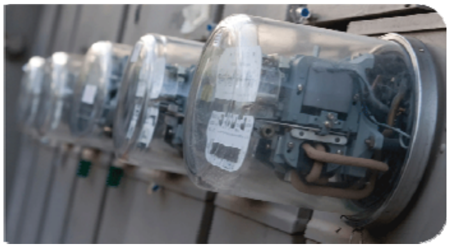
INNOVATIVE COOLING TECHNOLOGIES
of Canada Limited



When you think of air conditioning, is this all that comes to mind?

- **What if you could reduce AC energy costs 20 - 50%?**
- **What if someone else paid 40% of the system cost?**
- **What if you helped the environment too?**

OFF-PEAK COOLING

Air Conditioning For the 21st Century

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Electricity in Ontario

Ontario's electric power generation and distribution industry is in crisis. Approximately 80% of Ontario's existing electricity supplies will need to be replaced over the next 20 years.[1] The environment of annual increases in electricity consumption, combined with insufficient and aging generation and distribution systems, cannot continue. The reality facing Ontario's industry represents an immediate call for action.

Upgrading, replacing and adding new power generation capacity is a given. However, conservation and demand management is the cornerstone of the Province's strategy for reliable, stable power supply.

- *6,300 megawatt reduction in peak electricity demand by 2025*

This is the conservation and demand management objective set by the Government of Ontario and the Ontario Power Authority (OPA). The 2006 Chief Energy Conservation Officer's Annual Report explains the steps and programs being implemented to usher in a new era of conservation in the province of Ontario.

Why Target Air Conditioning?

Air conditioning (AC) is typically the largest single electrical load in a commercial building and one of the largest loads in industrial buildings. Commercial and industrial air conditioning solutions that time shift and/or reduce on-peak electricity consumption:

- have the potential to reduce on-peak demand by over 1,200 MW
- smoothes and stabilizes electricity demand over 24 hours enabling power generation facilities to operate more consistently at improved efficiency levels, reduces dependency on high cost peaking plants and out of province supplies, lowering overall production costs
- protects the environment by reducing harmful greenhouse gas emissions related to global warming
- can reduce customers' air conditioning related energy costs by 20 – 50%

Off-Peak Cooling with Thermal Energy Storage

In the simplest of terms, Off-Peak Cooling (OPC) is the process of making ice at night, when the demand for cooling and energy costs are at their lowest, and using the ice during the day to provide cooling for air conditioning (or other cooling processes).

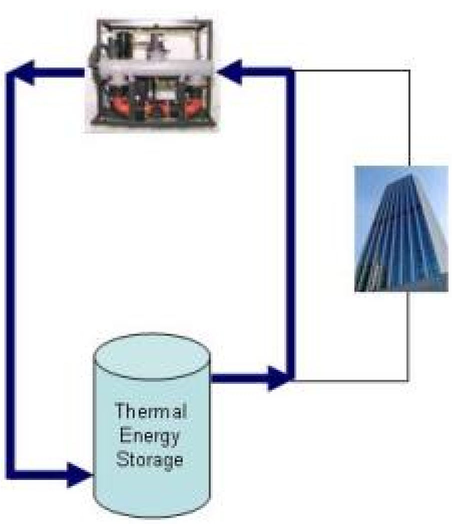
Off-Peak Cooling systems are based on the principal of Thermal Energy Storage (TES). Ice is fundamental to thermal energy storage for air conditioning applications. Ice has unique physical properties that permit storage of what is referred to as the 'heat of fusion'. Heat of fusion is defined as the amount of heat required to convert a unit mass of a solid at its melting point into a liquid without an increase in temperature. Ice by its very nature makes for a compact and environmentally inert thermal 'battery'.

[1] Ontario Power Authority – Annual Report 2006, Chief Energy Conservation Officer

Ice, made and stored at night, provides the cooling capacity necessary to maintain air conditioning during the day without operating energy-intensive chiller equipment.

How Off-Peak Cooling Works

Off-peak cooling has 3 modes of operation — charging, discharging and standby.

