Thermal Storage in New England

Shifting energy to reduce utility bills

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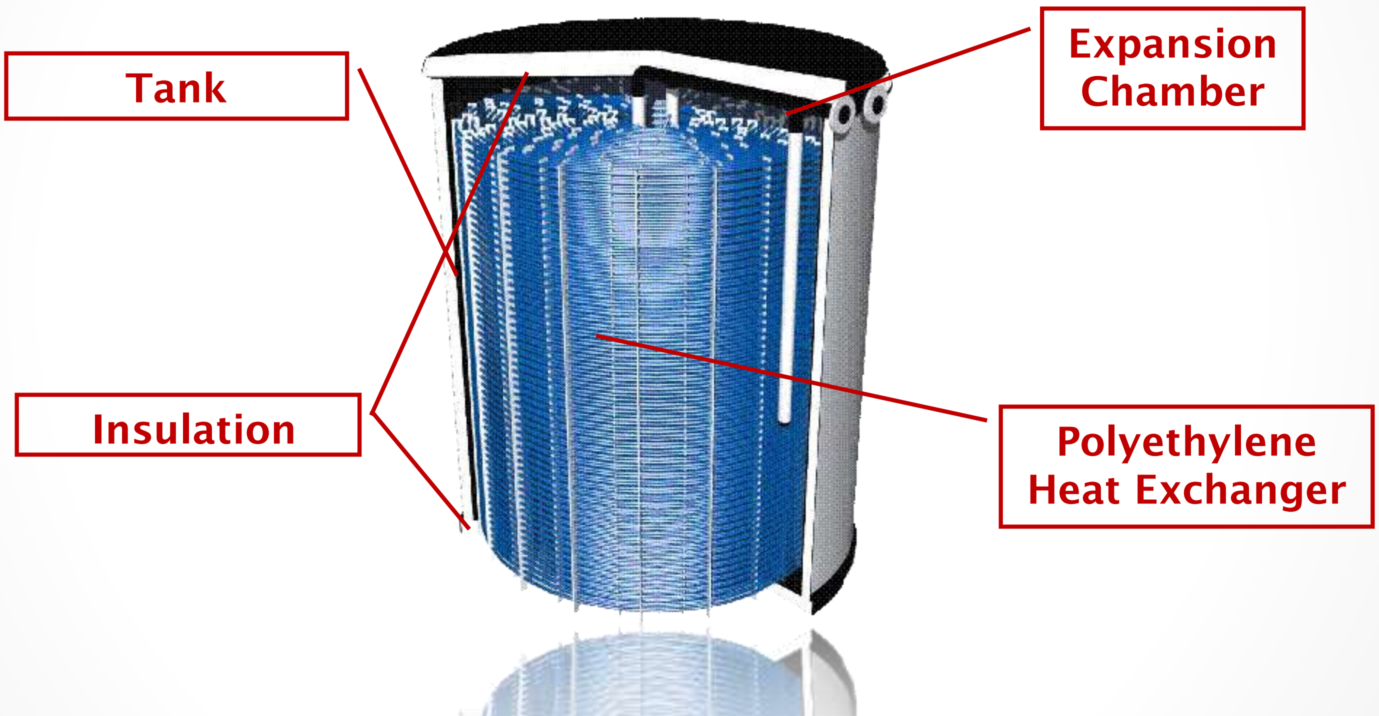
The IceBank®: Simple, Elegant

Ice-on-Coil Internal Melt Technology



Tank is 10% polyethylene tubing, 80% tap water, and 10% expansion space

Model 1190 (7.5′ in diameter, 8.5′ tall): 16-25kW load shift for 6 to 10 hours

Utility Bill Basics

1. **There are three ways to lower electric costs in Massachusetts:**

   a) Buy fewer units of energy.

   b) Purchase power when it's cheaper, at night.

   c) Negotiate a better rate.

