HEAT PUMPS

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October 29, 2025

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HEAT PUMPS

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- The “How?”
- The “Where?”
- The “Why?”
- Additional Resources.

THE “HOW?”

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HOW HEAT PUMPS WORK

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- Move Heat Instead of Generating It.
  - Efficiencies > 100%.
- Fully Functional Air Conditioners.
- Replace Existing Heating and Cooling.
- Offset Existing Heating and Cooling.
- Provide Heating and Cooling Where There Was None Before.

REFRIGERATION CYCLE

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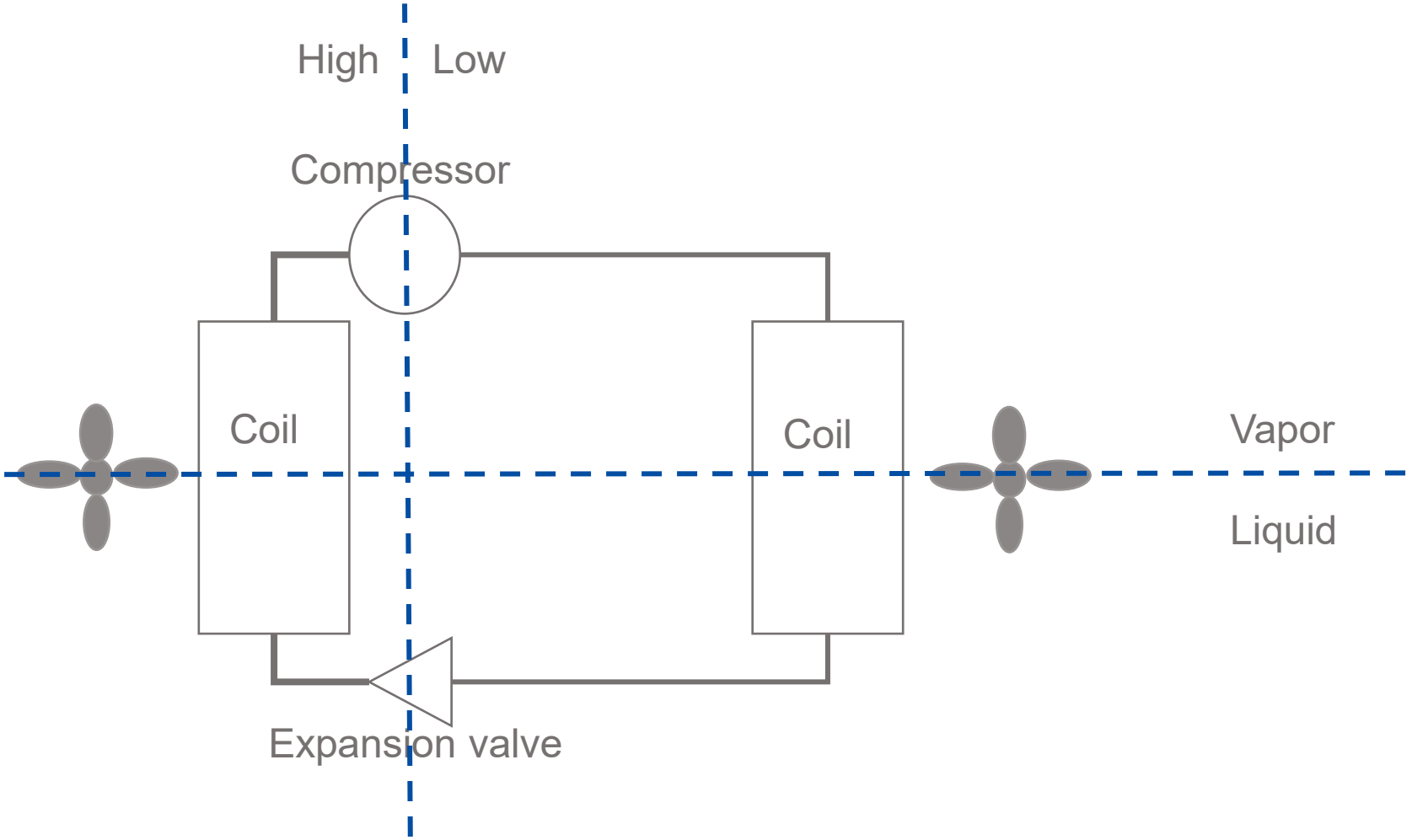

