

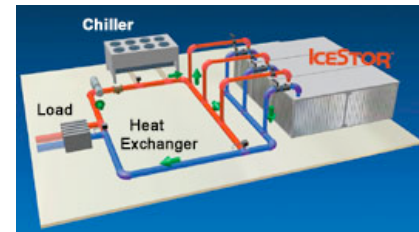


## Off Peak Thermal Storage

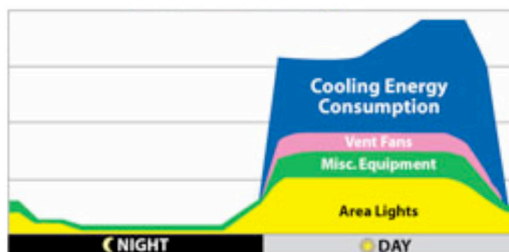
### Why consider this strategy and how to implement it

#### 1. What is Off Peak Thermal Storage (OPTS)?

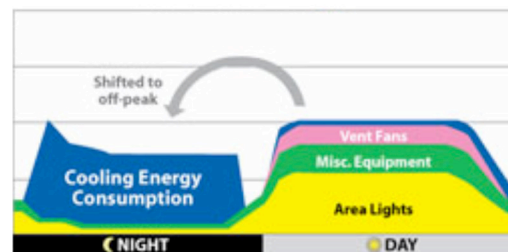
Off Peak Thermal Storage (OPTS) systems refers to HVAC technologies that store energy in a thermal reservoir for later reuse. These strategies are employed to balance energy demand between daytime and nighttime. This strategy does not produce energy, but rather CO<sub>2</sub> abatement brought about by 'peak shaving', which shifts the daytime power load to the evening when power may be less expensive (a benefit to the building user) which thereby reduces the peak electric power demand in the middle of day. Because the Northern Illinois region relies very heavily on nuclear power plants (which run at constant power output), peak shaving is often a great CO<sub>2</sub> reduction strategy. Peak demand, which primarily occurs in the summer to meet daytime air conditioning demand, is typically met with gas fired 'peaker plants', which generate substantial CO<sub>2</sub>. It has been estimated that for each 10,000 sq. ft. of office space utilizing this system, approximately 210 metric tons of CO<sub>2</sub> annually would be abated.



#### Hourly Load Profile for Typical Office Building



Typical Load Profile



Cooling Load Shifted to Nighttime

Systems can be sized to eliminate compressor energy use during periods when electricity is most expensive, but most systems are designed to simply augment mechanical cooling in order to limit peak demand. The latter type of storage system can be considerably smaller than the former.

#### 2. What Type of Building is Ideal for OPTS?

In general, the buildings that offer the highest potential are offices, retail, religious and medical facilities. Space for the additional equipment is required. This is far easier to design into a new building, as finding this space can be challenging for existing buildings, which are more predominant in Evanston.

#### 3. What are Effective Applications of Off Peak Thermal Energy Storage?

##### Facilities with...

- a. high utility demand costs

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- b. utility time-of-use rates (some utilities charge more for energy use during peak periods of day and less during off-peak periods)
- c. high daily load variations
- d. short duration loads
- e. infrequent or cyclical loads
- f. capacity of cooling equipment has trouble handling peak loads
- g. rebates available for load shifting to avoid peak demand

#### **4. What Type of Off Peak Thermal Storage System is the Correct One to Use?**

Water and/or ice storage systems are often used in new large cooling system applications in conjunction with cogeneration and/or district energy systems (downtown Chicago has such a district cooling system). Water-ice storage is the most common cooling storage in smaller applications. Because latent heat storage (phase change between water and ice) has a smaller volume, it is often considered for retrofit applications with limited space.

#### **5. What is the Economic Rationale for using Off Peak Thermal Storage?**

The economics of thermal storage is very site- and system-specific. A feasibility study is generally required to determine the optimum design for a specific application. Several examples exist of effective OPTS systems that were installed for less cost than conventional alternatives and that also provided significant energy and energy cost reductions. Payback periods vary but can be as low as 7 years.

OPTS projects often profit from unexpected benefits that are secondary to the primary reason for an action. For example, a well designed OPTS air conditioning application may experience reduced chiller energy consumption, lower pump horsepower, smaller pipes, high reliability, better system balancing and control, and lower maintenance costs.

#### **6. What is the process for integrating OPTS?**

A mechanical engineer, possibly in conjunction with a mechanical equipment manufacturer, will be required to design the system. Because of the space requirements associated with OPTS, the system is best designed into new projects at the very beginning of the design process. The permitting and installation should be the same as using conventional HVAC system without OPTS.

#### **7. Additional Information**

##### **Benefits and savings of chiller replacement & various thermal storage projects**

U.S. Army case studies <http://www.cecer.army.mil/ul/gascool/storage.htm>

##### **Ice Storage Retrofit for Rooftop Air Conditioning**

Federal Energy Management Program (FEMP) New Technology Demonstration Program evaluates ice storage retrofit for rooftop air conditioning.

[http://www1.eere.energy.gov/femp/technologies/newtechnologies\\_demo4.html](http://www1.eere.energy.gov/femp/technologies/newtechnologies_demo4.html)

##### **Thermal Storage – Chilled Water**

<http://tristate.apogee.net/cool/cxctw.asp>

##### **Chilled Water Storage Technology**

<http://www.chilledwatertech.com/>

##### **Chilled Water Storage**

<http://www.energy.rochester.edu/storage/chwtes.htm>

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