Efficiency Vermont

Heat Pumps

Community Workshop – Manchester Library, Manchester

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Efficiency Vermont
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Our Roadmap

- Brief Technology Overview
- Heat Pump Economics
- Successful Applications
- Program Support

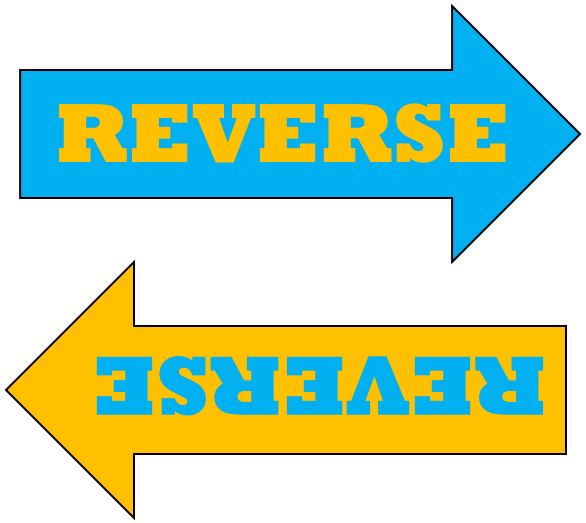
Benefits of Heat Pumps

- **Heating and cooling** from same piece of equipment
- **Cheaper** than most conventional heating systems
- Also **efficient cooling**
- Ductless heat pumps are a **quick and non-invasive** retrofit installation
- New construction - reduced need for **heating and cooling infrastructure**
- Can be completely **sustainable** if powered by renewables

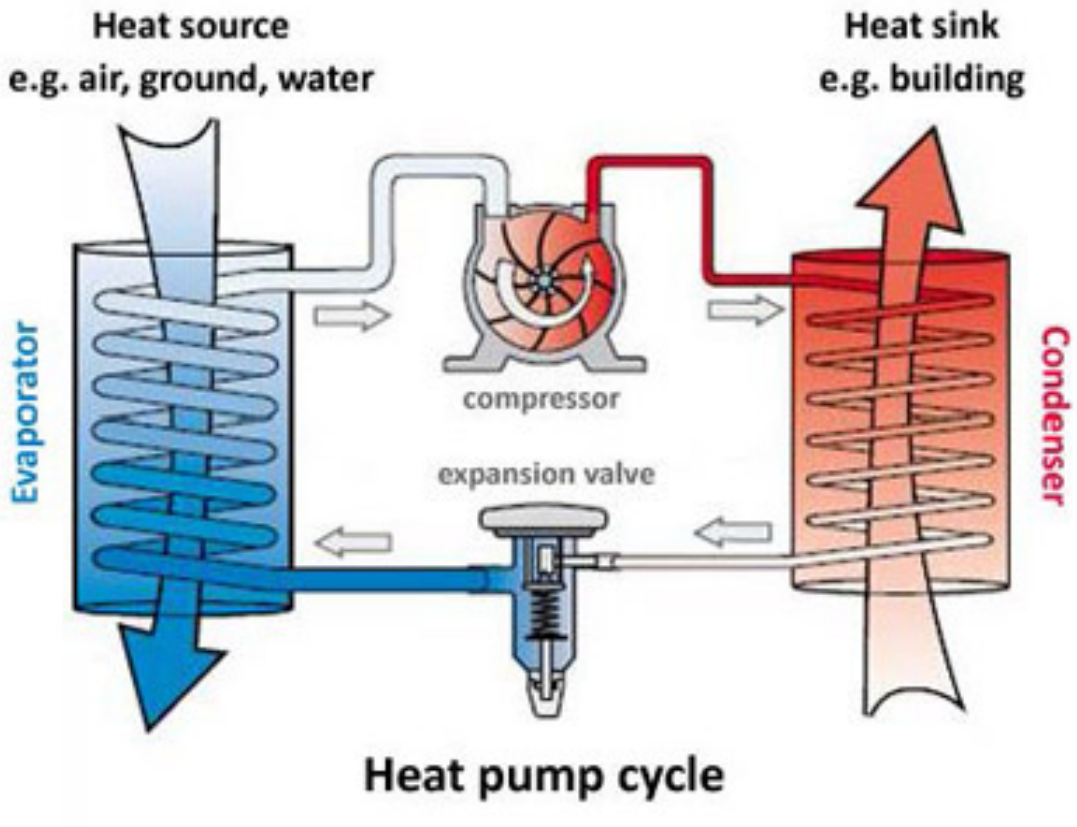
A Quick Technology Primer

What IS a heat pump, anyway?

