



Low Carbon HVAC Retrofits Strategies

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March 24, 2022

Agenda & Housekeeping

1 Introduction & Polls

2 Presentation from NREL

3 Q&A



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Today's Presenters



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Have you used heat pumps for HVAC systems?

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What is your primary motivation to use heat pumps for HVAC systems?

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Heat Pump Barriers

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Low Carbon Buildings and HVAC Systems

Low Carbon Prioritization

Energy efficiency is the **first step** in decarbonizing your building.

Envelope upgrades and energy efficiency can dramatically reduce HVAC loads and equipment sizing

Electrify fuel-fired equipment with heat pump technologies.

Decarbonization Priority Waterfall



Energy Efficiency

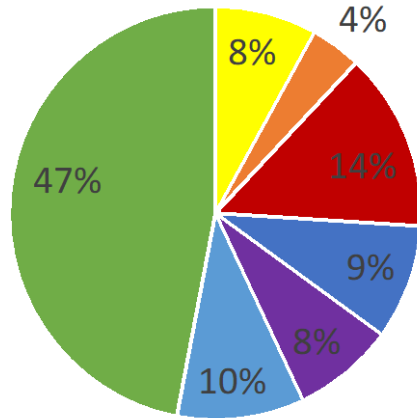
On-Site Renewables

Grid Interactivity

Off-Site Renewables

RECs & Carbon Offsets

Commercial Buildings Energy and Carbon Today



- Lighting
- Water Heating
- Heating
- Cooling
- Ventilation
- Refrigeration
- Plug and Process

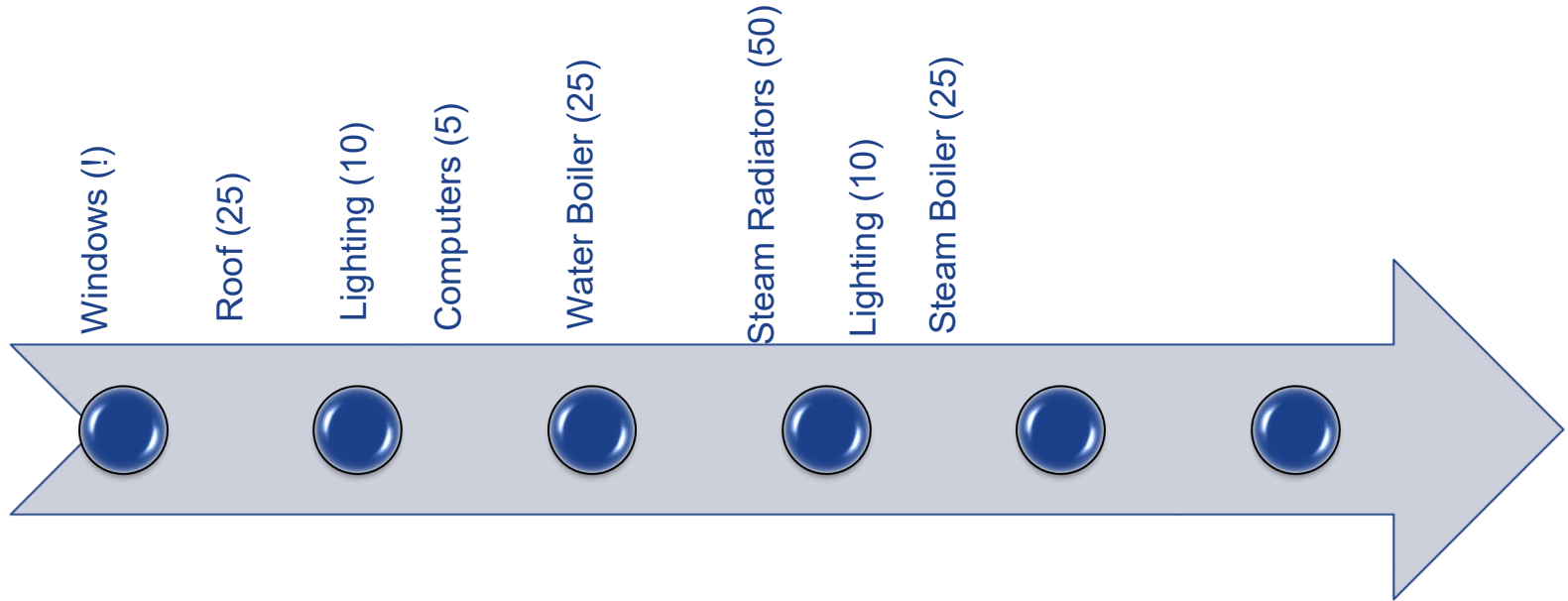
Energy Use breakdown by building end uses today

34% for HVAC –many components in HVAC systems use electricity

Why do we need HVAC systems?

