THE LOW-CARBON FUTURE IS ABOUT BUILDING ELECTRIFICATION.

- Energy Efficiency
- No Fossil Fuels
- Electrification of Systems
- Renewable Electric Grid
# BUILDING ELECTRIFICATION MEANS ELECTRIFYING HEATING (WATER, SPACE)

<table>
<thead>
<tr>
<th>Energy Efficiency Measures</th>
<th>Reduce Heating Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Carbon Electric Heating</td>
<td>Heat Pump Technology Not Electric Resistance</td>
</tr>
<tr>
<td>Heat Pump Technology</td>
<td>How Hot (Space Heating or Domestic Hot Water)?</td>
</tr>
<tr>
<td>Heat Recovery</td>
<td>What is the Heat Source (Warmer than the Outdoors)?</td>
</tr>
<tr>
<td>Thermal Storage</td>
<td>Is the Spare Heat Available When it is Needed?</td>
</tr>
<tr>
<td></td>
<td>When Resource and Need Don’t Line Up</td>
</tr>
</tbody>
</table>
OUTDOOR VENTILATION AIR NEED NOT ADD EXCESSIVE LOADS

Total energy recovery technology decreases ventilation heating loads.

VENTILATION WITH NO HEATING USING ENERGY RECOVERY
AIR-SOURCE HEAT PUMPS

Electric, but bulky, expensive, noisy; require access to the outdoors

- Sized to meet peak loads
- Space-intensive
- High cost
- Increase in electrical demand (winter peak)

FIND ADDITIONAL HEAT SOURCES TO MINIMIZE ASHP SIZE
HOW HOT? SPACE HEATING

Coil Design for Minimum Approach

HEAT THE BUILDING WITH THE COOLEST POSSIBLE HOT WATER
WHAT IS THE HEAT SOURCE FOR OUR HEAT PUMP

Building interior zones are reliable heat sources.

WHY ARE WE THROWING AWAY USEFUL HEAT?
WHEN IS HEAT NEEDED AND WHEN IS IT AVAILABLE?

Heating and cooling requirements vary with weather and use.

CAN EXCESS HEAT BE SAVED TO MEET LATER HEATING NEEDS?
Energy efficiency measures to reduce heating loads

Heat pump technology to lift cold temperature sources to temperatures warm enough to heat the building

Heat recovery from heat sources within the building

Thermal storage to carry the building through thermal deficit
Thermal piles add more than adequate thermal storage.

NEW MANHATTAN OFFICE BUILDING USING GROUND SOURCE

THERMAL STORAGE IN THE GROUND FOR ONLY 100 DAYS

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THERMAL STORAGE WITH THERMALLY ACTIVATED PILES

Small additional first cost to add circulation loop to piles.

MOST MANHATTAN HIGH-RISE BUILDINGS HAVE PILE FOUNDATIONS
Heat recovery and ice storage solve ASHP location problems.

ICE STORAGE ALSO USEFUL FOR SUMMER DEMAND REDUCTION
THERMAL STORAGE ARRANGEMENT

Chiller/Heat Pump

Ice Maker Chiller

Storage Tank (Ice)

Air-Source Heat Pump

Cooling Load

Heating Load

REJECTED HEAT FROM COOLING HEATS THE BUILDING
ASHP FALSE LOADS CHILLER TO INCREASE REJECTED HEAT
THERMAL STORAGE ARRANGEMENT

Heat rejected from ice making heats building

Chiller/Heat Pump

Heating Load

Ice Maker Chiller

Storage Tank (Ice)

Cooling Load

Air-Source Heat Pump

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THERMAL STORAGE ARRANGEMENT

ICE IS MELTED WHEN COOLING LOADS EXCEED HEATING LOADS
ICE THERMAL STORAGE FOR BOTH HEATING AND COOLING

Works well for heating, if you can melt the ice with excess cooling load.

Ice Storage Tanks in Basement Mechanical Room

Ice Storage Use for Summer Cooling Load Shifting

SAVING HEAT IN MELTED ICE TO MEET LATER HEATING NEEDS
NOW THE HARD PART...

CLIENT BUY-IN...
THE FIRST QUESTIONS...

- Why do I need to care about this?
- Who has done this before?
- How expensive is it?
- Will an electrified building cost more to operate?
- Who makes these heat pump products, and how long have they been around?
- Will my tenants or users value an electrified building?
AFTER THE CLIENT AGREES...

Operate

Design

Commission

Build
Simplify, simplify, simplify…

Explicitly describe each mode of operation (and test why it is essential).

Beware of “time constants” of control parameters.

Impose modularity.

Be creative with design deliverables.

Anticipate additional engagement with downstream stakeholders.
REDUCE. RECYCLE. ELECTRIFY.
QUESTIONS