

# Residential Heat Pumps in the Southwest

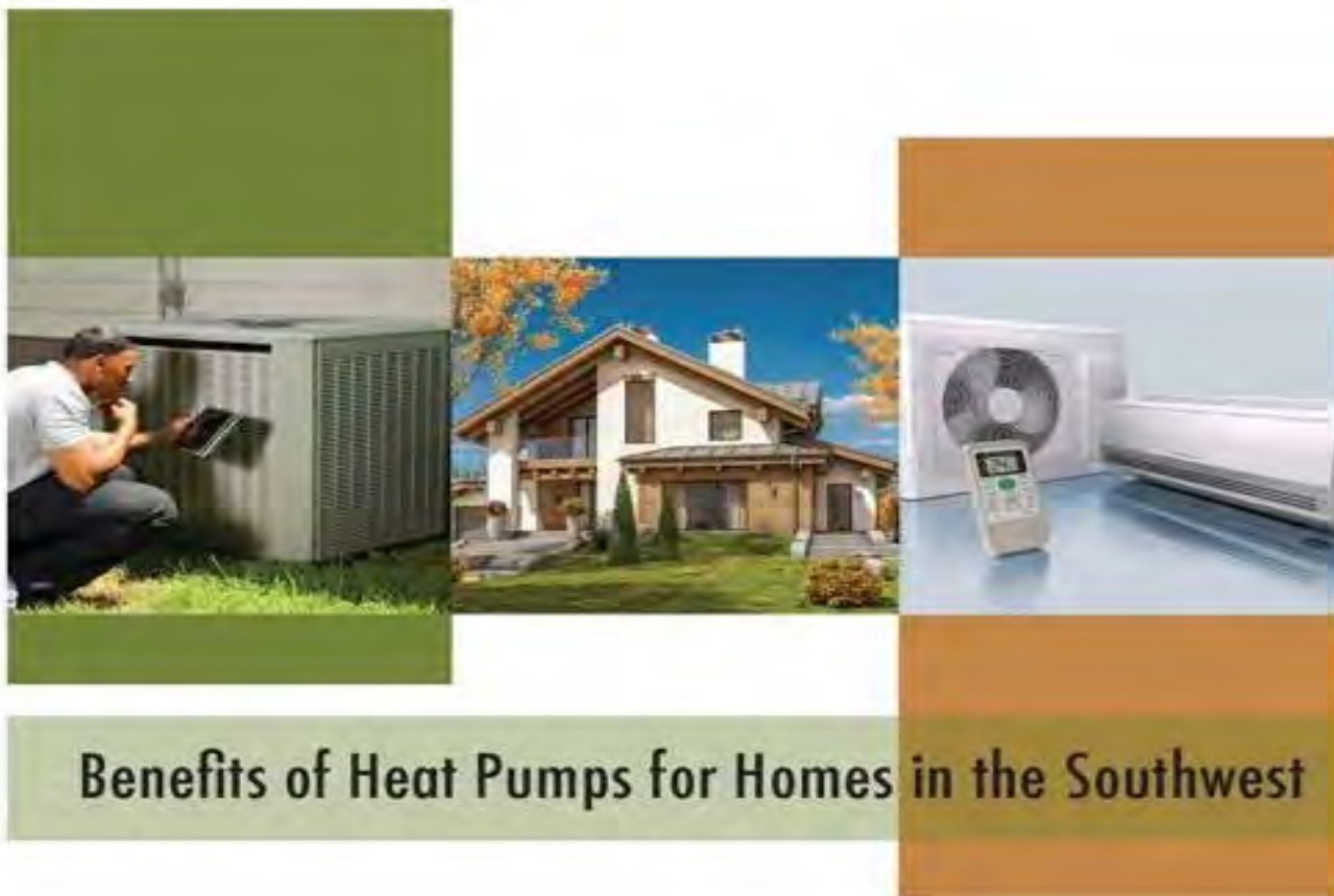
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SWEEP Workshop

Nov. 29, 2018



## Benefits of Heat Pumps for Homes in the Southwest

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# Potential Benefits of Heat Pumps

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- ❑ Reduced energy costs for consumers
- ❑ Reduced CO<sub>2</sub> emissions
- ❑ Improved load factors for electric utilities (increased load in winter months)

