Heat Pump Water Heater Proposal

Energy Code TAG

July 2021

What's in the Heat Pump Water Heating Proposal?

Summary:

Provide heat pump water heating, rather than fossil fuel or electric resistance water heating, for all commercial buildings. Exceptions are provided to allow electric resistance heating for hand washing facilities.

What's in the Heat Pump Water Heating Proposal?

- Applies to all commercial building types
- Requires heat pump water heaters that follow the Northwest Energy Efficiency Alliance (NEEA) Advanced Water Heating Specification
- Requires primary systems to be HPWHs, unless the following exception is met:
  - Solar thermal, wastewater heat recovery, other approved waste heat recovery, ground source heat pump, water-source heat pump system utilizing waste heat, and combinations thereof, are permitted to offset all or any portion of the required HPWH capacity where such systems comply with this code and the WA State Plumbing Code

What's in the Heat Pump Water Heating Proposal?

Allows for the installation of secondary water heating using electric resistance to provide:

a. Temperature maintenance
b. Defrost of compressor coils
c. Heat tracing of piping for freeze protection
d. Low-ambient temperature conditions
e. 24kW plus 0.1kW/SF of building area of stand-alone electric resistance water heating capacity is allowed per building.

Economic Model Assumptions

Economic model was based off of a 182,000 sq ft, multifamily building with 173 units.

Considered because it is the likely worst case scenario.

Baseline is a centralized heat pump water heating system that provides hot water for the whole building.

Alternative 1 is an electric boiler system

Alternative 2 is a gas boiler heating system

Economic Model Results

Life Cycle Cost Analysis	Central Heat Pump Water Heater	Central Electric Boiler	Central Gas Boiler
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	3.9	10.4	9.4
1st Construction Costs	$ 273,940	$ 196,040	$ 132,560
PV of Capital Costs	$ 664,331	$ 466,470	$ 214,758
PV of Utility Costs	$ 575,184	$ 1,540,422	$ 581,597
Total Life Cycle Cost (LCC)	**$ 1,239,515**	**$ 2,006,892**	**$ 796,355**
Net Present Savings (NPS)	**N/A**	**$ (767,377)**	**$ 443,160**

Source: OFM Cost Analysis Tool

Energy Results

Prototype	Code Edition	Case	4C		5B	
			EUI, kBtu/sf	% EUI Savings	EUI, kBtu/sf	% EUI Savings
Mid-rise Apartment	2006	Base	40.91		46.74	
	2018	Split HP	31.86	22%	33.40	29%
	2018	Split DX/Gas Furnace	32.59	20%	35.75	24%
	2030	Split HP	16.19	60%	17.62	62%
	2030	Split DX/Gas Furnace	18.16	56%	20.25	57%
	2030	VRF	16.09	61%	16.90	64%

Modeled EUI savings of roughly 5.5 kBTU/sf for multifamily building.

Source: NEEA, Washington State Commercial Energy Code Technical Roadmap Report, pg 4

