. Cline

Senior Manager,
Environmental Technologies

References:

1) Source: ASHRAE Handbook-HVAC Systems and Equipment-2008 Chapter 50 Thermal Storage
2) Source: Department of Energy E-Quest software-free energy evaluation download at: http://www.doe2.com/
3) Source: ANSI/ASHRAE 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings
4) Source: USGBC's LEEDv3 http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970
5) Source: Southern California Edison RTP-2 Rate Structure
6) Source: Source Energy & Environmental Impacts of Thermal Energy Storage, California Energy Commission (CEC), P500-95-005, Feb 1996.
7) Source: FPL Study 2008 ASHRAE Summer Meeting in Salt Lake City, UT, Seminar 69.
8) For large scale District Energy applications of Thermal Ice Storage, consult these documents published by the USGBC

District Energy and LEED NC/Schools: http://www.usgbc.org/ShowFile.aspx?DocumentID=4176

Guidance on Combined Heat and Power: http://www.usgbc.org/ShowFile.aspx?DocumentID=1354

LEED NC Guide for Multiple Buildings: http://www.usgbc.org/ShowFile.aspx?DocumentID=1097