An air conditioner in reverse

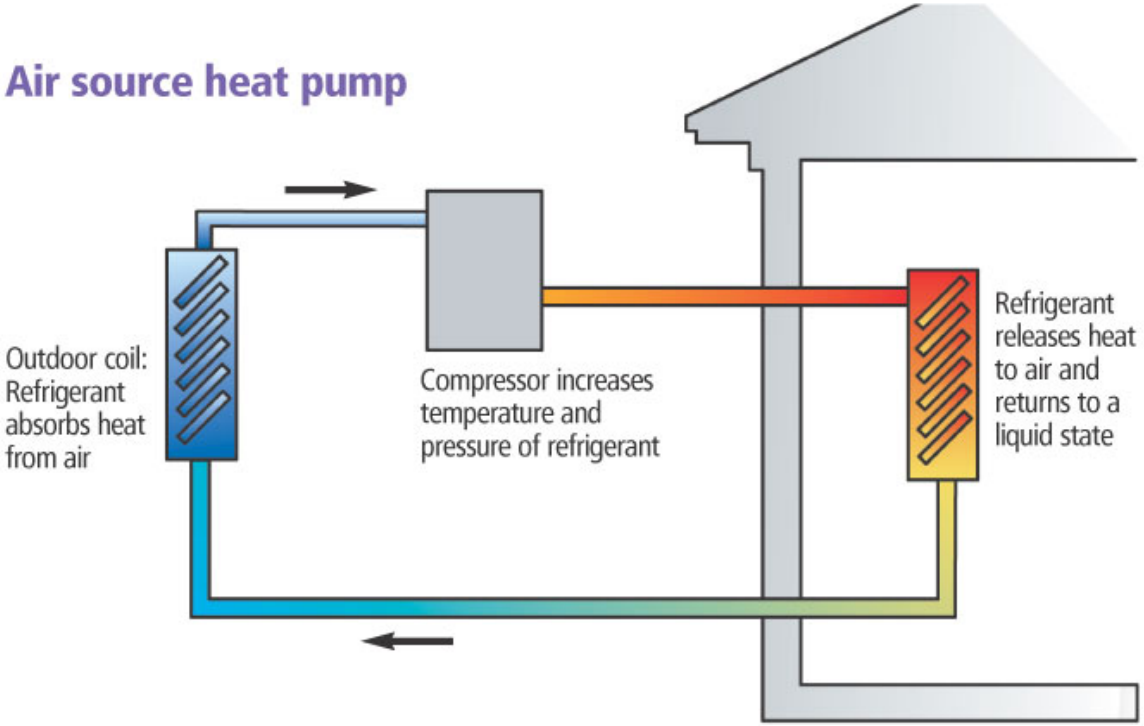


Heat Source → Heat Sink



Heat Source

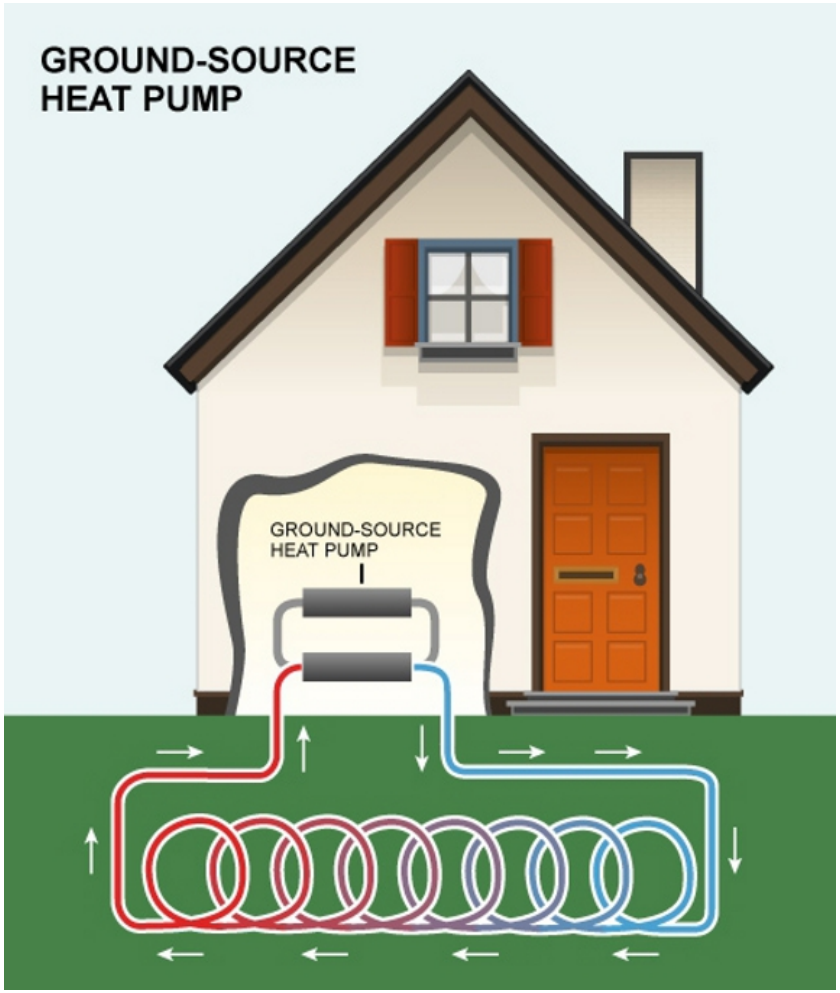
Air (Air Source Heat Pump)




