



Home Heat Pumps

A Homeowner's Experience

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Electrification- Why?

- ▶ Buildings: cause ~25% of California's Greenhouse Gas (GHG); need to address this to meet CA goals
- ▶ Methane (Natural Gas) as a GHG:
 - ▶ 84x more potent than CO2 in the short run
 - ▶ With leakage factored in, as dirty as coal
- ▶ Natural Gas causes other pollutants
 - ▶ Smog, Asthma
 - ▶ Natural gas cooking: formaldehyde, nitrogen dioxide
 - ▶ [Massachusetts Medical Society](#) recently recognized link gas cooking and asthma
 - ▶ Carbon monoxide risk in homes
- ▶ Electricity: Win-Win-Win...
 - ▶ SVCE, SJCE, PCE: carbon-free electricity
 - ▶ PGE: reducing it's carbon
 - ▶ Heat Pumps provide cooling, too
 - ▶ Heat Pumps- significantly more efficient than even high-efficiency gas furnaces
 - ▶ Induction range-tops: more powerful, safer, sleeker, more precise, easier to clean than gas

Electrification- How?

▶ New All-Electric Residences

- ▶ Save the up-front cost (\$1000's) of connecting to, and running plumbing for, natural gas
- ▶ Codes set by city / county
- ▶ Info: Fossil Free Buildings Silicon Valley, fossilfreebuildings.org

▶ Existing Residences

- ▶ Converting requires some planning
- ▶ Opportunity to convert
 - ▶ Hot water heaters- approx. 10-yr lifespan
 - ▶ Furnace- approx. 15-30-yr lifespan
 - ▶ Air conditioner- approx. 15-20-yr lifespan, or 1st-time installation

Our Project: Goals

- ▶ *Electrify our house to reduce GHGs !*
- ▶ High efficiency to reduce waste
- ▶ Replace (and re-locate) aging furnace, replace water heater before they failed
- ▶ Address other efficiency
 - ▶ Insulate the Ductwork
 - ▶ Improve Attic Insulation
 - ▶ Upgrade Whole House Fan

Before

- ▶ Installation: March, 2018
- ▶ 1650 sf, 1950's ranch house in Mountain View
 - ▶ 4KW solar panels
 - ▶ 200 Amp electrical service
 - ▶ 2 residents
- ▶ Natural gas furnace, with ducts, from 1980's. "High Efficiency", NOISY!
- ▶ Natural Gas water heater, 40-gal., 9.5 years old
- ▶ Cooling: 20-yr-old whole house fan, noisy and not insulated
- ▶ Several years ago- home energy assessment from Solar City
- ▶ Silicon Valley Clean Energy- 100% Carbon Free



How did I learn about heat pumps?

- ▶ Parents had heat pump space heater in all-electric house, Ohio in 1980's
- ▶ Past programs like today's in Palo Alto, Mountain View
- ▶ Energy.gov, Energystar.gov

Selecting a Contractor

- ▶ Goal: 1 contractor to address all projects, including permits, electrical, minor drywall work
- ▶ Used BayREN Program <https://www.bayrenresidential.org>
 - ▶ Contractor database on-line
 - ▶ Rebates for multiple energy-saving projects
 - ▶ Contractor handles the rebate paperwork
 - ▶ Home Energy Assessment
 - ▶ Free Home Energy Advisor to guide you through the process

Selecting a Contractor (cont.)

- ▶ Goal: 1 contractor to address all projects, including permits, electrical, minor drywall work
- ▶ Used BayREN Program
- ▶ Narrowed down to brand of heat pump first, used that to narrow list of contractors
 - ▶ Assumed- stay with ducted system*
 - ▶ Maximize efficiency- Energy Star
 - ▶ Minimize outdoor unit size
 - ▶ Minimize outdoor unit decibels

* “Mini-split” systems work for homes without ductwork

Selecting a Contractor (cont.)