# Previous Heat Pump Research

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- Heat pumps reduce CO<sub>2</sub> emissions and are cost-effective:
  - When replacing electric resistance heating
  - When replacing propane or fuel oil heating
- More cost-effective for new homes

# SWEEP Heat Pump Study: Objectives

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- Do heat pumps save energy, lower GHG emissions and save consumers money in homes in major cities in the Southwest?
- Compared to natural gas space heating
- In Denver, Salt Lake City (SLC), Reno, Las Vegas, and Phoenix
- Considers both new homes/ductless heat pumps and existing homes/ducted heat pumps
- Also compares gas water heaters to electric heat pump water heaters (HPWHs)

# SWEEP Heat Pump Study: Methodology

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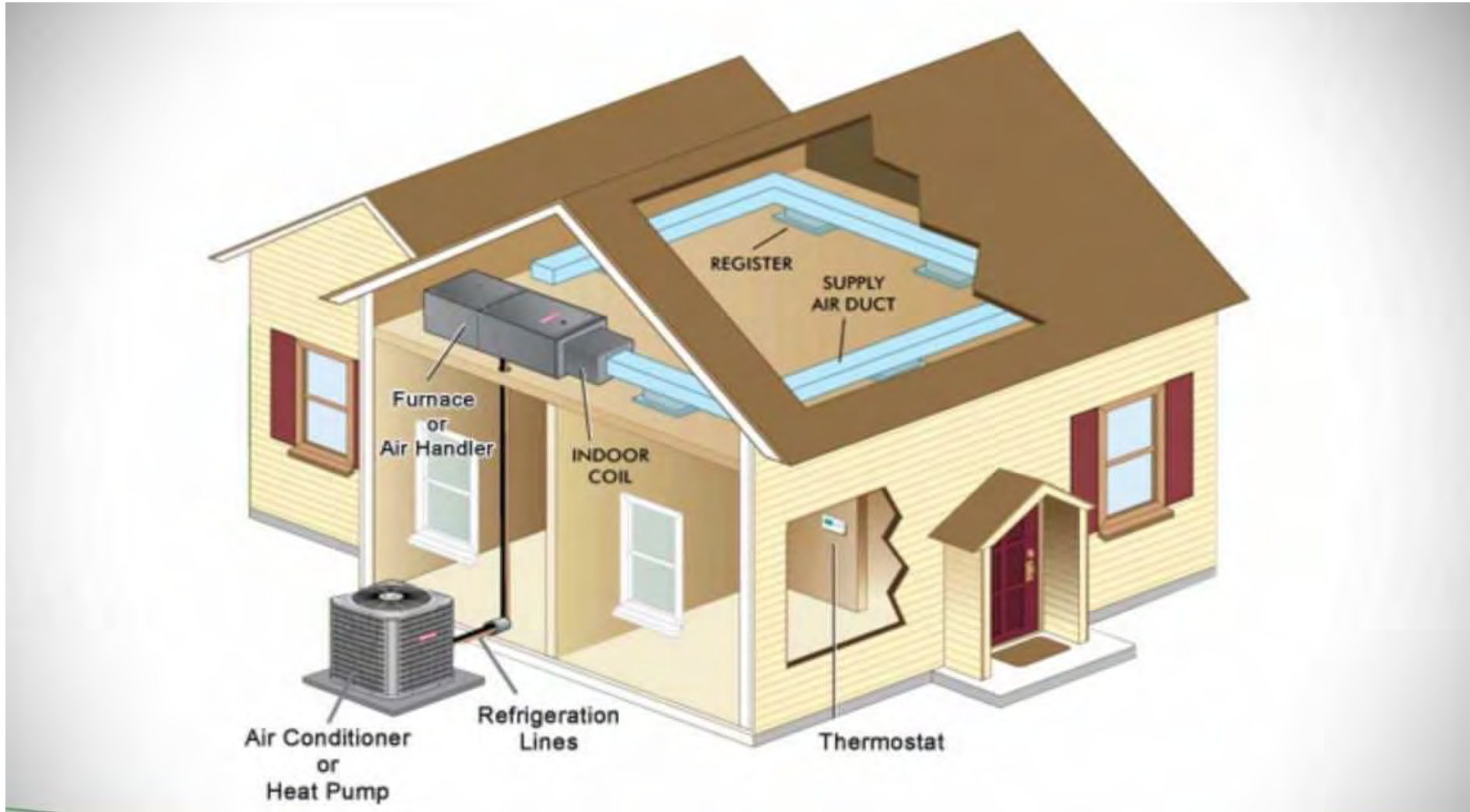
- Considers lifecycle cost from perspective of homeowner, using variable prices of electricity and natural gas in each city
- Analyzes primary energy use and CO<sub>2</sub> emissions
- Uses projected average CO<sub>2</sub> emissions factors for the major electric utility in each city
- Assumes ENERGY STAR rated equipment
- Existing homes: install HP when either furnace or CAC system needs replacing