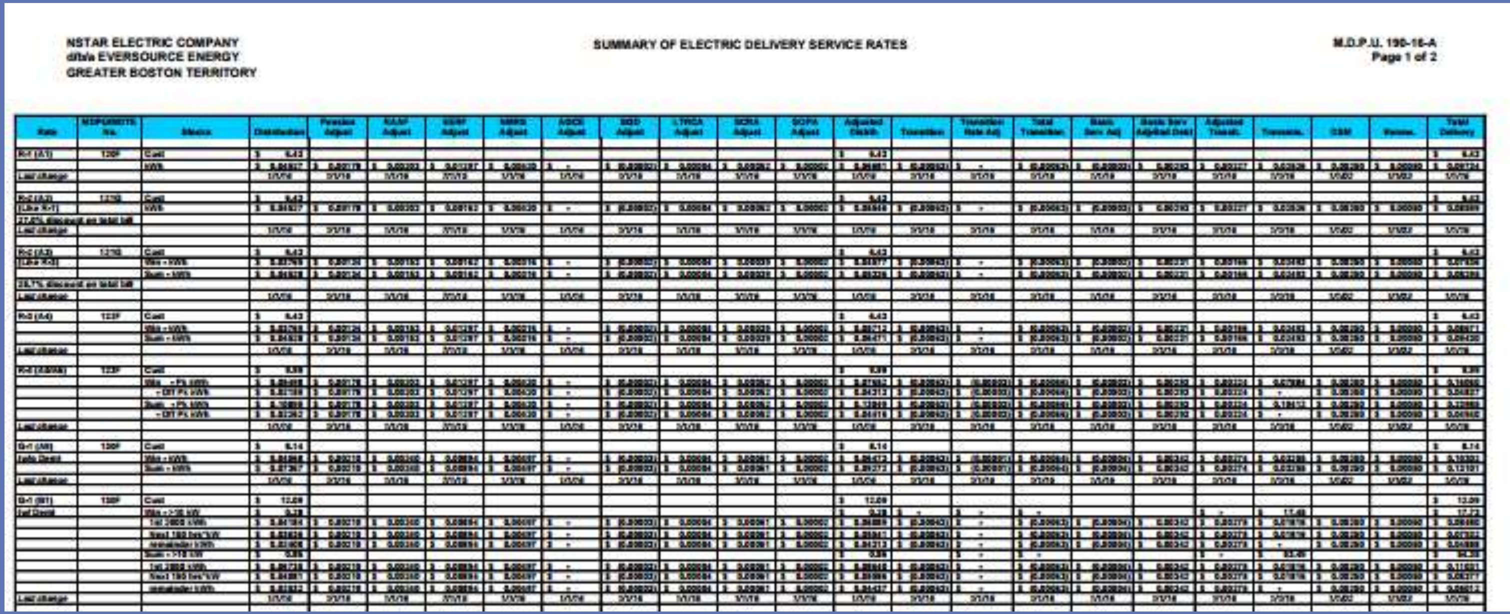
Utility Bill Basics

2. Commercial Rates are Different than Residential Rates:

a) Residential Rates are based solely on Usage (kWh)

b) Commercial Rates are based on a mixture of Usage (kWh) and Demand (peak kW).

Eversource's Greater Boston Rates


NSTAR ELECTRIC COMPANY
d/b/a EVERSOURCE ENERGY
GREATER BOSTON TERRITORY

SUMMARY OF ELECTRIC DELIVERY SERVICE RATES

M.D.P.U. 190-16-A
Page 1 of 2

Note: this is no easier to read when printed out.

The Demand Charge Effect

Eversource Greater Boston T-2 rate

Energy (usage):

Day: ~~$0.08/kWh~~ $0.262/kWh

Night: ~~$0.08/kWh~~ $0.008/kWh

Demand: ~~$29.80/kW/~~Month

How big an effect is the Demand Charge??

Energy is 69% less expensive at night

Demand Charge Effect.....

Do the Math (Back of the Envelope)

Conventional Chiller System

Demand Cost /month

1000 tons x 0.8 kW/ton = 800kW

800 kW x $30.00 = $24,000/month

Energy Usage for Chiller for Month

1000 tons x 10 Hrs x 75% x 0.8 kW/ton x 22 days/month = 132,000 kWh

Approximate Cost for Demand / kWh

$24,000/132,000 kWh/month = $0.182/kWh

Therefore Daytime Energy = $0.08 + $0.18 = 26 cents/kWh

NYC Installations

One Bryant Park

Rockefeller Center

55 Water Street

Goldman Sachs HQ

Others:

1155 Avenue of the Americas (Durst Bldg)
140 West Street (Verizon)
787 Seventh Ave. (AXA Equitable)
The New School
730 Third Ave. (TIAA-CREF)
Fordham Plaza
522 Fifth Ave. (Morgan Stanley)
11 Madison Ave. (Credit Suisse)
Park Avenue Plaza (Fisher Bros.)
111 8th Avenue (Google East Coast HQ)
NYU-Poly Brooklyn Campus

Case Study

Northern New Jersey School District

The Challenge:

- School district wanted to add cooling to their largest high school, but had limited money for upgrades
- No additional electrical capacity available at the site; a substation upgrade would cost many thousands of dollars

