The Sponsors of Energize Connecticut, and in partnership with Connecticut Passive House, are pleased to offer Passive House Initiative to support workforce development and help transform the energy efficiency and building construction industries in Connecticut.

For more information, please visit EnergizeCT.com/passive-house or email PassiveHouseTrainingCT@icf.com
Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more
# Passive House Incentive Structure for Multi-Family (5 Units or More)

<table>
<thead>
<tr>
<th>Incentive Timing</th>
<th>Activity</th>
<th>Incentive Amount</th>
<th>Max Incentive (Per Unit)</th>
<th>Max Incentive (Per Project)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Construction</td>
<td>Feasibility Study(^1)</td>
<td>Up to 100% of Feasibility Study Costs</td>
<td>N/A</td>
<td>$5,000.00</td>
</tr>
<tr>
<td></td>
<td>Energy Modeling(^2)</td>
<td>75% of Energy Modeling Costs (Before 90% Design Drawings)</td>
<td>$500.00</td>
<td>$30,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of Energy Modeling Costs (90% Design/50% Construction)</td>
<td>$250.00</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>Post Construction</td>
<td>Certification(^3)</td>
<td>Up to 100% of Certification Costs</td>
<td>$1,500.00</td>
<td>$60,000.00</td>
</tr>
</tbody>
</table>

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1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant.
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.
Reasons for Switching to All Electric
Since 1972, Steven Winter Associates, Inc. has been providing research, consulting, and advisory services to improve the built environment for private and public sector clients.

Our services include:

- Energy Conservation and Management
- Sustainability Consulting
- Green Building Certification
- Accessibility Consulting

We have over 125 staff across four office locations:
New York, NY | Washington, DC | Norwalk, CT | Boston, MA

For more information, visit
www.swinter.com
Adam Romano C.E.M.
Principal Building Systems Consultant
aromano@swinter.com
212.564.5800 x1110
Learning Objectives

**Summarize** the benefits of electrification

**Discuss** the major considerations when electrifying residential homes

**Understand** how heat pump systems operate and where they can be applied

**Describe** various available options for non-fossil fuel water heating

**List** the options for electrifying a variety of residential end-uses
electrification

district geo

heating/cooling
cold-climate
density/high designs
coordinating efforts

water
heat pumps
central plant strategies
low gwp refrigerants
current trends
rise
hotwater
heating
backup

high
pumps dhwcontrol

advance slide
passive
multideep-retrofits
electric options

family

efficient systems
central plants

real costs
"free"
pumpsnet-zero-ready
balancing hvac

dhw heating
Health Benefits

- Improved Local Air Quality
- Improved Indoor Air Quality
- Reduced Risk of CO Exposure
Comfort Benefits

• Localized delivery of heating and cooling

• Customizable temperature settings by room or zone
Cost Savings

- This is all great, but what do the economics look like?
Carbon Benefits

- Carbon reduction with improved electrical grid
Where to Begin
Ditch the Gas Meter

- Heat Pump Ready Home
- Space Conditioning
- Water Heating
- Cooking and Clothes Drying
- Additional Considerations
Heat Pump Ready Home
Heat Pump Ready Home

• Space heating is closely tied to the energy efficiency of the home.

• Inefficient homes, especially in colder climates, would benefit from bundling insulation and air sealing measures to reduce energy from space heating before sizing/installing a heat pump.
Air Sealing

- An effective air barrier consists of a continuous system of materials (building wrap, membranes, etc.), components (doors, windows, etc.) and accessories (tapes, sealants, etc.).

- These air barrier elements must be airtight individually and when used together.
Insulation

• All insulation work begins with air-sealing.
  • Never insulate a wall, roof, or floor without first making sure the air leaks within the vicinity are addressed.

• Typically the attic followed by the crawlspace are the most cost effective locations to perform insulating work.
Heat Pump Operation and Components
What is a Heat Pump?