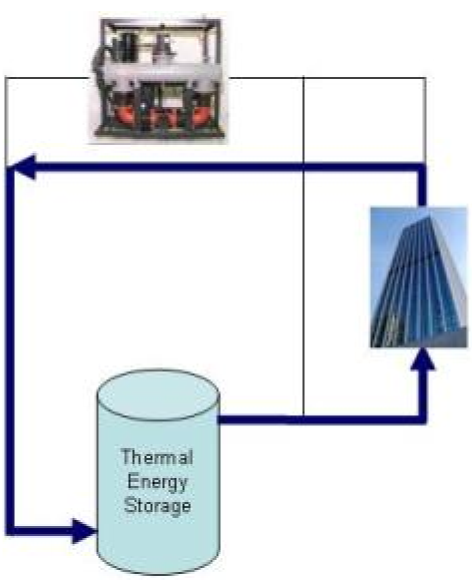


Charge Cycle – Ice Making

In charge mode a glycol/water mix is chilled to typically 22 - 28° F by the chiller. The super-chilled glycol is circulated through the Ice Balls in the storage tank freezing them to make ice.

Typically a smaller chiller than traditional AC systems would require can often be used due to the advantages of thermal energy storage and the optimal performance and efficiency achieved by operating at night in more favourable ambient conditions.

Charging is normally done during off-peak hours at night, bypassing the air conditioning load, and when electricity costs are the lowest.

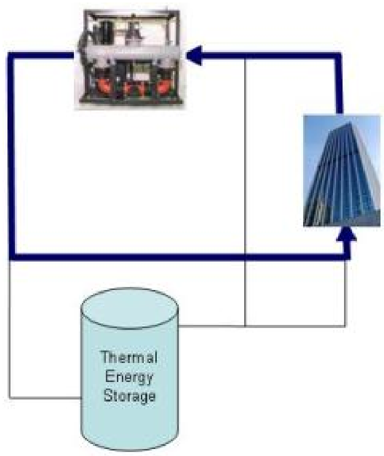


Discharge Cycle – Ice Melting

During discharge mode the chiller is bypassed. The glycol solution is circulated extracting the heat from air cooling systems and is then fed into the storage tank of ice. The warmer glycol melts the ice, the process of which re-cools the glycol.

The chilled glycol (this time by the Ice Balls instead of the chiller) is pumped back to the load to provide air conditioning (or process cooling) and the loop is repeated.

The discharge cycle is used during the day to satisfy peak load demand when air conditioning is required the most. By using ice to cool the glycol the chillers are off-line during the day dramatically reducing the peak electricity load and saving thousands of dollars.



Standby Mode – Traditional AC

In standby mode the thermal energy storage is bypassed and the chiller provides cooling directly without using ice. This allows ice to be conserved for later periods with higher demand or times of highest electricity prices.

Off-Peak Cooling for Air Conditioning Applications

Chilled Water Conditioning Systems

In chilled water conditioning systems heat is removed by passing air through coils filled with chilled water supplied by a chiller plant. Chillers operate during the day when air conditioning is needed the most — and the cost of operation is the highest. The chiller is the most energy-intensive component in the entire air conditioning system.

With off-peak cooling heat is extracted from glycol coolant by flowing it over the ice that was made and stored the night before. The re-chilled glycol is circulated back through the air conditioning system, by-passing the chiller, to maintain the air conditioning process and the cycle repeats.

Shifting the use of the chillers to night time operation is where “off-peak” cooling derives its name. Since electricity prices have been historically 30 – 40% lower on average (more on occasion) during off-peak hours, time shifting chiller operation like this can save thousands of dollars in energy costs.

Unitary Rooftop Systems

Unitary rooftop air conditioning systems absorb heat by evaporating a chemical refrigerant and condensing the resulting vapour by cooling it through a condenser thus providing cooling. They use ambient air as the coolant for the refrigeration process.

Unfortunately, the outdoor air temperature is very often significantly higher on the roof, often by more than fifteen degrees Fahrenheit. This means unitary rooftop units operate in the most unfavourable conditions and condense refrigerant using the hottest possible air source. This results in higher system operating pressures, significantly degraded capacity and efficiency and higher energy consumption. Unitary rooftop systems typically offer lower equipment costs but their operating costs, including energy costs, are often higher than alternatives.