REFRIGERATION CYCLE: COOLING

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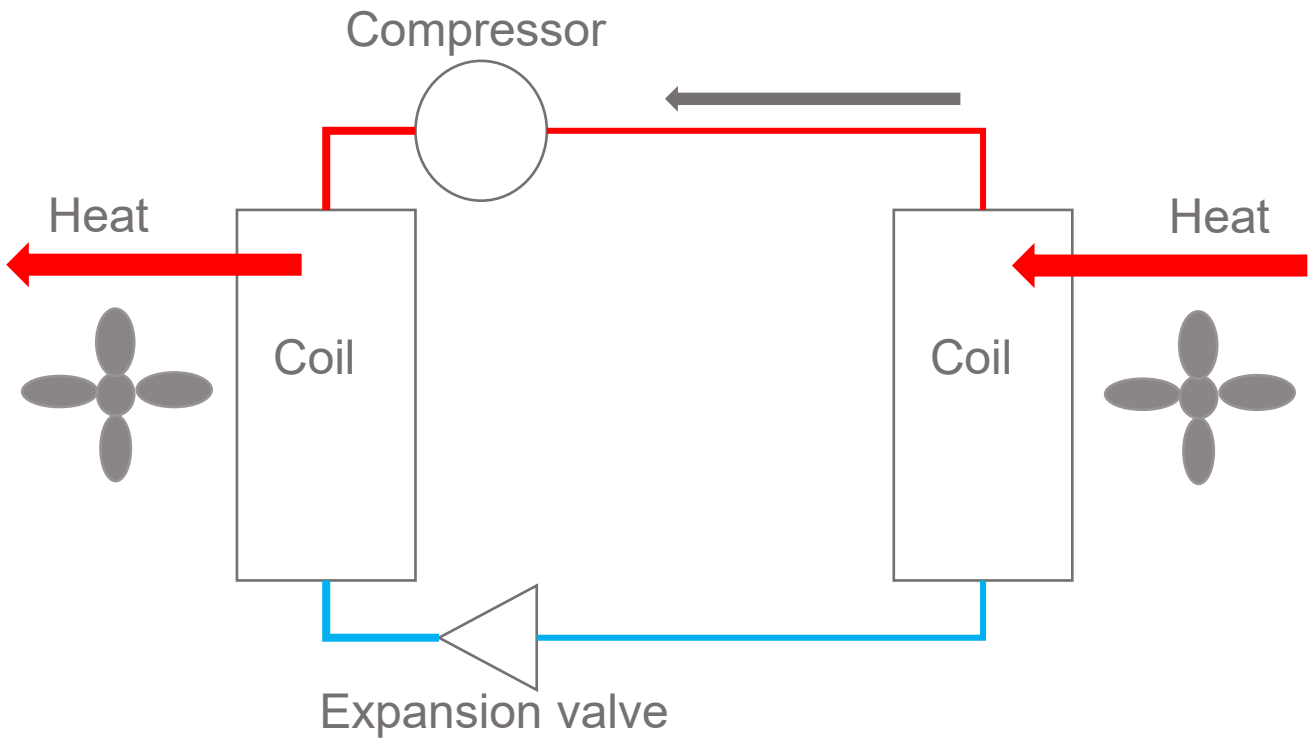

REFRIGERATION CYCLE: HEATING

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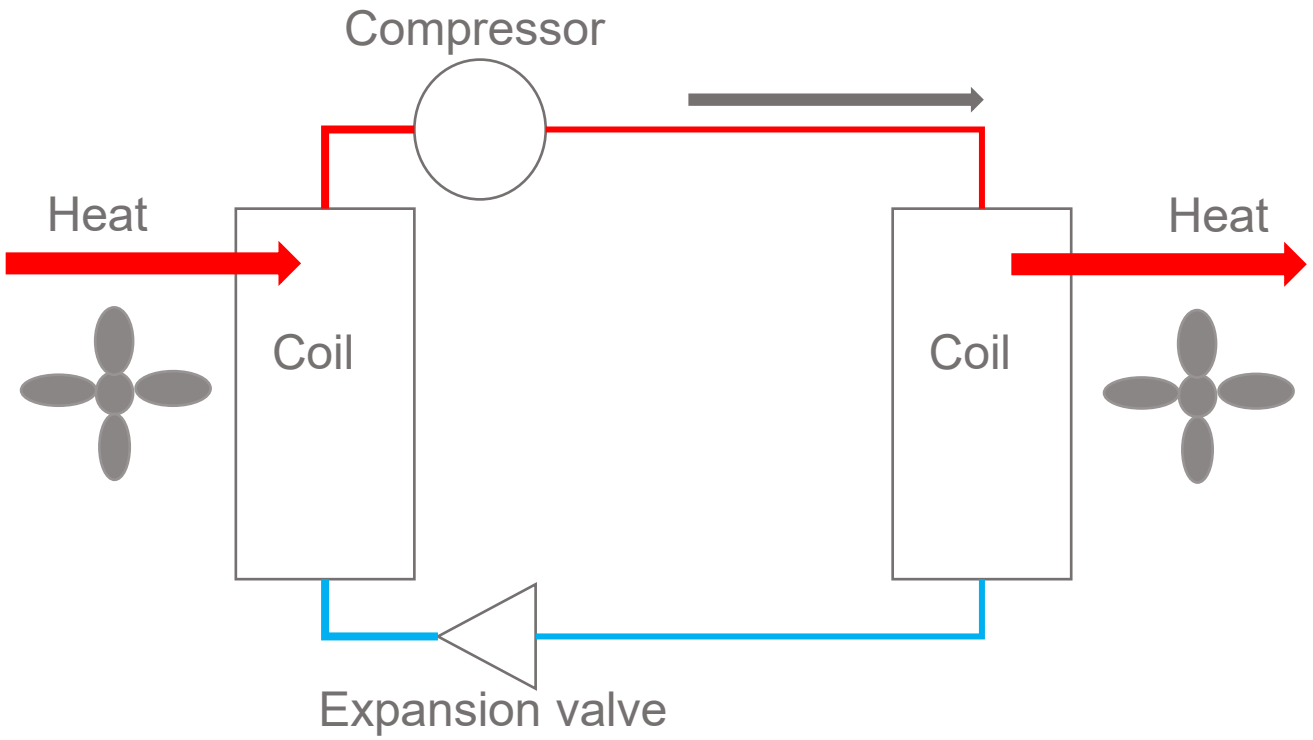