• Heat Pumps do not generate heat, they move heat.
  • When we discuss energy efficiency of heat pumps, it’s all about how much useful heat is pumped or moved compared to the amount of input energy consumed.
  • This work is performed using the vapor compression cycle.
Old Heat Pumps

- Used very often further south.
- Old HP’s didn’t work well below ~30°F
- BAD reputation in colder climates
New Heat Pumps

- Cold Climate Air Source Heat Pumps (ccASHPs) systems are an efficient clean energy solution to dramatically reduce the use of carbon-intensive space heating systems.

https://ashp.neep.org/
### ccASHP Performance

<table>
<thead>
<tr>
<th>Outdoor Temperature (°F)</th>
<th>Btu/h Output</th>
<th>COP</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>36,000</td>
<td>3.75</td>
<td>42,000</td>
</tr>
<tr>
<td>17</td>
<td>42,000</td>
<td>4.51</td>
<td>39,341</td>
</tr>
<tr>
<td>5</td>
<td>39,341</td>
<td>2.25</td>
<td>20,010</td>
</tr>
</tbody>
</table>

**Name Plate Capacity:** 36,000 Btu/h

**Source:** NEEP ccASHP Product Listing 01.31.2019, Carrier Performance Data
Heat Pump System Types
Ground Source

- Takes heat from the ground and injects it into the indoor air.
- Consist of an indoor unit and ground loop.
  - Ground loops can be horizontal, vertical, or pond/lake
System Types Geothermal

- One central ducted geothermal unit
- Indoor unit contains a heat exchanger that absorbs/rejects heat to ground loop.
  - Typ. 2 - 5 tons
  - “Fully ducted”
Air Source

- Takes heat from the outdoor air and injects it into the indoor air.
- Consist of an outdoor and indoor unit connected via a refrigerant line set.
1 **Low-wall** or **floor mount** units may be installed where radiators once were. Do not block them with furniture.

2 **High-wall** are the most common and versatile.

3 **Recessed** can be flush with ceilings or walls. Ask your installer about installation and maintenance.
**Conventional air handlers** move air through larger ducts. They are often located in basements, attics, or utility closets. They can be installed to blow air upwards, downwards, or sideways to fit within your home.

**Compact ducted air handlers** usually serve smaller areas such as one to three rooms. Their slim profile means they often fit in dropped ceilings, but leaving access for maintenance is important.
System Types **Mini-Split**

- Smaller decentralized air-source heat pump systems
  - Split and Mini Split <1.5 Tons

- Here are one-to-one systems where you'll have one outdoor unit coupled with one.

- Indoor units are typically small and that indoor unit can be either ductless or ducted.
System Types **Multi-Split**

- This is again one outdoor unit, but it's connected to multiple indoor units.
- We would have refrigerant piping going from the outdoor unit to a couple of indoor units
  - One outdoor unit
  - 2+ indoor units
  - Ducted, Ductless, or mix
  - 1.5 – 4 tons typ.
System Types **Central Split**

- One outdoor unit, one central ducted air handler
- More conventional residential A/C system
  - Typ. 2 - 5 tons
  - “Fully ducted”
Questions?
Water Heating
Flow Rates

- Lower flow rates to improve efficiency.
- SWA rec flow
  - 1.0 gpm bath sink
  - 1.5 shower and kitchen
- Complaint zone
  - 0.5 gpm in residences

Residential Water Use

- Toilet: 24%
- Shower: 20%
- Faucet: 19%
- Clothes Washer: 17%
- Leak: 12%
- Other: 8%
System Types

Electric Resistance: Tank Type
System Types

Electric Resistance: Tankless
System Types: Heat Pump Water Heater (HPWH)
System Types Split Heat Pump Water Heater
Appliances
Cooktops Electric Resistance

Typical Plug In Element
Cooktops Induction

eddy currents produced in base of frypan

ceramic surface

coil supplied with high frequency AC

rapidly changing magnetic field

AC B
Clothes Dryer Electric
Clothes Dryer Heat Pump

1. Drum
2. Filter
3. Warm Humid Air
4. Evaporator
5. Condensate
6. Compressor
7. Expansion Device
8. Condenser
9. Blower
10. Hot Dry Air
Additional Considerations
Assessing Electrical Capacity

- The electric service in a home is measured in amps. Most homes today have either a 150 amp or 200 amp service.

- It's important to have a professional determine the electrical load before installing the service.
Electrical Work

- Heat Pump 208/240v 30amp
- Induction Range 208/240v 40amp
- Heat Pump Dryer 208/240v 30amp
- Integrated Water Heater 208/240v 30amp
- Split Water Heater 208/240v 15amp
Adding Solar PV

• If an electrical upgrade is needed, it may be a good time to evaluate adding solar PV.
Thank You

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