

# BENEFITS OF BUILDING ELECTRIFICATION: WEBINAR ONE-PAGER

## BACKGROUND

[Energize Denver](#) was created to implement a building performance policy that includes energy efficiency improvements and strategic electrification of all existing buildings and homes to achieve net zero energy by 2040. The [Energize Denver Ordinance](#) is broken down into three sections: [Benchmarking](#), [Performance](#), and [Electrification](#).

Denver's [Electrification](#) program amends the building and fire code to require partial electrification of space and water heating systems at time of replacement. The [Renewable Heating and Cooling Plan](#) lays out seven conversion playbooks that highlight options for partial and full electrification for the most common space and water heating typologies found in Denver's buildings and homes. Additionally, the [Cost Effective Strategies for Electrification](#) provides a comprehensive review of the ease of replacing existing systems with partial electric systems.

## HEAT PUMPS

Heat pumps do not generate heat, they move it. Systems can be 200 – 300% efficient because there is no lost energy as seen in a combustion process. Because heat pumps run on electricity, they will also use less carbon intensive fuel sources as Denver's grid gets cleaner. Heat pumps can transfer heat from the air, water, or the ground. The most common systems are air-source heat pumps which can be unitized or centralized.

### System Types

Type	Description	Considerations
<b>Space Heating and Cooling</b>		
<b>Packaged Terminal Heat Pumps (PTHPs)</b>	Unitized Through-wall unit provides efficient heating + cooling to a single room.	Refrigerant contained in unit, minimized risk of leaks; Limited cold climate models on the market; Condensate drains at every unit; Through-wall penetrations reduce envelope effectiveness
<b>Mini-Split Heat Pumps</b>	Unitized Small, outdoor compressor provides efficient heating + cooling to fan coil units in a single apartment.	Maintenance and accessibility of increased quantity of equipment; Outdoor unit spacing; Short refrigerant lines
<b>Multi-Split Heat Pumps</b>	Unitized Small, outdoor compressor provides efficient heating + cooling to fan coil units in multiple zones, typically in a single apartment.	Allows for more control of temperatures in each zone; Maintenance and accessibility of units; More refrigerant volume than mini-splits
<b>Variable Refrigerant Flow (VRF)</b>	Centralized Large rooftop compressors provides efficient heating + cooling to fan coil units in multiple apartments. May include heat recovery which increases efficiency.	Most applicable for commercial and multifamily buildings; Fewer outdoor units; Longer refrigerant lines; High refrigerant volume; Careful zone design to maximize heat recovery
<b>Rooftop Units with Heat Pump</b>	Centralized RTU models that include a cold climate heat pump section and energy recovery wheel.	Still uses gas to heat; Limited carbon reduction; Puts more emphasis on complex controls integration
<b>Air-to-Water Heat Pump (AWHP)</b>	Centralized Terminal units accept low or moderate temperature ranges (typically above 70F for cooling, below 110F for heating) from a hydronic loop heated by air-to-water heat pumps	Best used in high efficiency, low load buildings; provides simultaneous heating and cooling; Limited options for very cold climates

<b>Water Source Heat Pumps (WSHP)</b>	Centralized	Packaged reverse cycle heat pump units interconnected by a water loop.	Provides simultaneous heating and cooling; Ground loops introduce additional cost and complexity compared to air source alternatives
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### Domestic Hot Water (DHW)

<b>Integrated Heat Pump Water Heaters (HPWH)</b>	Unitized	All components are integrated into one system which uses the conditioned air of the space they are located to heat the water.	Most applicable for single family homes; Can increase heating load; Cools space in which they are located; Can be loud
<b>DHW Air-to-Water Heat Pump (AWHP)</b>	Unitized/ Centralized	Large or multiple small outdoor compressor provides heating to water storage tank and heat pump water heater to serve zones or entire building.	Space needs for multiple outdoor units; Refrigerant management; Allows for more control of temperatures in each zone; Maintenance and accessibility of units; Limited product selection
<b>DHW Water-to-Water Heat Pump (WWHP)</b>	Centralized	Heat pump combined with hydronic or geothermal systems.	Good option for hydronic heating distribution system; Ground loops introduce additional cost and complexity compared to air source alternatives

## RETROFIT CONSIDERATIONS

### Select Cold Climate Products

Cold climate models must be selected in Denver for every technology discussed. Cold climate heat pump (CCHP) technology is reliable and is rapidly expanding. CCHPs use variable compressors to adjust the compressor speed depending on real time temperatures. They also use refrigerants with a lower boiling point compared to refrigerants commonly found in traditional heat pumps.

### Sizing and Capacity

Proper sizing is extremely important to maintain comfort. It is essential to plan for capacity at design temperature to be sure it can meet the heating and cooling needs on design temperature days. Oversized systems may stay in “low” fan speed and be less efficient. For low-load spaces, it may be beneficial to have one system heating and cooling multiple rooms.

### Location

The location of the indoor and outdoor units impacts efficiency. Because room temperature is stratified, if the indoor unit is placed high on the wall, it may not provide adequate heating to the lower part of the room. Consider floor/low-wall fan coils for heating-dominated settings. Outdoor units need to be properly spaced so that they are not impacting the efficiency of a neighboring unit. Because outdoor units will go into defrost mode in winter to melt frozen condensate on the coil which causes runoff. If you site units in a vertical fashion, units above might drip down into units below which would then cause the water to freeze on the entire unit. Additionally, it is important to account for snow drift and accumulation to ensure that outdoor units remain clear throughout the year.

### Refrigerant Management

Unitized systems, such as mini-splits, require numerous refrigerant/condensate lines and therefore careful consideration of placement. In centralized systems, the refrigerant/condensate lines are consolidated but there is a greater volume of refrigerant overall, making leakage a greater concern. Centralized systems require greater oversight and commissioning. However, both unitized and centralized systems, line installations require penetration and can be invasive. Additionally, it is important to consider the global warming potential of the refrigerants being used.