REFRIGERATION CYCLE

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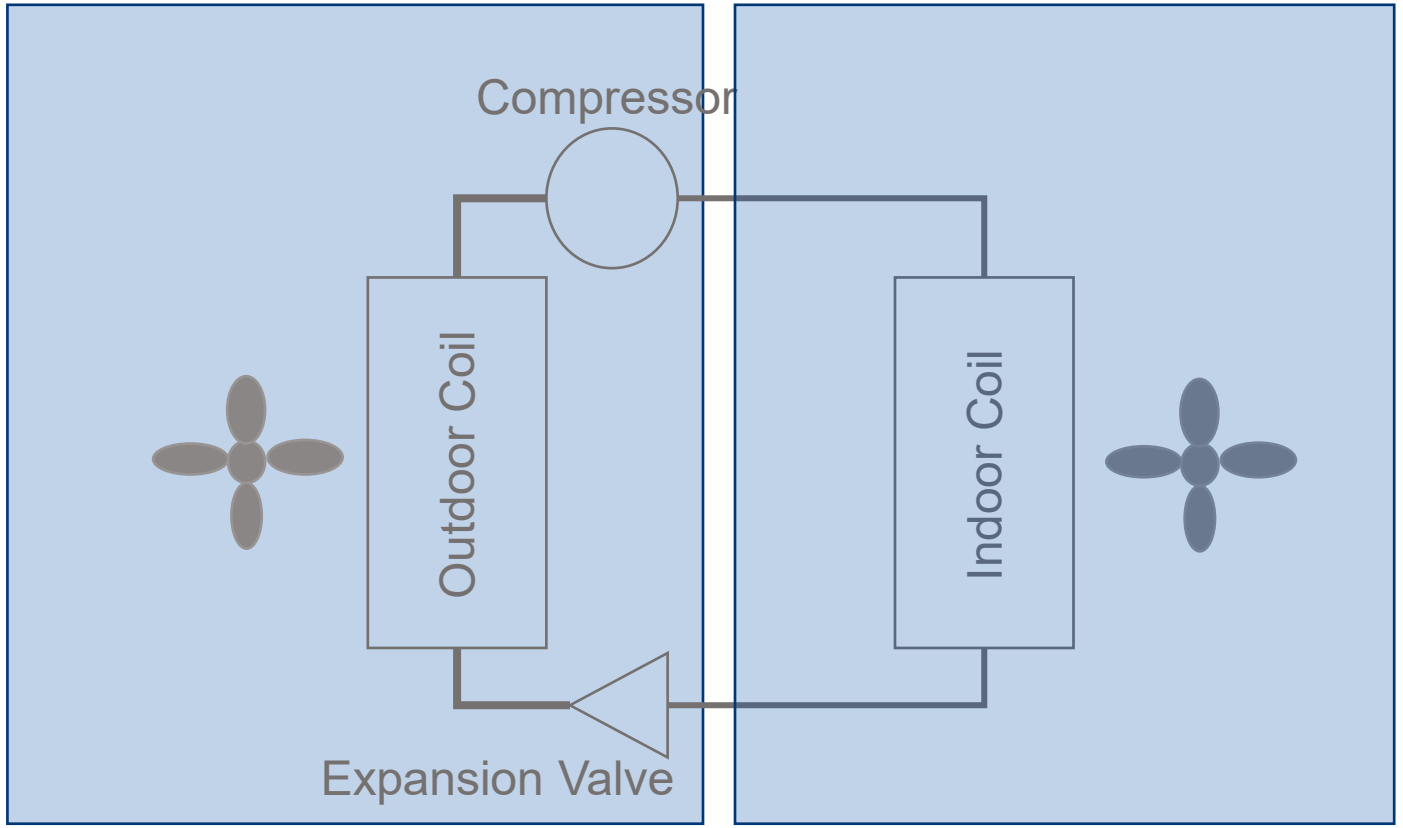

REFRIGERATION CYCLE

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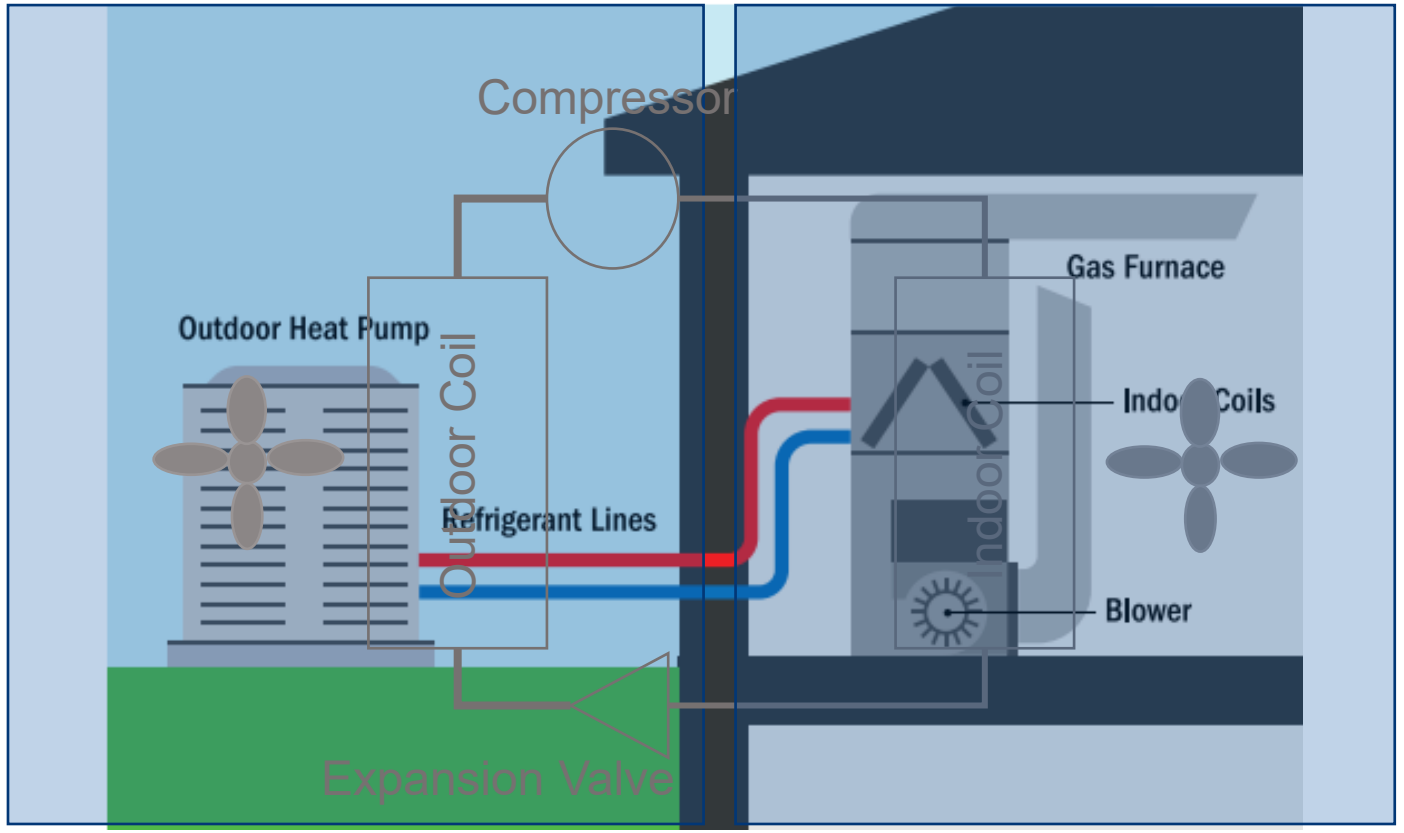