To balance out and make up for all the rest!

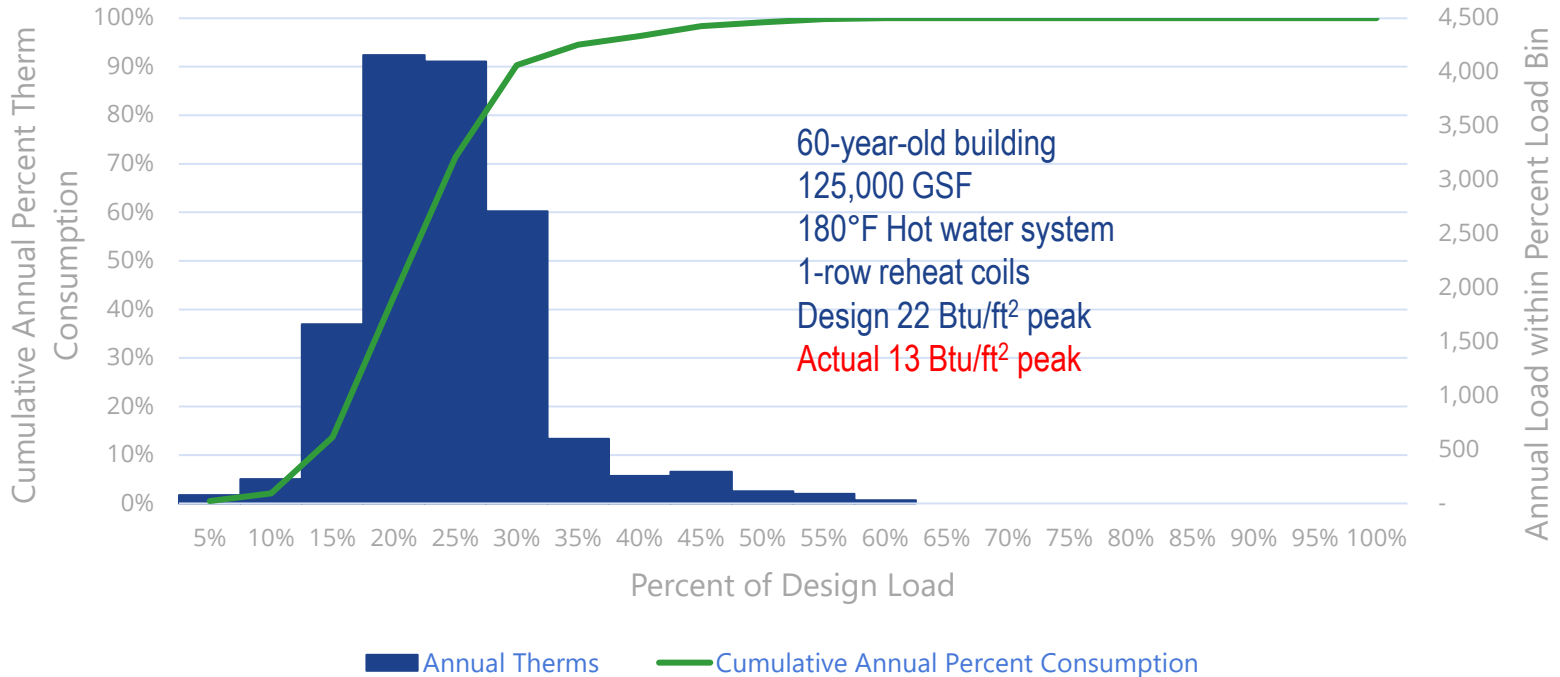
Building Lifecycle



Look for opportunities where money will be spent on the building

Understanding Your Building Heating Load

Existing Building Annual Heat Load Distribution



Information Courtesy of P2S Engineering

What are the Solutions?