- ▶ Goal: 1 contractor to address all projects, including permits, electrical, minor drywall work
- ▶ Used BayREN Program
- ▶ Narrowed down to brand of heat pump first, used that to narrow list of contractors
- ▶ Checked on-line reviews, got multiple bids, selected contractor

The Heat Pump Space Heater

- ▶ New unit outdoors (air-to-air heat pump)
- ▶ Needed new electrical circuits
- ▶ Indoor attic unit (evaporator coil, air handler) has a condensation drain pipe



Outdoor unit



Indoor Attic unit

The Heat Pump Water Heater

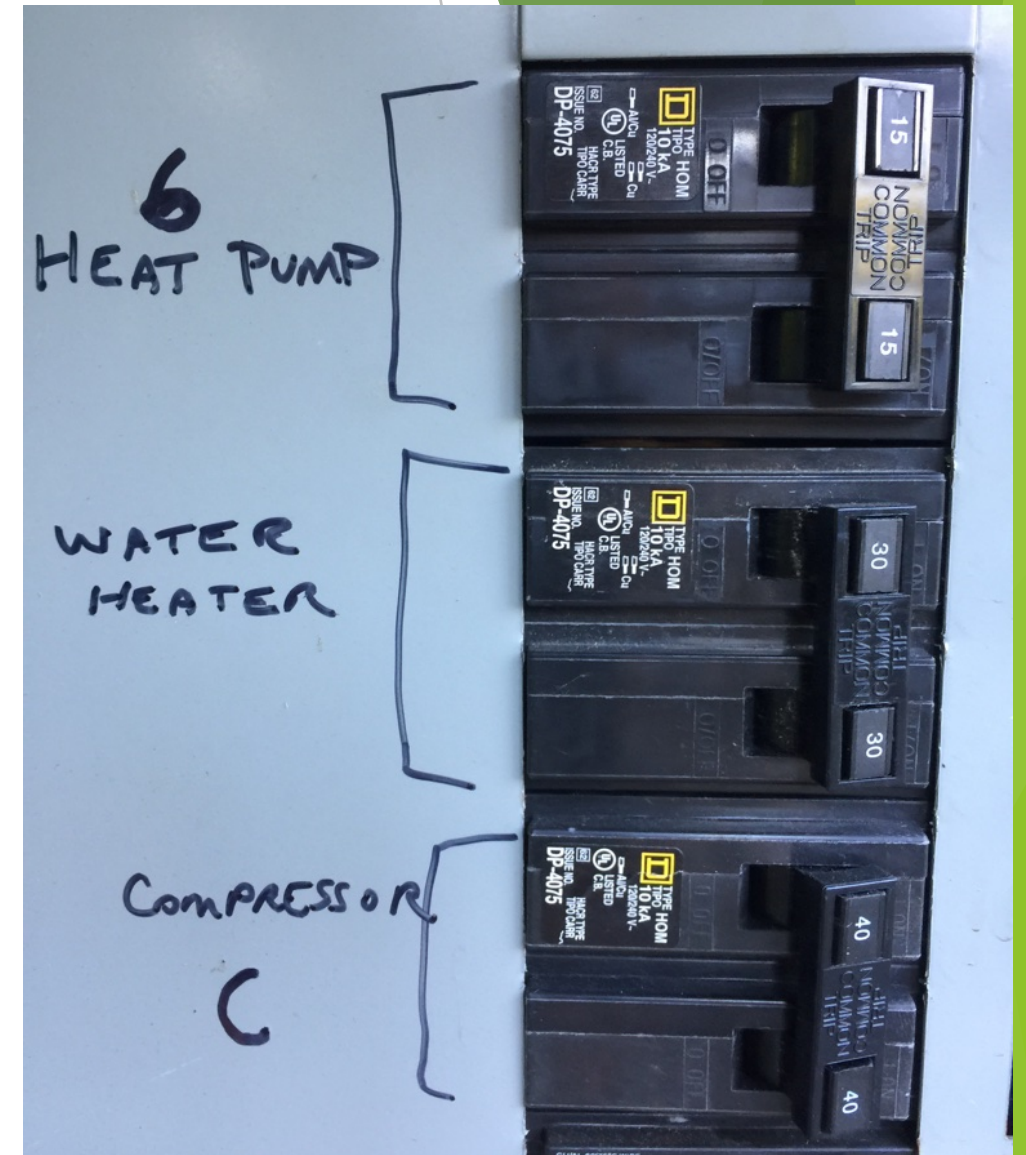
- ▶ Same location as old heater (garage)
- ▶ Walls taken down to provide ventilation
- ▶ Needed a new electrical circuit
- ▶ Has a condensation drain pipe



Other Components



Smart Thermostat



Circuit Breakers



Cold Air Return (close)
Whole House Fan (far)

Decision

▶ Contractor: Building Efficiency

Item	Installed Cost
Carrier 25VNA Infinity Series 16.8 - 20 SEER/11.4 - 16 EER/10.3 - 13.0 HSPF Variable Speed Heat Pump with Aprilair 2210 Air Cleaner	\$13,500*
Heat Pump Water Heater State Pro-line XE Hybrid Heat Pump, 50-gallon	\$4,150
Total	\$17,650
	*Included moving to attic