REFRIGERATION CYCLE

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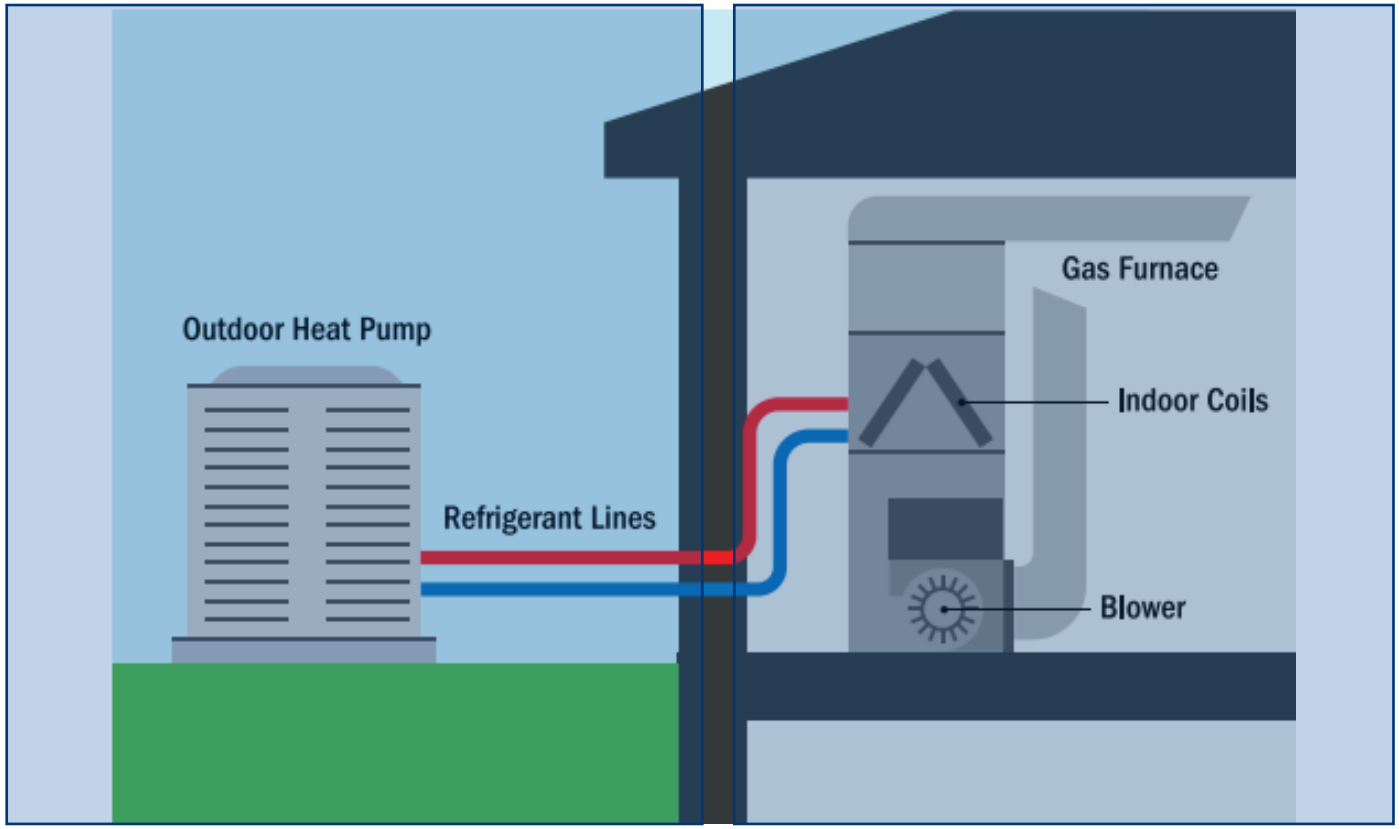