With off-peak cooling chilled water cooling coils are substituted for the original cooling coils of the standard rooftop equipment. A glycol coolant replaces the chemical refrigerant and a chiller, operating at night during off-peak hours, makes ice. The ice, instead of hot ambient air, is used during the day to extract heat from the coolant that circulates through the air conditioning system providing cooling without intensive energy consumption during expensive on demand peak hours.

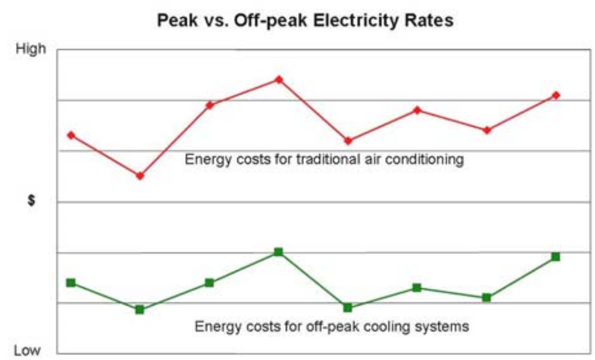
Since most of the original AC equipment is preserved, as is the heating system in combined heating/cooling units, retrofitting unitary rooftop systems for off-peak cooling is an attractive alternative.

Benefits of Off-Peak Cooling with Thermal Energy Storage

Off-peak cooling (OPC) and thermal energy storage (TES) provides many benefits for customers, Local Distribution Companies (LDCs), power generators and the environment.

Customers

- reduces AC energy costs up to 50%
- dramatically reduces electricity peak load consumption resulting in huge savings
- lowers AC-related operating and maintenance costs
- lower total cost of ownership
- reduces company's carbon footprint
- qualifies for substantial government incentives to offset costs



Environment

- shifts significant peak load electrical consumption to off-peak times
- reduces GHG emissions by consuming power when it is more efficient and less costly to generate
- improves the performance and efficiency of AC equipment which reduces energy consumption
- overall lower consumption of energy

Power Generators & LDCs

- peak-load shifting enables LDCs to deliver maximum kWh with lower overall kW demand
- power generation assets operate more efficiently
- production costs are lower and more predictable
- mitigates the need to purchase expensive, often dirty, "out-of-province" on-peak power

Other Applications for Off-Peak Cooling

Backup Cooling (i.e. Data Centers)

Ice Ball provides an effective backup cooling system for mission critical cooling applications like data center/computer room cooling. Data centers, in particular, have requirements for high availability and redundant systems. This means large, expensive back up generators capable of producing sufficient power to operate energy intensive air conditioning chillers and equipment in the event of a power interruption.

Using Thermal Energy Storage backup cooling can be “stored” by maintaining a charged tank of ice. The TES capacity can be sized to provide 1, 2 or even 3 days of reserve cooling – whatever is necessary to deliver the required protective cooling period. Once charged, only a minimal amount of energy is required to maintain the TES reserve in a fully charged state ready for immediate use.

A TES cooling reserve means that back up generators can be substantially reduced in size as they need only accommodate the significantly lower power requirements for fans, pumps and some lighting (and the computers themselves of course which is constant in either scenario). A TES back up cooling system drastically lowers the capital cost associate with providing crucial redundancy and back up capabilities.

Medium Temperature Refrigeration

Most commercial refrigeration systems use air-cooled condensers that operate on a demand basis. Converting these systems to glycol cooled condensers permits the use of Thermal Energy Storage and off-peak cooling, thereby shifting a large portion of the refrigeration electricity consumption to off-peak hours.

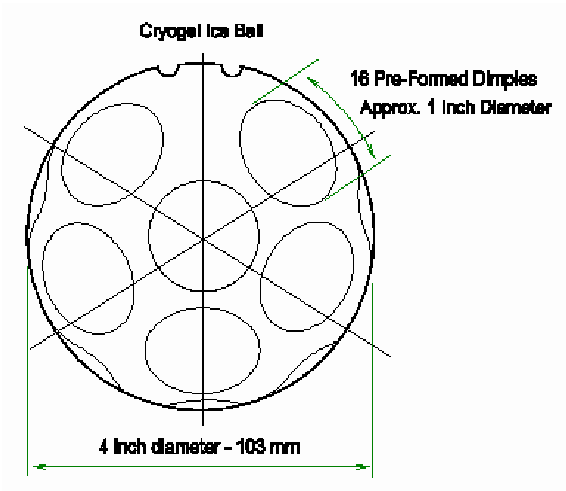
In many instances, existing low-temperature condensing units can be used to provide the off-peak chilling capacity required to manufacture ice. By leveraging this existing equipment, the cost of additional chilling capacity may be avoided.