During the Project

- ▶ Project went smoothly
- ▶ Heat pump air heater- about a week
- ▶ Contractor lent us electric space heaters for ~ 3-4 days while heat down
- ▶ Hot water- down less than 1 day

After the Project: Results

- ▶ Insulation: House temperature now very stable
- ▶ Heat pump space heater:
 - ▶ Quiet (Is it running?)
 - ▶ Temperature- stable, great
- ▶ Heat pump water heater: plenty of hot water

After the Project: Results

Heat Pump Space Heater

	Heating kwh	Cooling kwh	Total kwh
2018 (half a heating season)	337	38	
2019	903	99	1002
2020 (pandemic, summer fires)	5887	2844	8731

Next Steps!

- ▶ Assess your gas appliances (age, condition, other)
 - ▶ Hot water heaters, approx. 10-yr lifespan
 - ▶ Furnaces, approx. 15-30-yr lifespan
 - ▶ Air conditioner replacement, approx. 15-20-yr lifespan, or 1st-time installation
 - ▶ While you're at it- gas drier, gas stove, gas automobile
- ▶ If electrical upgrade needed, consider adding enough to cover all of the above
- ▶ Check for rebates / Ask your utility to add one!
- ▶ Contractors: check with friends / neighbors / BayREN / SVCE eHub / SwitchIsOn.org
- ▶ Meanwhile
 - ▶ Consider an energy audit, or energy score
 - ▶ Adjust your thermostat when away (manually, or programmable/smart thermostat)

Possible Savings! More Info!

▶ Rebates

- ▶ SwitchIsOn.org
- ▶ BayREN
- ▶ Utility

▶ More Info

- ▶ SVCE, PCE, etc.
- ▶ SwitchIsOn.org
- ▶ [Redwood Energy Pocket Guide to All-Electric Retrofits](#)
appliances options, using 100Amp service, budget tips, more

▶ Other Possible Savings

- ▶ Switch to the PGE baseline for all-electric heating
 - ▶ “baseline”- amount of electricity you get at the cheapest rate

Good Luck!