REFRIGERATION CYCLE: DUCTED HEAT PUMP

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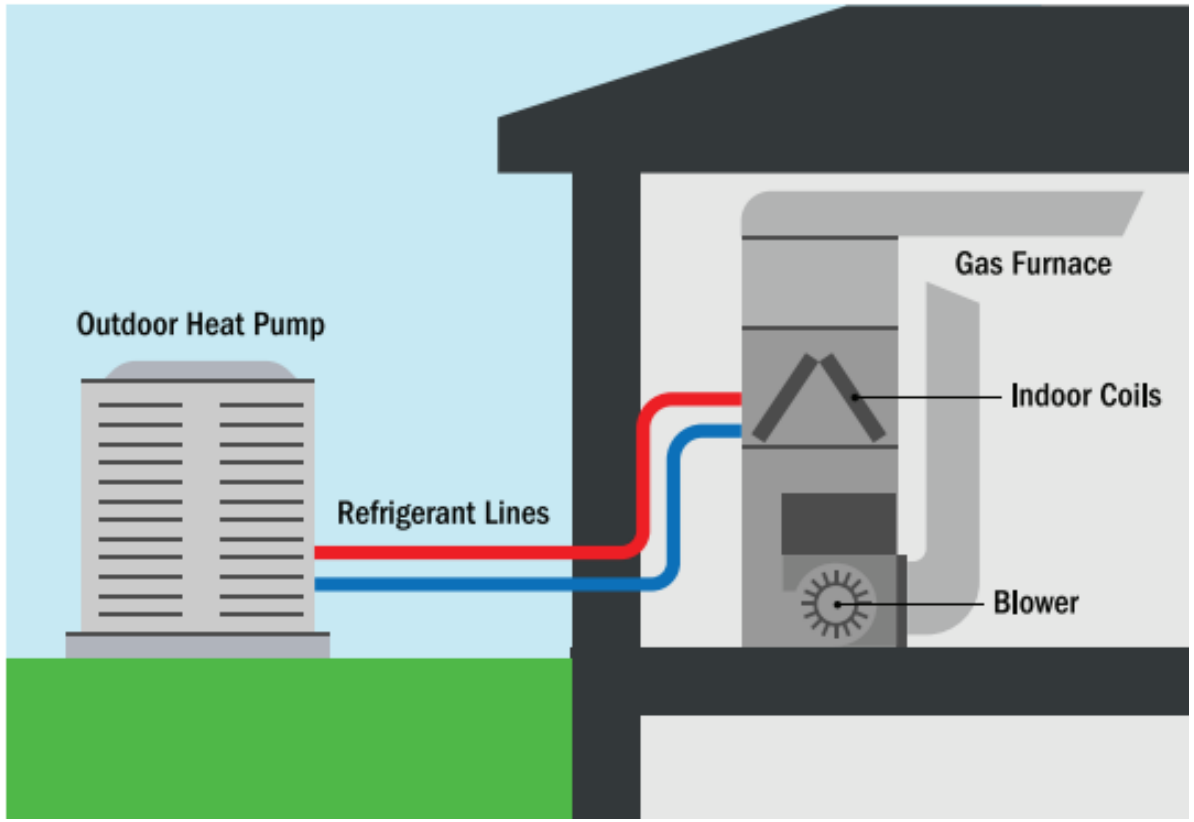

REFRIGERATION CYCLE: DUCTLESS HEAT PUMP

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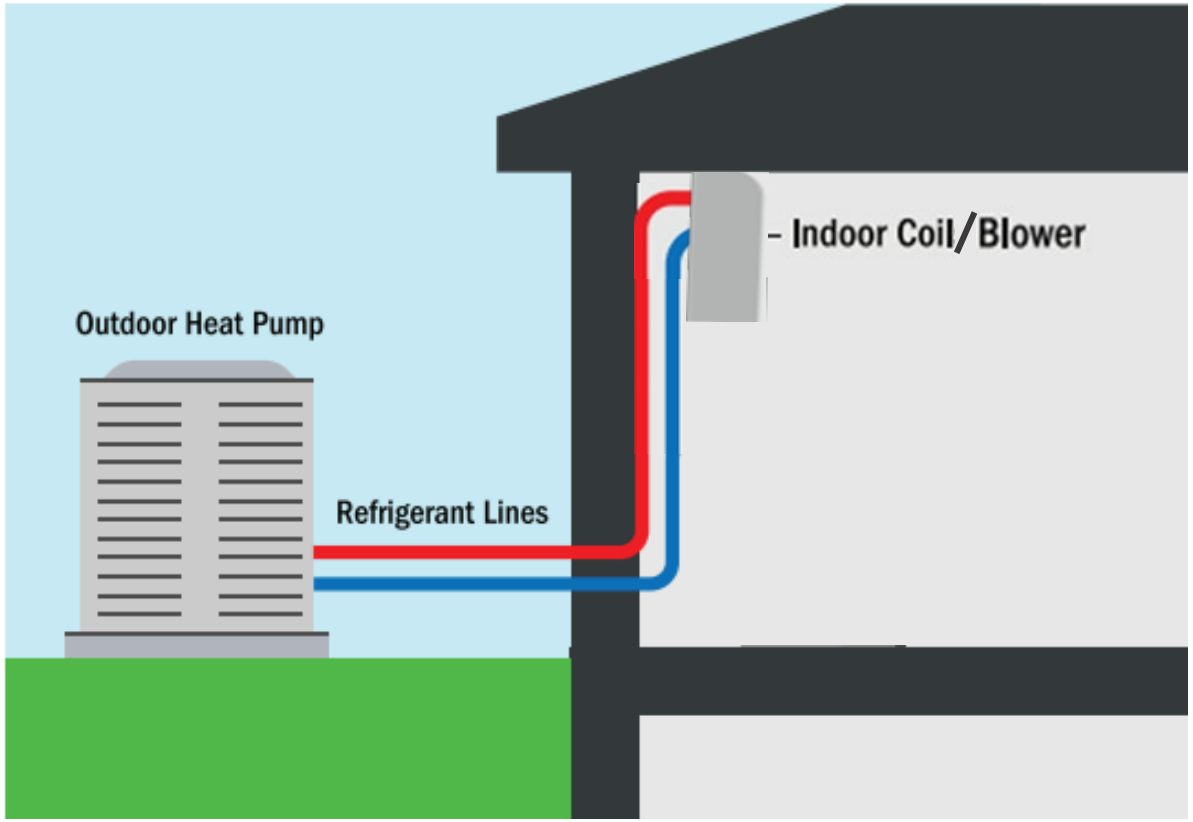

THE “WHERE?”