# Ductless Mini-Split Heat Pump System

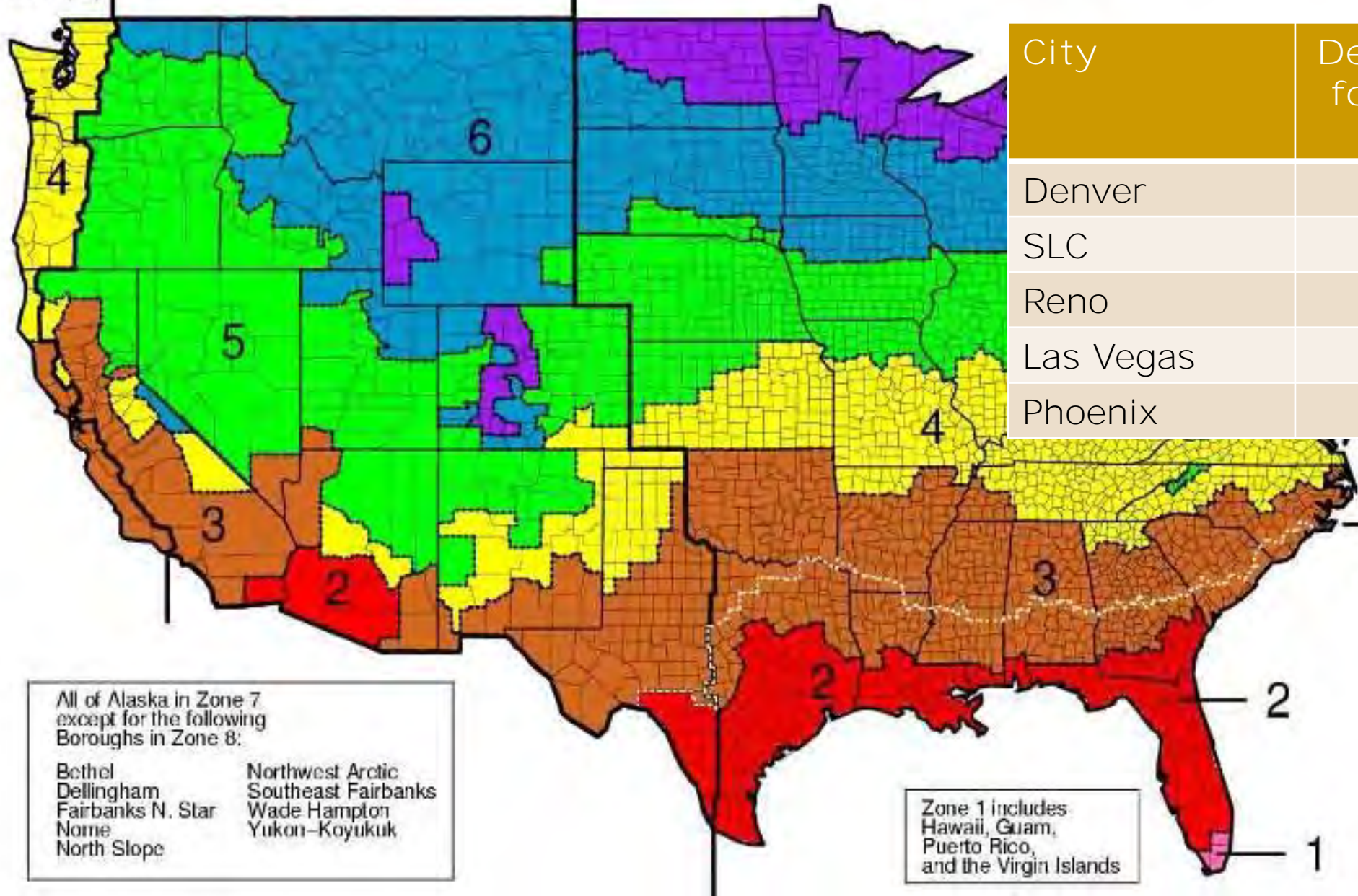


*Photo illustration: U.S. EPA ENERGY STAR*

# Ducted Heat Pump System







City	Design temp for heating (F)
Denver	5
SLC	14
Reno	17
Las Vegas	33
Phoenix	40

Warm-Humid Below White Line

All of Alaska in Zone 7 except for the following Boroughs in Zone 8:

Bethel	Northwest Arctic
Dellingham	Southeast Fairbanks
Fairbanks N. Star	Wade Hampton
Nome	Yukon-Koyukuk
North Slope	

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands

# Cold Climate Heat Pumps

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- ❑ Achieve better energy performance at colder temperatures
- ❑ Available in both ducted and ductless mini-split types
- ❑ Minimum COP of 1.75 at an outdoor temperature of 5 degrees F (NEEP)
- ❑ Variable-speed compressor
- ❑ Slightly more expensive than ENERGY STAR-rated HPs

# Backup Furnace Alternative (for colder climates)

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HP with backup gas furnace vs. HP-only retrofit

City	Balance Point Temp (F)	Relative Energy Savings	Equipment cost savings (NPV)
Denver	20	89%	\$600
SLC	25	89%	\$100
Reno	25	88%	\$100

# SWEEP Heat Pump Study: Results

Do Heat Pumps Save Money? Energy? Greenhouse Gas Emissions?

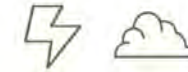
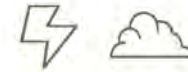


Ductless Heat Pump in New Home

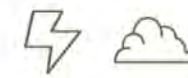
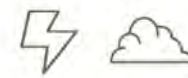
Ducted Heat Pump in Existing Home

Heat Pump Water Heater in New or Existing Home

Denver



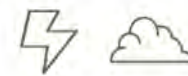
Las Vegas



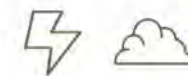
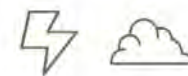
Phoenix