MITSUBISHI
ELECTRIC
Mr.SLIM
R410A

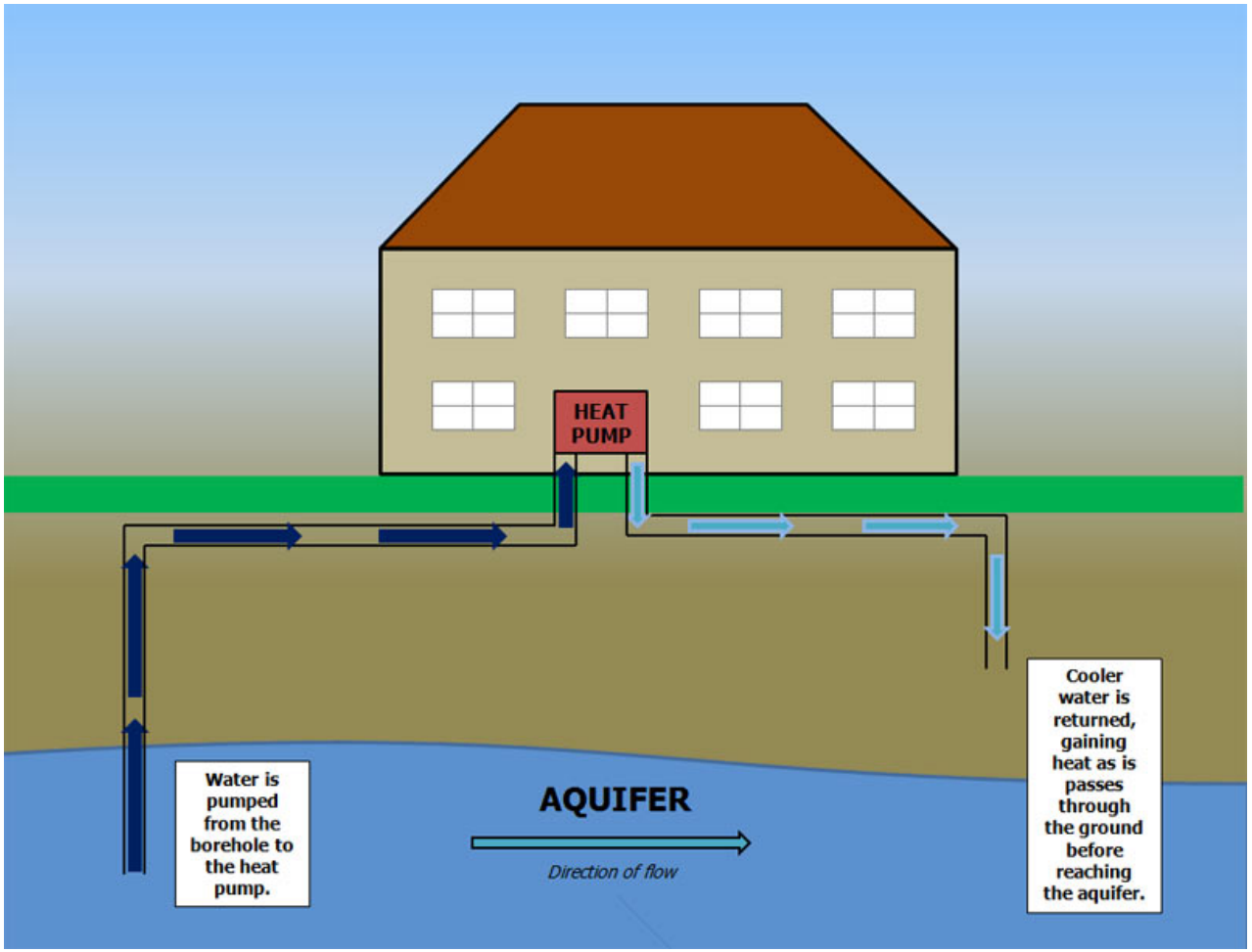
Ground (Ground Source or Geothermal Heat Pump)