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INSTALLATION CONSIDERATIONS

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- Ducted:
  - Homes with forced air.
  - Higher airflow than a furnace.
    - ~400 cubic feet per minute (CFM) per 12,000 British Thermal Units per hour (BTUh) for air source heat pumps.
    - ~180 CFM per 12,000 Btuh for furnaces.
  - Most ductwork is undersized.
    - Noise?
    - Freezing air conditioner coil?
  - Most furnaces are oversized.
  - Is it a wash?
    - Manual J is needed for sizing.
    - System sizing for heating load vs. cooling load.
    - Ductwork reconfiguration to make sure the system can deliver air.

INSTALLATION CONSIDERATIONS

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- Ductless:
  - Homes without forced air.
  - Additions/trouble spots.
  - Can it work for a whole home?
    - Multiple indoor units?
    - Multiple outdoor units?

INSTALLATION CONSIDERATIONS

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- Dual-Fuel System:
  - Uses natural gas (NG)/liquid propane (LP)/oil as a backup.
  - Separate units or combined in one.
- All Electric:
  - Uses electric resistance as a backup.
  - Separate units or combined in one.

INSTALLATION CONSIDERATIONS

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- Other Considerations:
  - Is the air colder?
    - Register temperature for both should be ~100 °F.
    - But heat pump is likely moving more air.
    - Let the customer know.
      - Where do they sit most of the time?

INSTALLATION CONSIDERATIONS

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- Other Considerations:
  - Condensate drain.
    - At the indoor unit during cooling.
    - At the outdoor unit during heating (defrost too).
  - Defrost.
    - Additional energy use.
    - Water will drain around the unit in winter (ice).
    - Unit may output some “cold” air during heating.
  - Maximize distribution of air.
    - Inside.
    - Outside.

INSTALLATION CONSIDERATIONS

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- Other Considerations:
  - Mount unit above the snow line.

THE “WHY?”

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WHY INSTALL A HEAT PUMP?

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- It Is Efficient:
  - Furnace.
    - Existing: 65% to 92%.
    - New: 95%+.
  - Boiler.
    - Existing: 65% to 84%.
    - New: 95%+.
  - Electric Resistance.
    - Existing: 100%.
    - New: 100%.
  - Heat Pump.
    - Lowest point: 110%?
    - Highest point: 200%, 300%, 400%???

WHY INSTALL A HEAT PUMP?

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- Efficiency Progression:
  - Reduce your use.
    - Turn it off/unplug it.
    - Install water saving showerheads and aerators.
    - Insulate and air seal.
  - Install more efficient equipment.
    - Lighting.
    - Heating and cooling.
    - Water heater.
    - Appliances.
  - Renewables.

WHY INSTALL A HEAT PUMP?

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- Does It Make Financial Sense?
  - Electric.

$/kWh	$ 0.10
Equipment Efficiency	100%
$/MMBtu	$ 29.31

  - NG.

$/Therm	$ 1.00
Equipment Efficiency	92%
$/MMBtu	$ 10.87

  - LP.

$/Gal of LP	$ 1.50
Equipment Efficiency	92%
$/MMBtu	$ 17.92

WHY INSTALL A HEAT PUMP?

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- Does It Make Financial Sense?

Natural gas rate, $/therm, (furnaces and boilers)

Electric rate, $/kWh (ASHP)	$0.60	$0.65	$0.70	$0.75	$0.80	$0.85	$0.90	$1.00	$1.15	$1.33	$1.50	$2.00	$2.50	$2.75
$0.05	25°	20°	15°	10°	5°	0°	-5°	-10°	-10°	-10°	-10°	-10°	-10°	-10°
$0.06	35°	30°	25°	20°	15°	15°	10°	0°	-10°	-10°	-10°	-10°	-10°	-10°
$0.07	45°	40°	35°	30°	25°	25°	20°	10°	0°	-10°	-10°	-10°	-10°	-10°
$0.08	50°	45°	40°	40°	35°	30°	25°	20°	10°	0°	-10°	-10°	-10°	-10°
$0.09	60°	55°	50°	45°	40°	40°	35°	30°	20°	10°	0°	-10°	-10°	-10°
$0.10	60°	60°	55°	50°	50°	45°	40°	35°	25°	15°	10°	-10°	-10°	-10°
$0.11	60°	60°	60°	60°	55°	50°	45°	40°	30°	25°	15°	-5°	-10°	-10°
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$0.14	60°	60°	60°	60°	60°	60°	60°	55°	45°	35°	30°	10°	-5°	-10°
$0.15	60°	60°	60°	60°	60°	60°	60°	60°	50°	40°	35°	15°	0°	-5°
$0.16	60°	60°	60°	60°	60°	60°	60°	60°	55°	45°	40°	20°	5°	0°
										$1.22	$1.37	$1.83	$2.29	$2.52

Propane rate, $/gallon, (furnaces and boilers)

www.mnashp.org/guides

WHY INSTALL A HEAT PUMP?