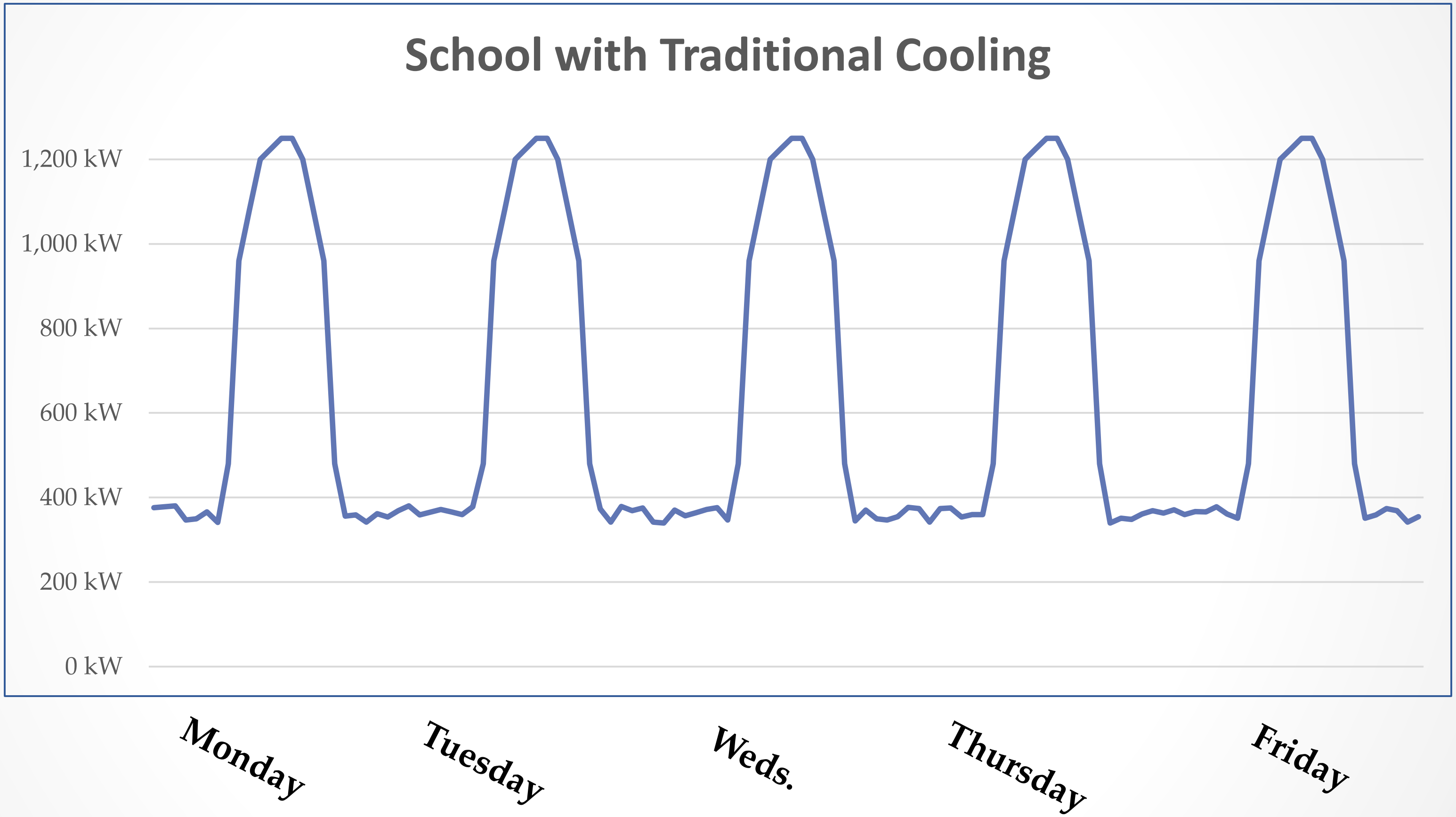
Case Study

Northern New Jersey School District

<u>The Solution:</u>

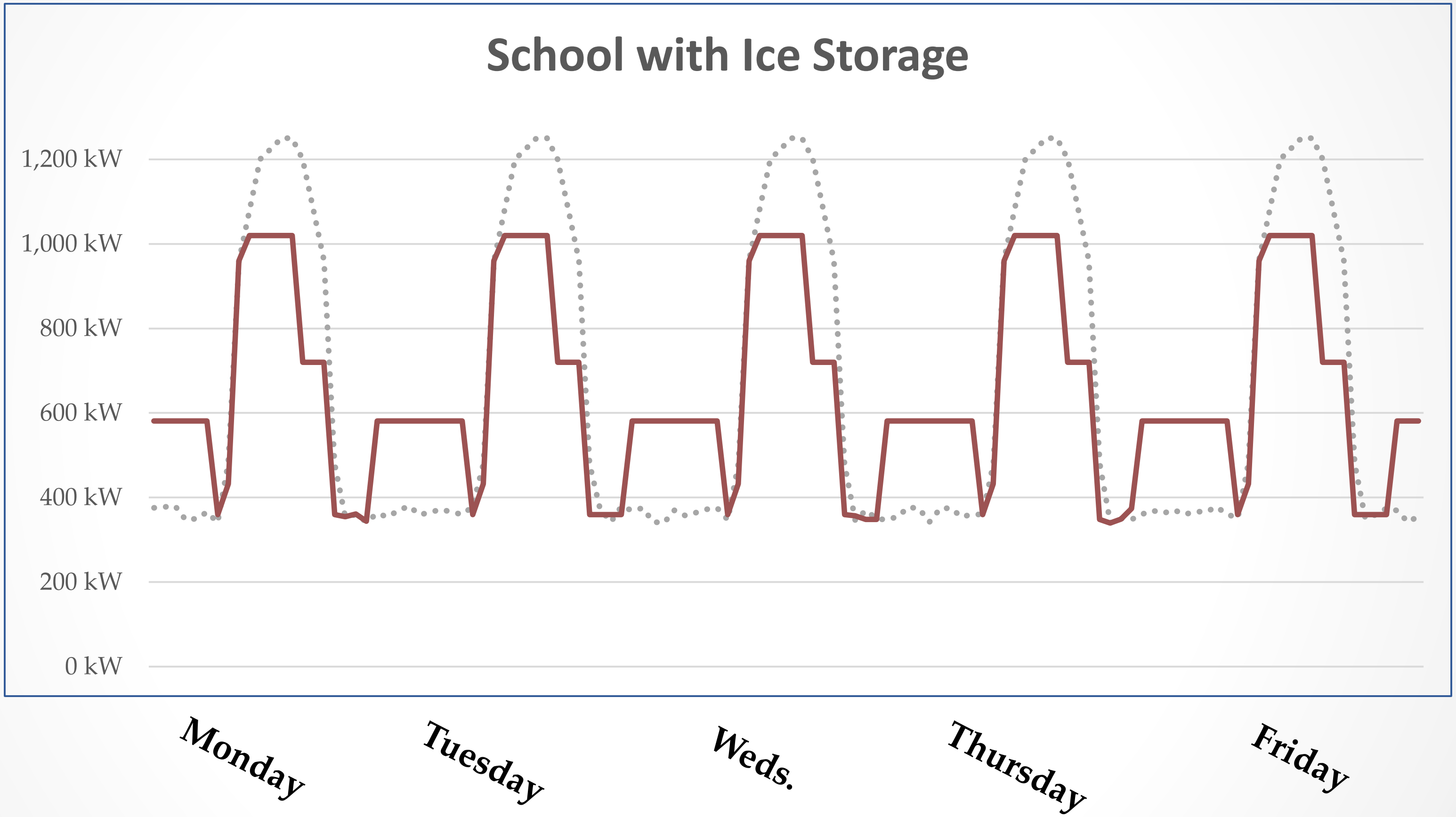
- An ice-based chilled water system: two ~150-ton Trane air-cooled chillers and 12 Calmac IceBanks.
- Partial storage: the chiller makes ice at night, and then both the chiller and the ice operate during the day to meet the building's 500 ton load.
    - Downsizing the chiller saves money and limits connected electric load.
    - The chiller operates at its max efficiency at night and during the day, and the ice provides the balance.
- The Trane Ice Completion Module is the glue that keeps this system operating effectively.

Ice Storage & Schools



Schools have a particularly spiky peak - in many U.S. market (Florida, Ohio, Minn.), K12 projects account for >50% of all Calmac jobs.

Ice Storage & Schools



By shaving 250 kW, we saved this customer over $30,000 per year.
NJ's rates are about two-thirds as high as Boston's.

Ice-Enhanced Air-Cooled Chiller Plant Layout

The pre-packaged system also includes controls that be viewed and modified remotely.

Another K12 ice plant in South Florida

Benefits of Ice Storage

To the consumer:

- First cost savings: storage avoided the need for very expensive substation upgrade
- Annual electricity savings of roughly 10%
- Replicable – school district in negotiations to buy additional, identical packages for other schools

To the grid:

- Major congestion relief, targeted at the ***source of peak***
- ***Higher load factor*** on the grid --> less T&D infrastructure
- More "smart assets" in key places; this is essentially a 250 kW/ 2.0 MWh battery in a highly congested region.

Questions?

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