- Earth



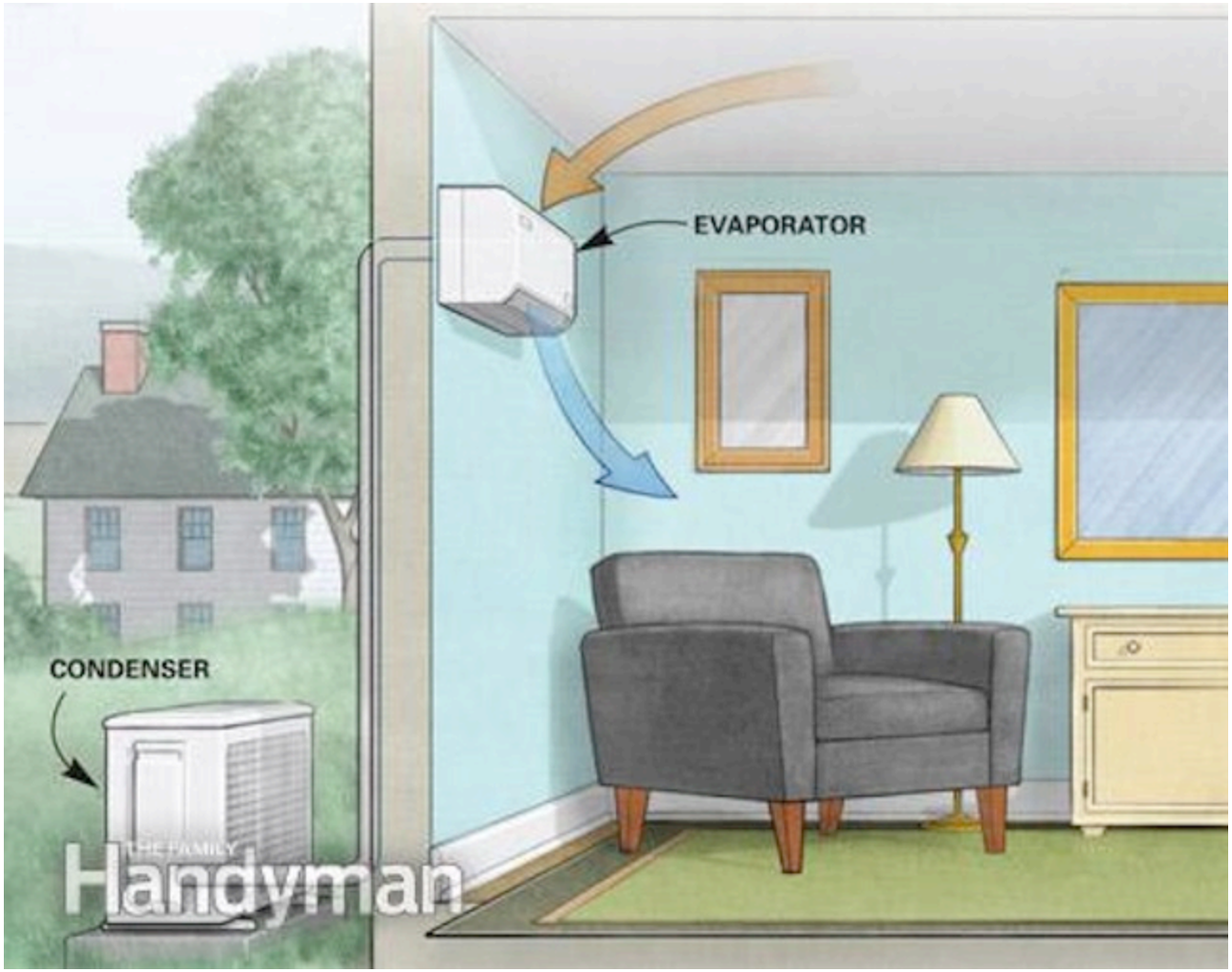

CliTech

➢ Water


HEAT PUMP
Water is pumped from the borehole to the heat pump.
AQUIFER
Direction of flow
Cooler water is returned, gaining heat as is passes through the ground before reaching the aquifer.

Heat Sink – Space Heat

Air Delivered



Heat Sink – Space Heat

Water Delivered

Heat Sink – Domestic Hot Water

Heat Pump Water Heaters

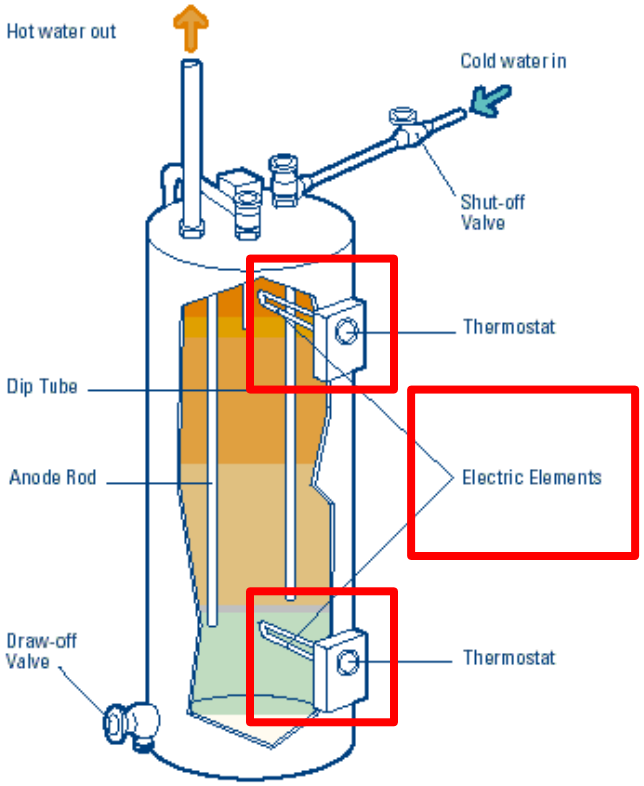
- Air → Water
- 1/3-1/2 the electricity compared to a standard electric water heater (**saves 50-66% in water heating costs**)
- $**550 Efficiency Vermont discount** on this equipment
- **New federal standards** in April, 2015 will *require* electric water heaters >55 gal to be a heat pump water heater

What's the Difference?