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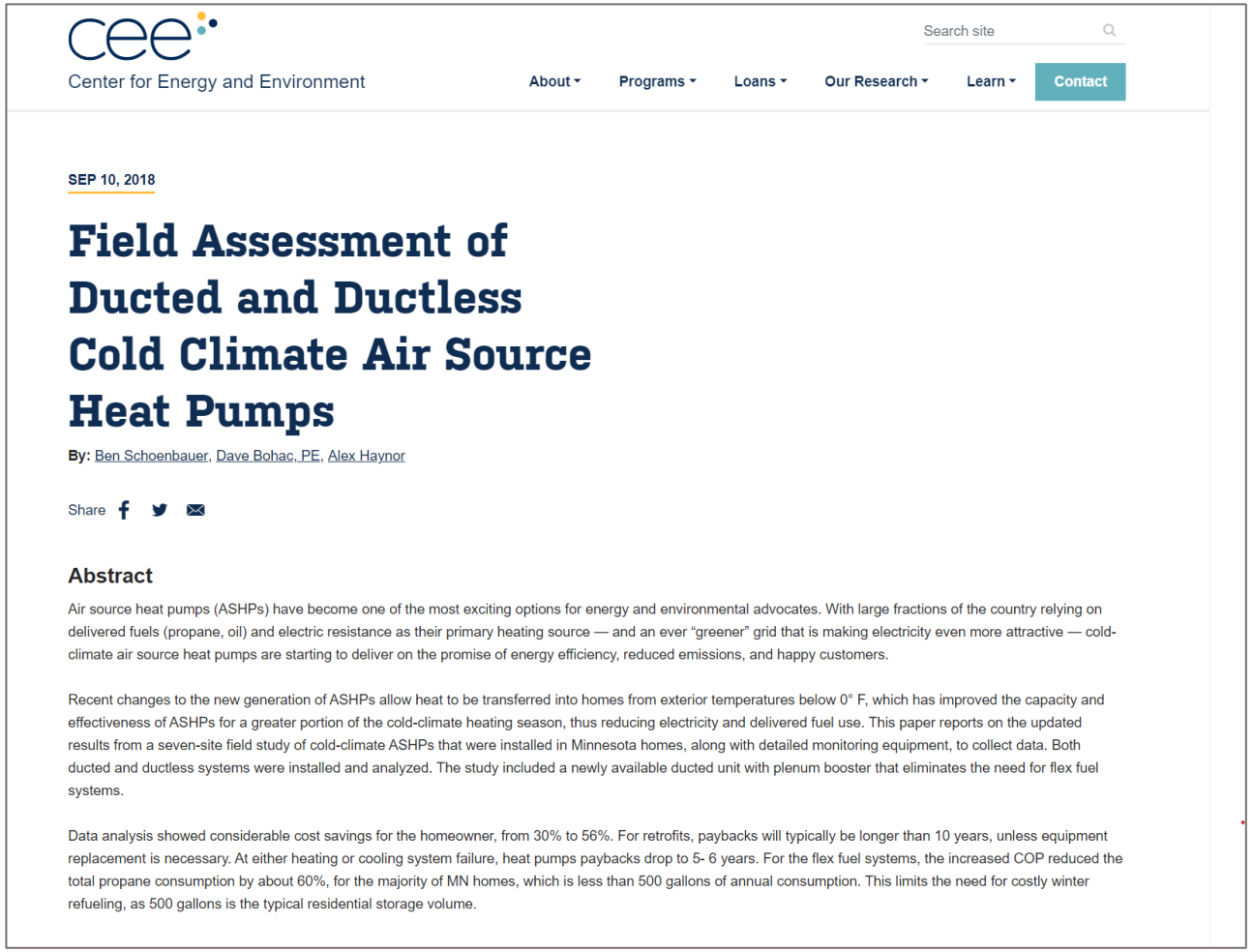
- In Wisconsin? What About In Minnesota?
  - 46%-56% energy savings.
  - 33%-53% heating savings.
  - Between $369 and $764 saved per year.



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SEP 10, 2018

Field Assessment of Ducted and Ductless Cold Climate Air Source Heat Pumps

By: Ben Schoenbauer, Dave Bohac, PE, Alex Haynor

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Abstract

Air source heat pumps (ASHPs) have become one of the most exciting options for energy and environmental advocates. With large fractions of the country relying on delivered fuels (propane, oil) and electric resistance as their primary heating source — and an ever "greener" grid that is making electricity even more attractive — cold-climate air source heat pumps are starting to deliver on the promise of energy efficiency, reduced emissions, and happy customers.

Recent changes to the new generation of ASHPs allow heat to be transferred into homes from exterior temperatures below 0° F, which has improved the capacity and effectiveness of ASHPs for a greater portion of the cold-climate heating season, thus reducing electricity and delivered fuel use. This paper reports on the updated results from a seven-site field study of cold-climate ASHPs that were installed in Minnesota homes, along with detailed monitoring equipment, to collect data. Both ducted and ductless systems were installed and analyzed. The study included a newly available ducted unit with plenum booster that eliminates the need for flex fuel systems.

Data analysis showed considerable cost savings for the homeowner, from 30% to 56%. For retrofits, paybacks will typically be longer than 10 years, unless equipment replacement is necessary. At either heating or cooling system failure, heat pumps paybacks drop to 5- 6 years. For the flex fuel systems, the increased COP reduced the total propane consumption by about 60%, for the majority of MN homes, which is less than 500 gallons of annual consumption. This limits the need for costly winter refueling, as 500 gallons is the typical residential storage volume.

WHY INSTALL A HEAT PUMP?

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- Look at the data:
  - Study of LP and electric offset, not NG.
  - NG savings will be significantly less.
    - Tens of dollars, not hundreds.

WHY INSTALL A HEAT PUMP?