Reno



Salt Lake City

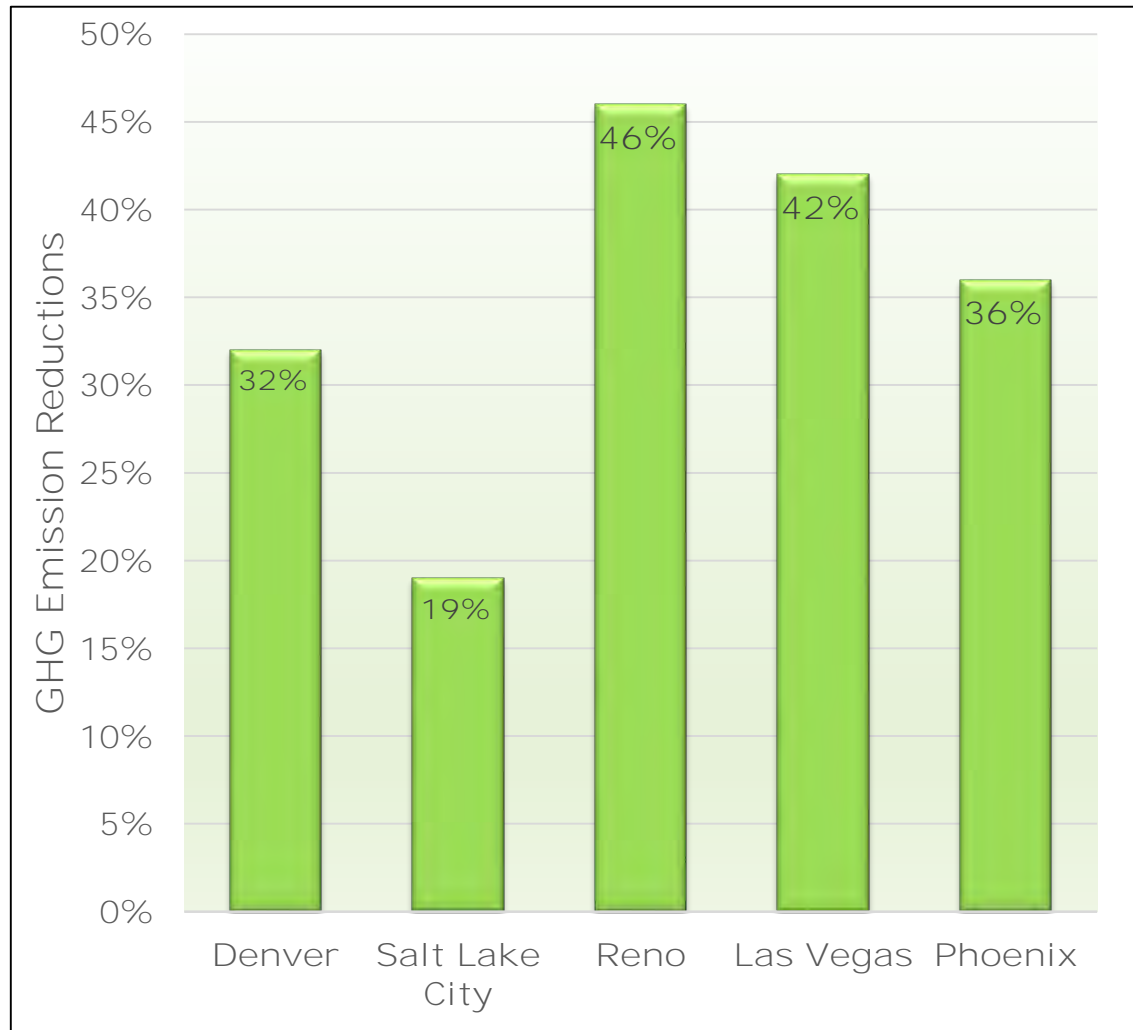


# Ductless Heat Pumps – New Homes

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City	Primary Energy Savings	GHG Emission Reductions	Life-cycle cost savings
Denver	31%	32%	14%
SLC	32%	19%	21%
Reno	32%	46%	21%
Las Vegas	32%	42%	29%
Phoenix	29%	36%	31%

# Ductless HP GHG Benefits - New Homes



## Electricity GHG Emission Factors

City/Utility	GHG Emission Factor (lb CO <sub>2</sub> /MWh)
Denver/Xcel	945
Salt Lake City/RMP	1215
Reno and Las Vegas/NV Energy	732
Phoenix/APS	685

# Ducted Heat Pumps – Existing Homes

City	Primary Energy Savings	GHG Emission Reductions	Life-cycle cost savings
Denver	16%	18%	-32%
SLC	18%	2%	-7%
Reno	17%	35%	-20%
Las Vegas	10%	22%	-5%
Phoenix	3%	14%	6%

# Heat Pump Water Heaters

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City	Primary Energy Savings	GHG Emission Reductions	Life-cycle cost savings
Denver	50%	52%	-32%
SLC	50%	38%	-9%
Reno	52%	63%	-27%
Las Vegas	54%	64%	-22%
Phoenix	52%	66%	7%



# Comparison of Heat Pumps and HPWHs

Equipment	Heating efficiency	Primary energy savings - heating
ENERGY STAR gas furnace	95% AFUE	-----
Cold-climate ductless HP (Reno)	2.93 COP	33%
Cold-climate ducted HP (Reno)	2.64 COP	19%
ENERGY STAR natural gas water heater	0.68 UEF	-----
ENERGY STAR heat pump water heater	3.38 UEF	52%

# Recommendations

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- Provide incentives and/or attractive financing for:
  - Ductless HPs for new homes
  - HPs in existing homes with electric resistance heating
  - HPs in targeted existing homes (e.g., Phoenix)
  - HPWHs (new and existing) - based on large energy and GHG benefits

# HP Incentives

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Utility	Ductless HP Incentive	HPWH Incentive
Puget Sound Energy (WA)	\$800	\$500
National Grid (MA)	\$500	\$750
Rocky Mountain Power (UT)	\$1,300	\$550

# Recommendations, cont.

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- ❑ Offer Time-of-Use (TOU) electric rates
- ❑ Educate/train consumers, builders, HVAC contractors
- ❑ Establish a regional heat pump market transformation initiative in the Southwest

<https://www.youtube.com/watch?v=aHhRZ4vpN7U>

# SWEEP

*Dedicated to More Efficient Energy Use in the Southwest*

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SWEEP heat pump study:

<http://swenergy.org/publications/building>

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