Generally, it's easier to move something, than to make something…

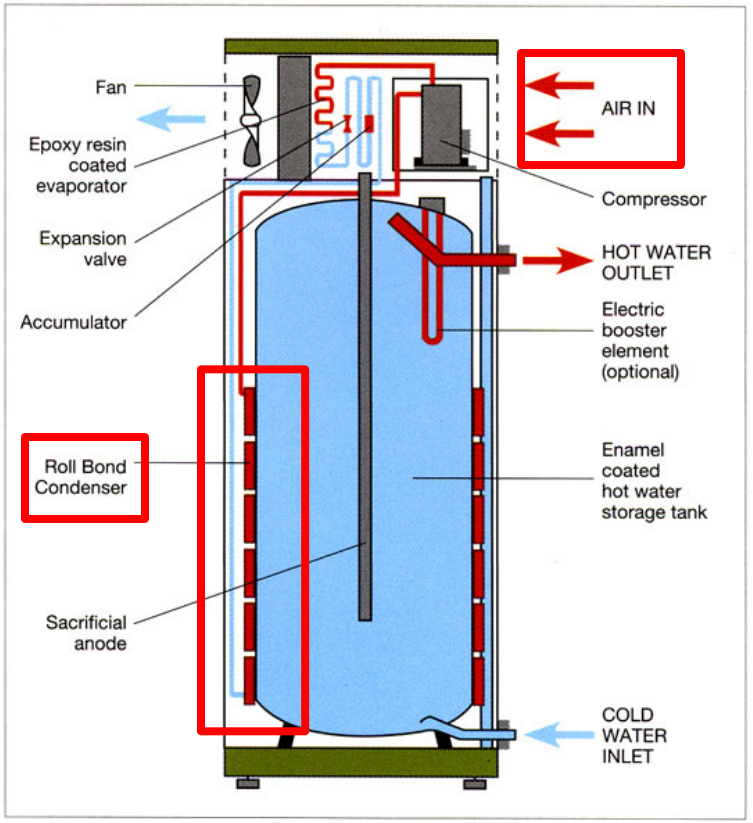
Standard Electric Water Heater

Creates heat using electricity (with a heating element)



Heat Pump Water Heater

Moves heat (energy) from one place (air) and transfers it to another (water).



Heat Pump Water Heater Considerations

- Units should be installed in a space where the temperature stays above ~50°F
- Better suited to basements than living spaces
- At least 750 cubic feet of air space around the unit
- Requires a condensation drain – either pumped outside, or passively drained to a lower receptacle

A Closer Look at Space Heating with Heat Pumps

Some Equipment Terminology

Heat Pump – Overarching technology

Ductless Heat Pump – A heat pump which delivers space conditioning without ducts

Mini-Split – A heat pump in which the system is "split" between indoor and outdoor components

Multi-Split (also, **multi-port** or **multi-zone)** – As above but with multiple indoor units connected to a single outdoor unit

Ductless Mini-Split – A ductless delivery split system

Air Source Heat Pump – Heat pump equipment with air derived heat energy

Geothermal (Ground Source) Heat Pump – Heat pump equipment with ground or water derived heat energy

Efficiency Acronyms – Why 3?

(*Expressed as btus/watt*)