Retrofit Options to Replace my RTUs

- Packaged RTUs are the most common HVAC system in commercial buildings (50% commercial floor space)
- What are my efficient electric options?
 - Heat Pump RTUs are available by most commercial HVAC manufacturers
 - Sizes 3 ton up to 28 tons for some manufactures (most offer up to 20 tons)
 - Dual fuel heat pump
 - Variable refrigerant flow (VRF) or water-to-air systems including ground-source heat pumps (GSHP) are options but require substantial renovation
- Key Considerations
 - Limited cold-climate performance capabilities
 - Although a COP ~2 is still twice as efficient as electric resistance and gas units.....
 - Large capacity units (> 30 tons) currently not available
 - Weight capacity and electrical infrastructure need to be considered
 - Unit duct work connections and curb dimensions may require additional collaboration with manufacturers



Photo: Lennox

Retrofit Options to Replace my Furnace

- Some small/light commercial buildings rely on ducted split systems with either gas furnace or electric resistance heat (less than 20% of commercial floor space)
- What are my efficient electric options?
 - Heat Pump solutions are widely available by most commercial HVAC manufacturers
 - Variable refrigerant flow (VRF) or ground-source heat pumps (GSHP) are options but require substantial renovation
- Key Considerations
 - Need to pay attention to cold-climate performance capabilities
 - Different grades of heat pumps based on how they operate at cold temperatures
 - Although a COP ~2 is still twice as efficient as electric resistance and gas units.....

Retrofit Options for my Hydronic System

- Boiler heating systems serve nearly one-third of commercial building floor space
- Many considerations may require careful and custom system re-design
 - Traditional high temperature systems (150°F – 180°F)
 - Low temperature systems (110°F – 150°F)
 - Steam systems (more common in larger district application, and older vintage buildings)
 - Terminals include radiators, radiant floors, heating coils, reheating coils
- The opportunity is that many of these are approaching end of life—especially the piping systems

Retrofit Options for my Hydronic System

- What are my efficient electric options?
 - Air-to-water and water-to-water heat pumps can generate temperatures typically between (110°F – 140°F) – ideal for low temperature hydronic systems
 - When installing new radiators, VAV boxes, coils, etc. → Design for this temperature range—the lower the better.
 - Heat recovery chillers
 - Variable refrigerant flow (VRF) or ground-source heat pumps (GSHP) are options, but require substantial redesign and renovation

Retrofit Options to Replace my Hydronic System

Heat Recovery Chillers vs Heat Pumps

- Heat Recovery Chillers (Heat Reclaim Chillers)
 - Systems are designed to chill water for COOLING!
 - Heat is **recovered** – warm water (85°F - 95°F)
- Heat Pump
 - Designed for HEATING!
 - Heat is **generated** – hot water (110°F - 150°F most technologies)!
 - Capacity of heat controlled by Leaving CONDENSER Water Temperature

Retrofit Options to Replace my Hydronic System

- Emerging Technologies
 - Modular air-to water and water-to-water units
 - Simultaneous chiller and heat pump modular units
- Other Considerations
 - Reusing hydronic piping infrastructure in high-to-low temp retrofit applications may be feasible especially if envelope or other weatherization upgrades have been complete or are planned at a facility
 - **Update heat load calculation or consider a building energy model to for annual performance and operation**

Resources

- Join us! [BetterBuildingsSolutionCenter.energy.gov](https://www.betterbuildingsolutioncenter.energy.gov)
- [Better Climate Challenge | Better Buildings Initiative \(energy.gov\)](https://www.energy.gov/better-climate-challenge)
- [Low Carbon Pilot | Better Buildings Initiative \(energy.gov\)](https://www.energy.gov/low-carbon-pilot)
- [Decarbonization Hub](https://www.energy.gov/decarbonization-hub)
- [Low Carbon Technology Strategies](https://www.energy.gov/low-carbon-technology-strategies)
- [Decarbonizing HVAC and Water Heating in Commercial Buildings](https://www.energy.gov/decarbonizing-hvac-and-water-heating-in-commercial-buildings)
- www.ashrae.org/aedg

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Audience Q&A Session

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*Reach out to us with any
questions!*

Thank you!