Off-peak cooling is an effective strategy for grocery stores, food processing and other businesses requiring refrigeration.

Industrial/Process Cooling

Many manufacturing processes require cooling. Even partial electricity peak load shifting using off-peak cooling can generate substantial energy savings. Often off-peak cooling can be combined with other conservation measures such as heat recovery systems or even off-peak heating to generate substantial savings and environmental benefits.

Ice Ball™ Thermal Energy Storage



Ice Balls are 4 inch (103mm) diameter spheres constructed of high performance polyethylene and filled with water to form ice for cool energy storage. Ice Balls are placed in storage tanks and are charged (frozen) and discharged (melted) by means of circulating a glycol based heat transfer fluid around the balls.

Ice Ball is a patented TES technology of Cryogel Corporation of San Diego, California. Ice Ball is a proven technology/product. Over 20,000,000 Ice Balls provide thermal energy storage for schools, hospitals, airports, office buildings and manufacturing facilities around the globe. Innovative Cooling Technologies is the exclusive supplier/partner in Ontario for the Cryogel Ice Ball TES product.

Patented Dimple Design

As water inside the Ice Ball freezes to form ice, the dimples flex out to allow for expansion. This relieves the stress and stretching of the plastic walls that would otherwise occur and extends the life and durability of the Ice Ball. Moreover, this eliminates any chance of overcharging the system, since the ice is encapsulated in the Ice Balls and the dimples accommodate the expansion, there is no possibility for expansion stresses to seriously damage the tank or internal tank components as exists with ice-on-coil systems.

Ice Ball™ vs. Ice-on-Coil For Off-Peak Cooling

The fundamental difference between Ice Ball TES technology, exclusively available through ICT, and Ice-on-Coil tanks is in the inherent simplicity and reliability of the Ice Ball design. Water is contained, and frozen, within the individual Ice Balls. The patented dimple design of the Ice Ball absorbs the expansion that occurs during freezing. There is no additional stress placed on the tank and no possibility of overcharging. The flexibility of the Ice Ball permits tanks of various size, shape, orientation and construction.

Ice-on-coil tanks, by contrast, are tanks that contain fragile coils and are filled with water. Ice is created by flowing a chilled refrigerant (typically a glycol mix) through the coils to freeze the surrounding water in the tank. During the discharge cycle warmed refrigerant flows through the coils surrounded by ice to extract the heat and re-cool the glycol. However, the use of coils within a tank of water often results in uneven freezing and melting of the ice requiring additional expensive controls, air pumps and other parts to prevent ice caps, ice bridging, flow channeling and even overcharging that can damage the tanks and cripple performance.

Feature Comparison	**Ice Ball**	**Ice-on-Coil**
Tank Flexibility & Design	Virtually any shape or size Steel, concrete, fiberglass, atmospheric or pressurized Above or below grade, vertical or horizontal installation No heat exchanger tubes, fittings, air pumps or moving parts	Fixed sizes & cooling capacities, often requires more expensive multi-tank farms Coil-inside construction increases failure points and maintenance/service costs Limited installation options
Individual Containment Spheres	Eliminates points of failure No welded joints No costly biocide water treatment No possibility of overcharging causing expensive tank damage	Requires complex, expensive ice-limiting controls to prevent serious damage and inefficient operation caused by ice caps, ice bridging, flow channeling and overcharging Water filled tanks require biocide treatment and *winterization* when not in use
Surface Area	30 – 300% more surface area per nominal ton hour vs. ice-on-coil – superior performance	Less efficient operation Requires more energy to produce equivalent cooling

For More Information

More information about off-peak cooling, thermal energy storage and our exclusive Ice Ball™ solutions can be found at our web site. Visit www.offpeakcooling.ca or www.ictcanadaltd.com or call us at 613-907-1806.