HSPF – Heating Seasonal Performance Factor

- **Seasonal heating** efficiency of a heat pump

SEER – Seasonal Energy Efficiency Ratio

- **Seasonal cooling** efficiency of a heat pump

EER – Energy Efficiency Ratio

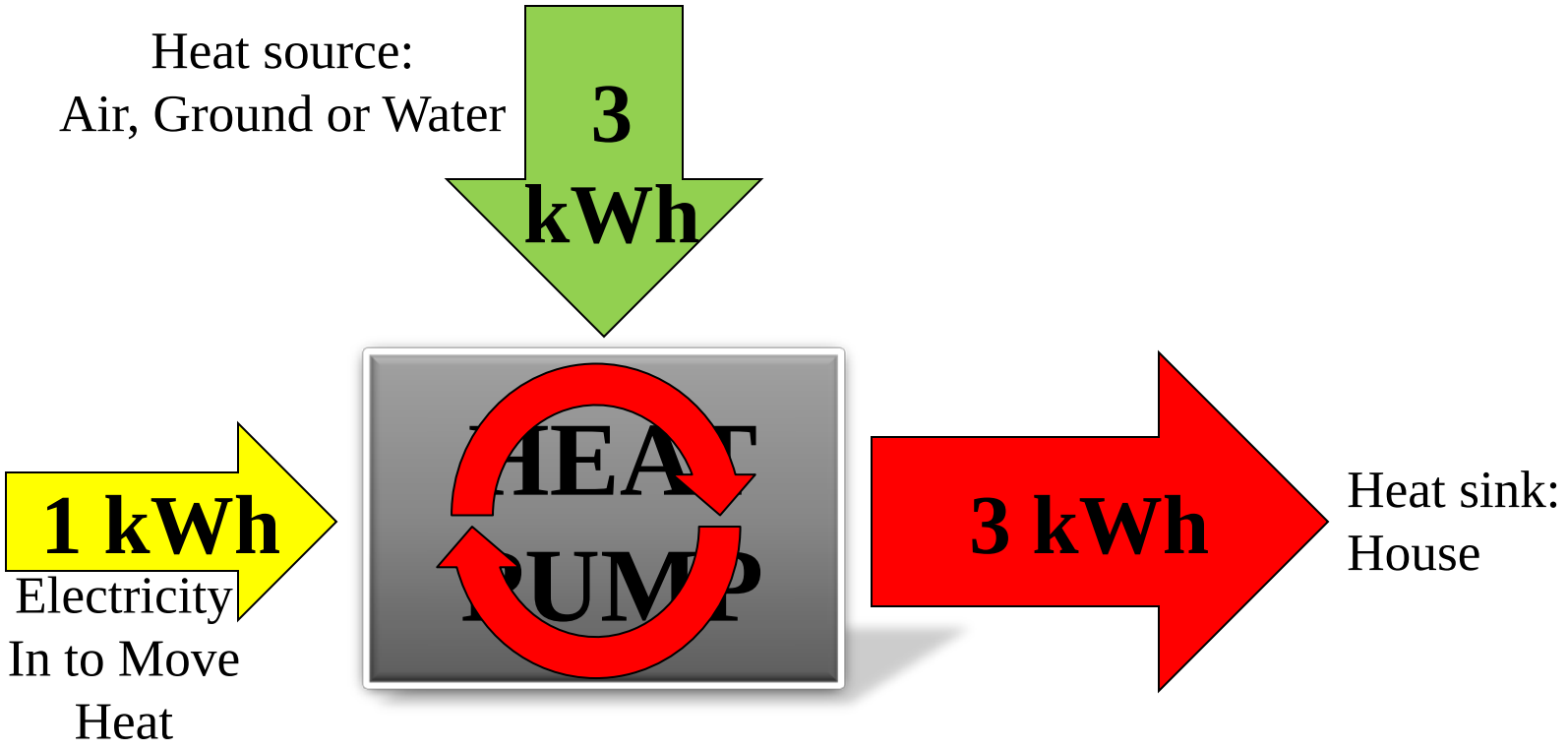
- **Peak cooling** efficiency of heat pump running at 95°F

Are they efficient?

- They *Move* Heat, rather than *Generate* Heat
- Leverage heat existing in the environment (stored solar energy) rather than burn fuel to release energy
- High SEER - Cooling
- High HSPF - Heating
- COPs of 2.0-4.0+
  - What is COP???
  - COP (Coefficient Of Performance) = Energy Out/Energy In

So… A COP of 2-4 is equivalent to 200-400% efficiency!

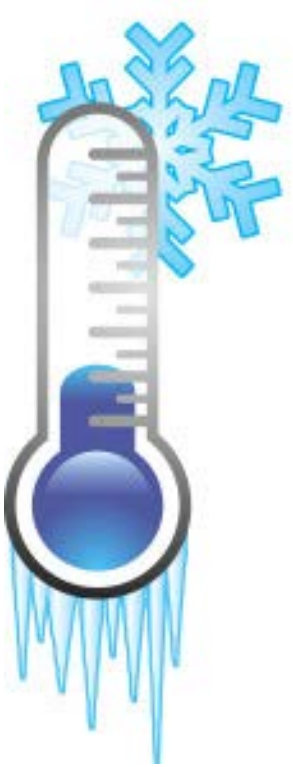
More Out than In (COP of 3)?



Cold Climate Performance

Cold Climate Heat Pump

- Maintain capacity at very cold temperatures (below 5°F)
- High efficiency at these low temperatures



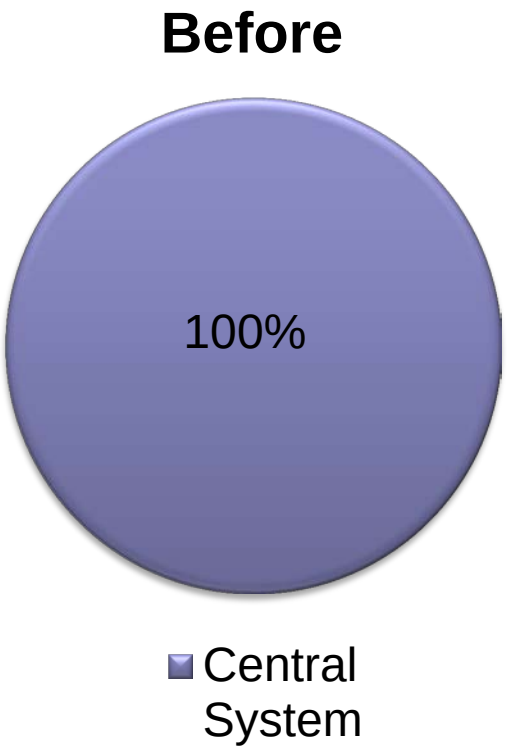
How is this achieved?