Our final electrified appliance



Reference Slides



Entire Project Cost

► Contractor: Building Efficiency

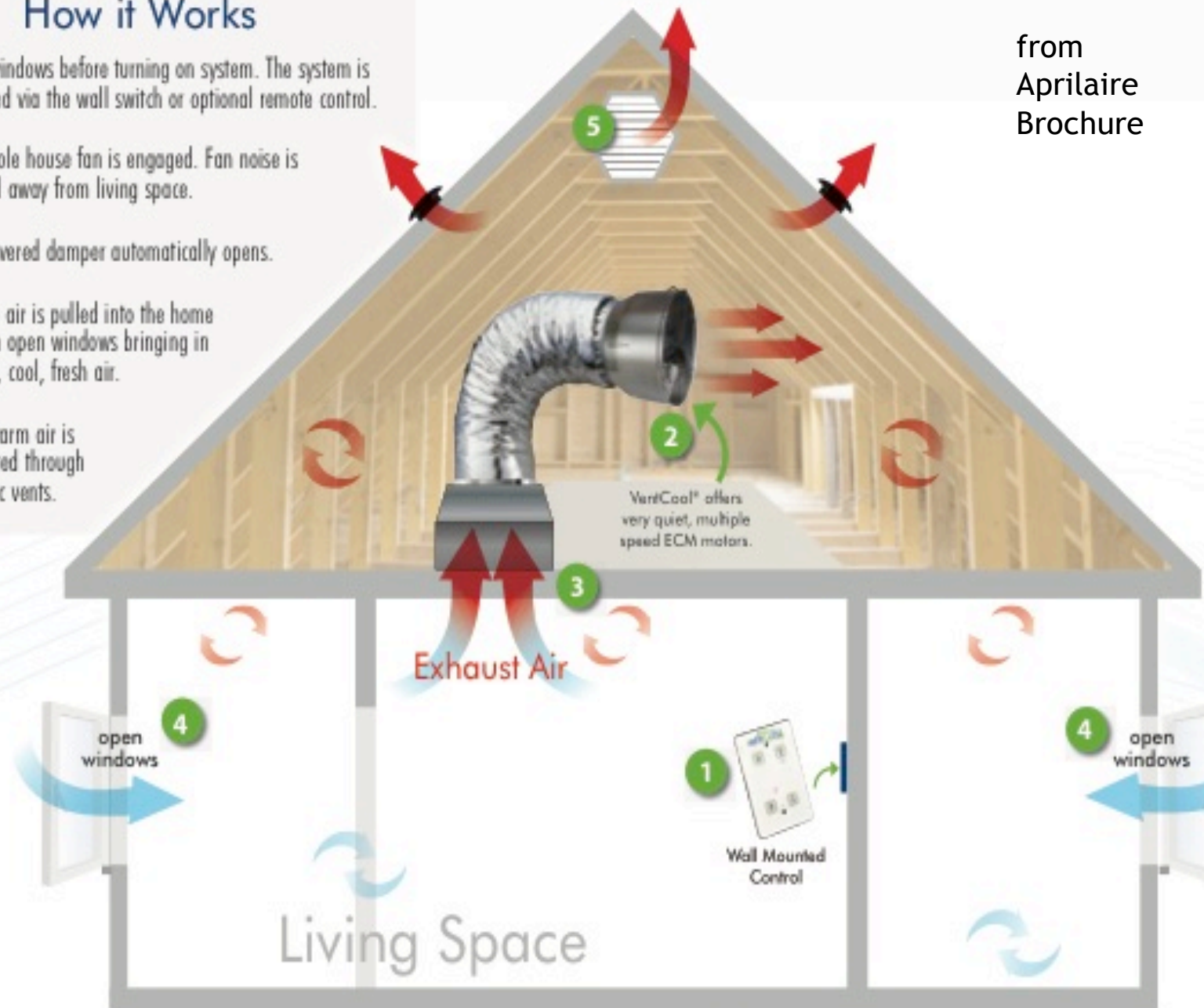
Item	Cost
Carrier 24VNA8 Infinity Series 16.8 - 20 SEER/11.4 - 16 EER/10.3 - 13.0 HSPF Variable Speed Heat Pump with Aprilair 2210 Air Cleaner	\$13,500
New Heat Pump Water Heater State Pro-line XE Hybrid Heat Pump, 50-gallon	\$4,150
Ductwork: (9) R6 flex ducts with dampers	\$4,650 *
Insulation: seal, remove batts, blow in R-44 (cellulose)	\$3,360 *
Whole House Fan VentCool 2.5 with insulated doors and timer	\$3,200
* Rebate item via BayREN	< \$2,850 >
Total	\$26,010

The Whole House Fan

How it Works

- 1 Open windows before turning on system. The system is activated via the wall switch or optional remote control.
- 2 The whole house fan is engaged. Fan noise is isolated away from living space.
- 3 The louvered damper automatically opens.
- 4 Outside air is pulled into the home through open windows bringing in natural, cool, fresh air.
- 5 Stale warm air is exhausted through the attic vents.

from
Aprilaire
Brochure



Power Seal Motorized Damper Models

Electric Rate Example

PGE Baseline for all-electric heating: Example in 2018

Example Baseline Rates (Territory X, Billing type E-6)		
Type of Heating	Winter Baseline (Nov. 1 - Apr 30) (daily kwh allotted)	Summer Baseline (May 1 - Oct. 31) (daily kwh allotted)
Not Electric	10.9	10.1
All-Electric	16.7	9.3

Heat Pump Space Heater Efficiency Ratings

- ▶ HSPF- efficiency for heating Heating Seasonal Performance Factor
- ▶ SEER- efficiency rating for cooling Seasonal Energy Efficiency Ratio
- ▶ EER- combined rating Energy Efficiency Ratio

Current Energy Star requirements:

Equipment	Specification
Air-Source Heat Pumps	≥ 8.5 HSPF/ ≥ 15 SEER/ ≥ 12.5 EER* for split systems ≥ 8.2 HSPF ≥ 15 SEER/ ≥ 12 EER* for single package equipment including gas/electric package units.

All Project Goals

- ▶ *Electrify our house to reduce GHGs !*
- ▶ Reduce waste & monthly costs
- ▶ Furnace replacement:
 - ▶ Replace aging furnace before it fails
 - ▶ Minimize noise
 - ▶ Variable speed
 - ▶ Gain 10 sf of closet space in house
 - ▶ Add high efficiency cooling capability
 - ▶ Improve air quality
 - ▶ Small footprint outside
- ▶ Hot Water Heater replacement
- ▶ At same time:
 - ▶ Replace 9.5 year-old Water Heater
 - ▶ Upgrade Whole House Fan
 - ▶ Insulate the Ductwork
 - ▶ Improve Insulation for the house