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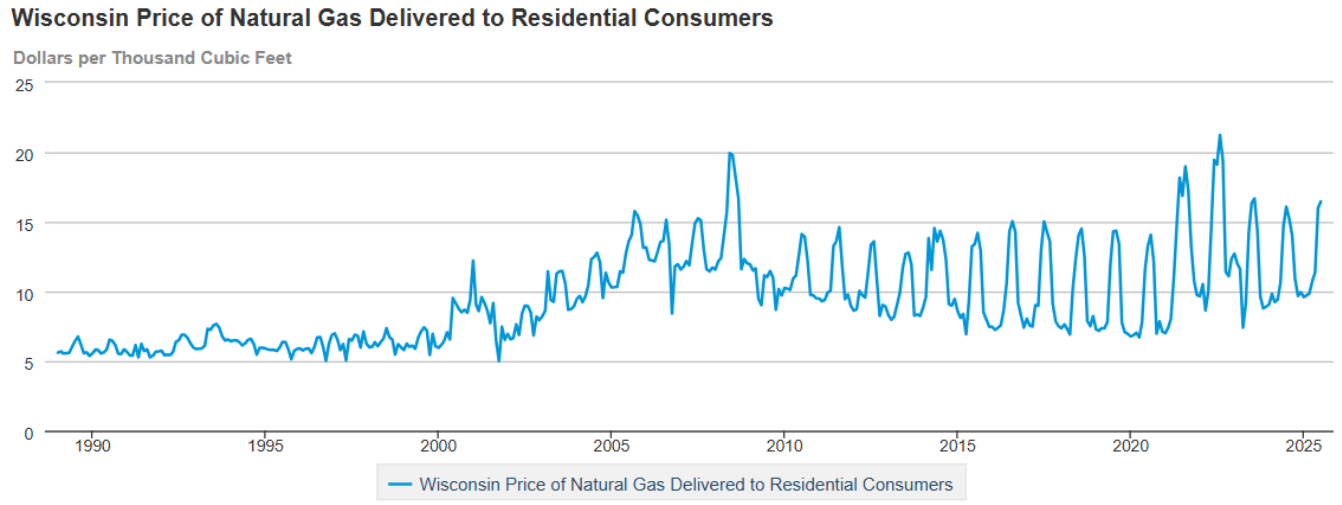
- Does It Make Environmental Sense?
  - Carbon/greenhouse gas emissions.
- Insurance Against Price Changes.
  - NG was:
    - ~$0.70 in January 2021.
    - ~$0.97 in January 2022.
    - ~$1.27 in January 2023.
    - ~$0.91 in January 2024.
    - ~$0.96 in January 2025.



WHY INSTALL A HEAT PUMP?

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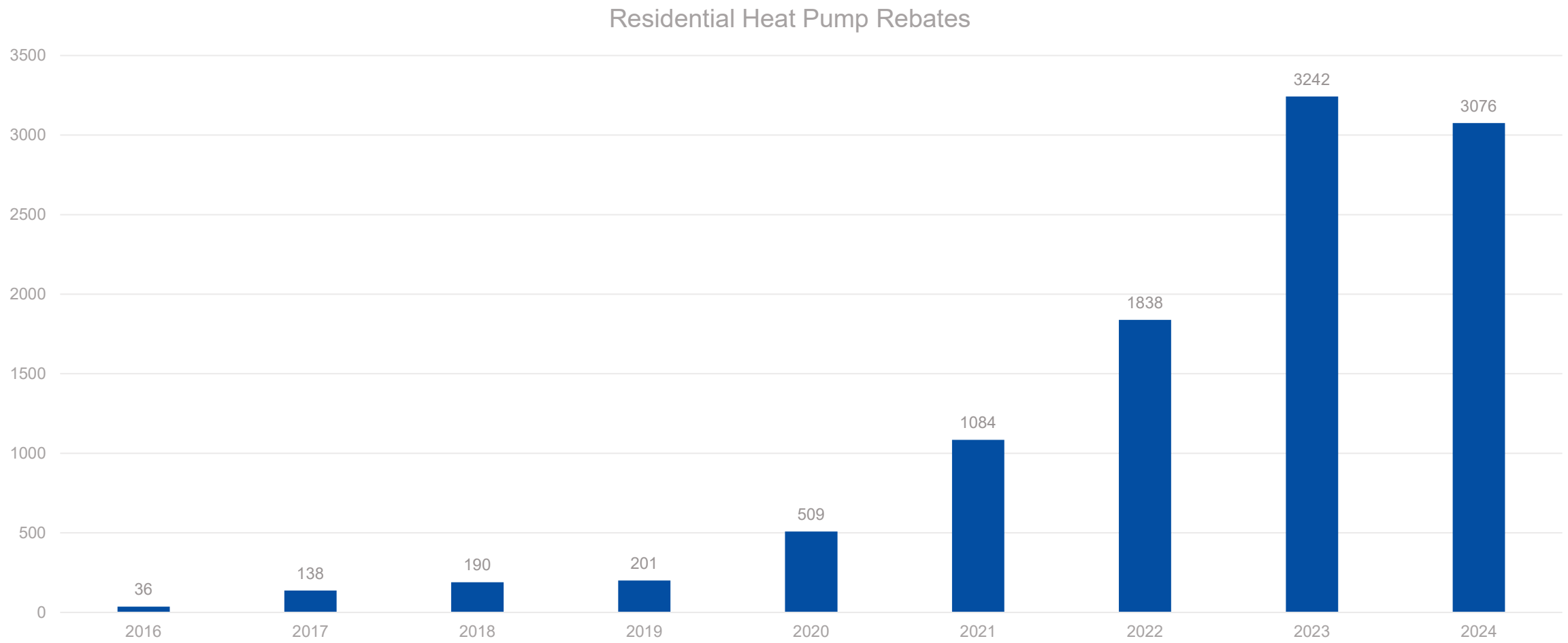
- Focus on Energy Rebates for Tribal Nations.
  - 80% of project cost, up to $3,000 (single family).
  - $800 to $1,000 (multifamily).
- Inflation Reduction Act
  - HOMES
    - Any income level
    - Modeled savings
    - Up to $10,000 (can include heat pumps)
  - HEAR
    - Incomes less than 150% AMI
    - Rebate per product
    - Up to $14,000 (up to $8K for heat pumps)

HEAT PUMP HISTORY



ADDITIONAL RESOURCES

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ADDITIONAL RESOURCES

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- focusonenergy.com/equipment/heat-pump
  - Videos
  - Heat pump definitions.
  - Heat pump buyers guide.
  - Heat pump research (National and Focus).

CONTACT INFORMATION

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