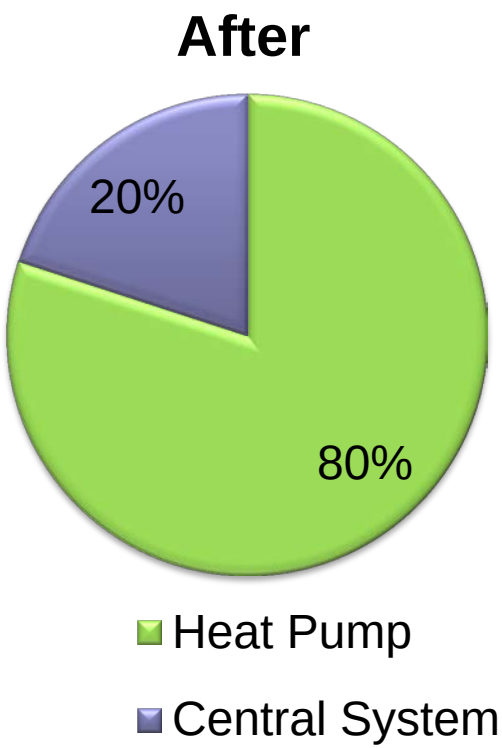
- New refrigerants
- Ultra high pressure systems
- Variable speed compressors
- Sophisticated controls

Heat Pump Economics

Ductless Mini Splits

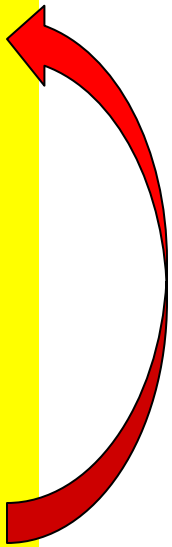
The Displacement Model





A Comparison of Heating Fuels

Fuel Type	Unit	Btu/Unit	Efficiency	$/Unit	$/MMBtu
Natural Gas	Therm	100,000	90%	$ 1.48	$ 16.44
Wood	Cord	22,000,000	60%	$ 227.00	$ 17.20
Pellets	Ton	16,400,000	80%	$ 294.00	$ 22.41
Fuel Oil	Gallon	138,200	85%	$ 3.22	$ 27.41
Kerosene	Gallon	136,600	85%	$ 3.80	$ 32.73
Propane	Gallon	91,600	90%	$ 2.86	$ 34.69
Electricity	kWh	3,412	100%	$ 0.15	$ 43.96
Electricity (Heat Pump)	kWh	3,412	250%	$ 0.15	$ **17.58**



Typical Residential Heating Fuel Costs (75 MMBtu/Yr)

Fuel	Volume	Unit	$/Unit	$/Year
Natural Gas	833	Therms	$1.48	$1,233
Wood	5.7	Cords	$227.00	$1,289
Pellets	5.7	Tons	$ 294.00	$1,680
Fuel Oil	603	Gallons	$3.22	$2,055
Kerosene	610	Gallons	$3.80	$2,454
Propane	910	Gallons	$2.86	$2,601
Electricity	21,981	kWh	$0.15	$3,297

- Without Natural Gas (or biomass), heating costs run $2000-$3000+ per year

Heating Fuel Cost Savings with an ASHP (COP 2.5)

Fuel	75 MMBtu/Yr
Natural Gas	-$68.43
Wood	-$23.28
Pellets	$289.41
Fuel Oil	$589.58
Kerosene	$908.56
Propane	$1,026.41
Electricity	$1,582.65

- Savings ~$600-$1600/yr
- Assuming 80% heating fuel offset and no cooling effects

Play with Numbers

(80% Displacement, 75 mmbtu/yr home, 85% efficient oil system)

House before:

- 640 gallons fuel oil ($3.22/gal)
- $2060/yr for heat (88 MMBtu)

House after:

- 128 gallons oil + 7050 kWh electricity ($0.15/kWh)
- $410 (oil) + $1060 (electric) = $1470/yr for heat (42 MMBtu)
- Net Savings - $590/yr (46 MMBtu – 52% Reduction)
- 3600 lbs CO_2/yr NET reduction

Cost of Heat Pumps

- Single Zone Ductless - $4,000
- Multi Zone Ductless – $6,000 - $20,000
- Ground Source – $20,000+

Successful Applications

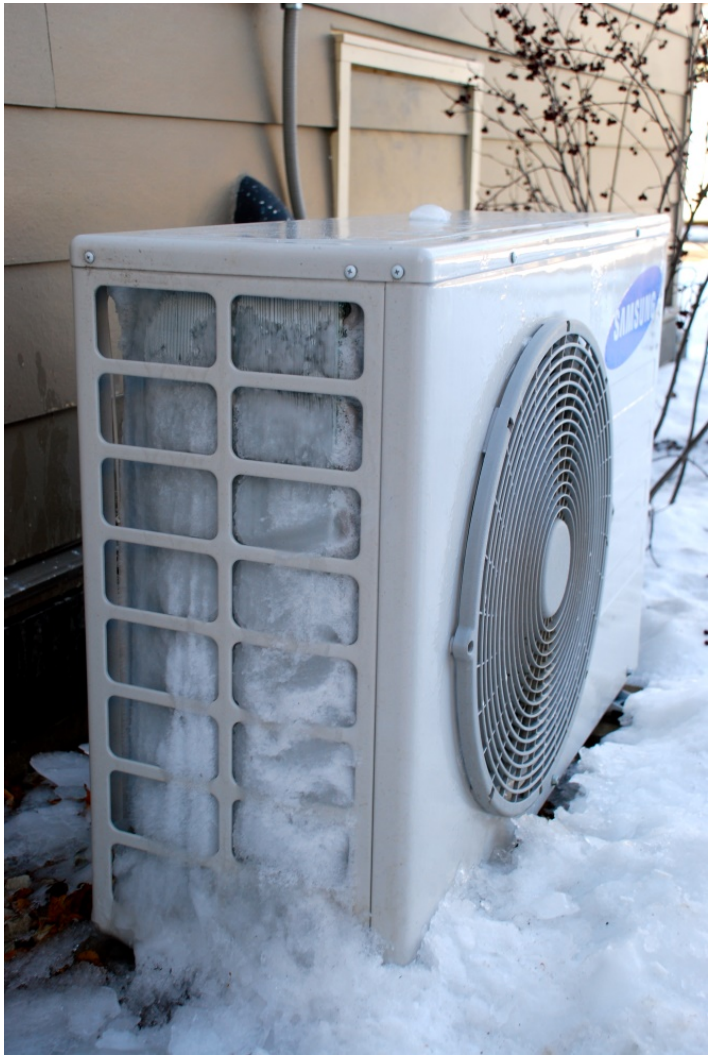
Air-source heat pumps

Good Building Characteristics for Heat Pumps

- Well air sealed and insulated
- Open floor plan/Open doors
- Multi-story homes
- Existing multi-zonal heat
- Functional backup system
- Expensive heating fuel
- Site based electrical generation

A Good Installation

- Install at least 18-24” off the ground
- Do not install under eave without a cover
- Indoor unit placed with best access to volume of space
- Refrigerant line penetration air sealed
- Line-set is insulated and protected
- Properly wired and evacuated
- Integration with existing heating system considerations



Additional Considerations

- They make noise
  - Indoor vs. outdoor noise
  - Wall brackets vs. ground stands
- They are not invisible
- Decreased output as it gets colder
- Decreased efficiency as it gets colder
- Electrical infrastructure (double 15/20 breaker required)
- Low end temperature setting

Heat Pump Myths – Busted!

Myth - Heat Pumps don't work when it gets really cold

Truth – Cold Climate Heat Pumps operate effectively below -5F

Myth – Heat Pumps are a great replacement when your current heating system dies

Truth – Air source heat pumps provide heating displacement, but not full replacement. You'll need a backup

Myth – The fuel for heat pumps is coolant

Truth – Heat pumps run on electricity. The coolant (refrigerant) is contained inside a closed loop and is not "used up"

Myth – Heat pumps will lower all my bills

Truth – For most people, they lower fuel bills, but raise electric bills

Efficiency Vermont Program

Cold Climate Heat Pumps

How does it work?

1. Installation contractor (or homeowner) purchases eligible equipment from a participating wholesaler
2. Provide some basic information about installation
3. $300 Discount applied to purchase
4. No forms or waiting for a check

Eligible Equipment

- HSPF ≥ 10.3, EER ≥ 12.0, SEER ≥ 20.0
- COP @5°F ≥ 1.75 (at maximum capacity operation)
- Operation at -5°F or below

FUJITSU

DAIKIN

MITSUBISHI ELECTRIC
COOLING & HEATING

For a list of eligible models, visit:
https://www.efficiencyvermont.com/docs/for_partners/contractors/evt-cchp-qpl-bymanufacturer.pdf?v=7

Participating Distributors

For a full list of Participating Distributors and branch locations, visit:
https://www.efficiencyvermont.com/docs/for_partners/contractors/evt-cchp-distributors.pdf?v=3

Pay for it with a **low** or **no** interest loan

- Energy efficiency loans pay for improvements such as
  - Cold climate heat pumps
  - Upgrading heating systems (including pellet boilers and furnaces)
  - Air sealing or insulating leaky attics
  - New efficient windows and doors… and more!

- Financing often results in **saving more** money on monthly utility bills **than you are paying** in loan payments

What are the financing options available?

Improvement loans exist from select financial institutions, but they may not be geared toward energy efficiency upgrades… here are a few that are:

- For Homeowners
  - Heat Saver Loan Program
  - PACE (Property Assessed Clean Energy)
- For Businesses
  - Business Energy Loan Program
  - Energy Loan Guarantee Program
- For Farms
  - Efficiency Vermont Ag Loan Program

How to save, with Efficiency Vermont

- Look for SMART CHOICE electronics & appliances at local retailers

  We've researched the products that are proven to save you money and energy, and marked them with a SMART CHOICE label.

  Plus! Most have **cash back rebates** available.

- Discounted LEDs starting at **$4.99** & CFLs starting at **99¢**
- Home weatherization offers like a **$100** discount on an energy audit and up to **$2,000** off eligible improvements
- Efficiency assistance from our customer service and technical support teams

We can help you determine the best options for your home... Call us!

Thank You!