Energy Results

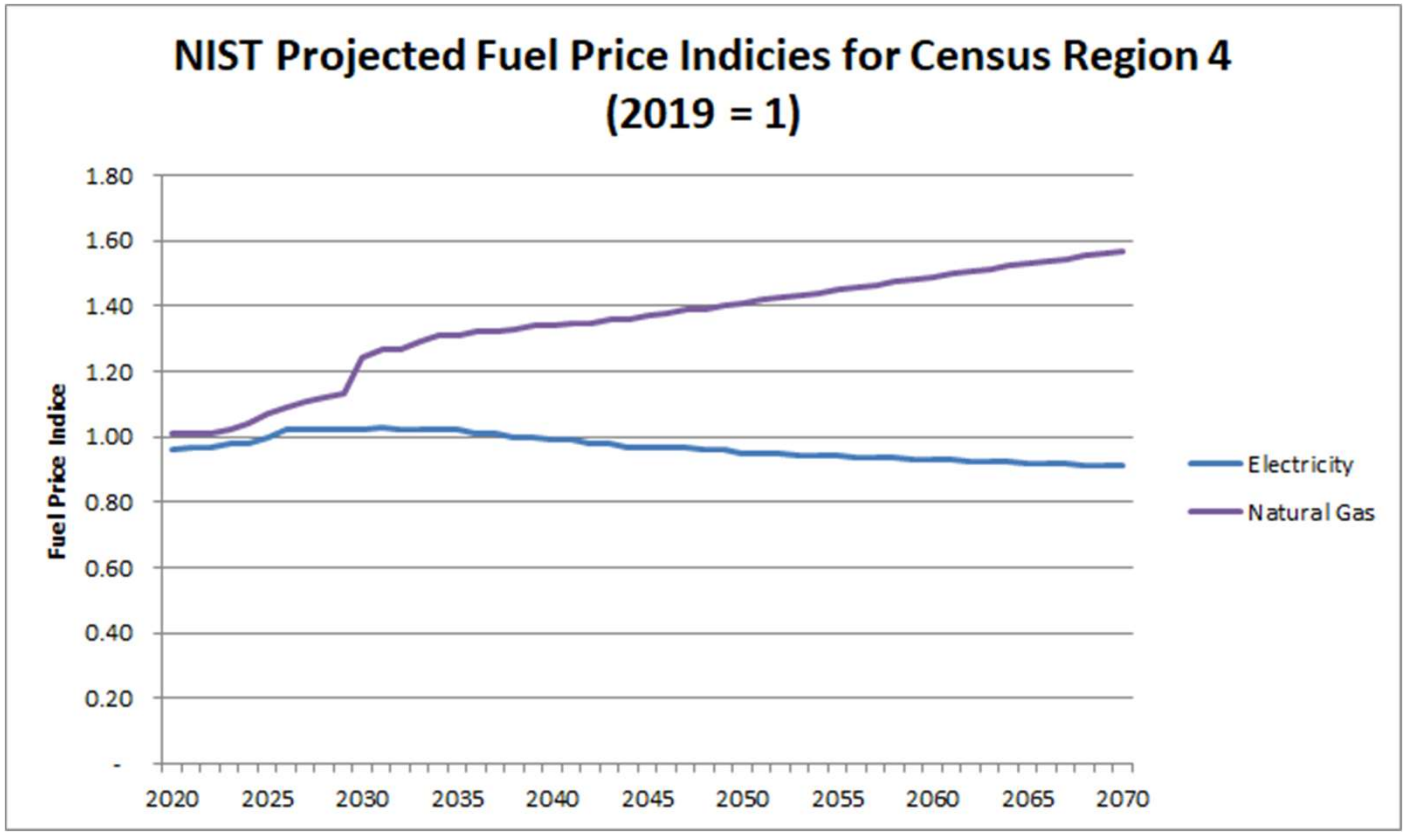
	Minimum SCOP*	Minimum Features	Sound Levels	Demand Response-Enabled?
Tier 1.0	2.1	• ENERGY STAR compliance • Freeze protection	dBA < 65	Optional
Tier 2.0	2.4	Tier 1 plus: • Minimal use of resistance heating elements (see Section 5.1) • Compressor shut-down/notification • 10 year warranty • Condensate management	dBA < 60	Optional
Tier 3.0	2.7	Tier 2 plus: • Override and default mode behavior as per Section 6.1	dBA < 50	Required
Tier 4.0	3.1	Tier 3 plus: • Physical design or default controls that limit resistance element heating to less than upper 50% of tank	dBA < 50	Required
Tier 5.0	3.6	Tier 4 plus: • No resistance element usage in default mode unless outside ambient air temperature is below -5°F	dBA < 50	Required

** SCOP (seasonal coefficient of performance) is a different variable from CCE. SCOP applies to split systems where the heat pump is subject to outdoor air conditions (see Appendix B.4). A blend of five Pacific Northwest cities was used as the reference climate for the SCOP.*

*** See Appendix D for details on Sound Level definition and calculation method.*

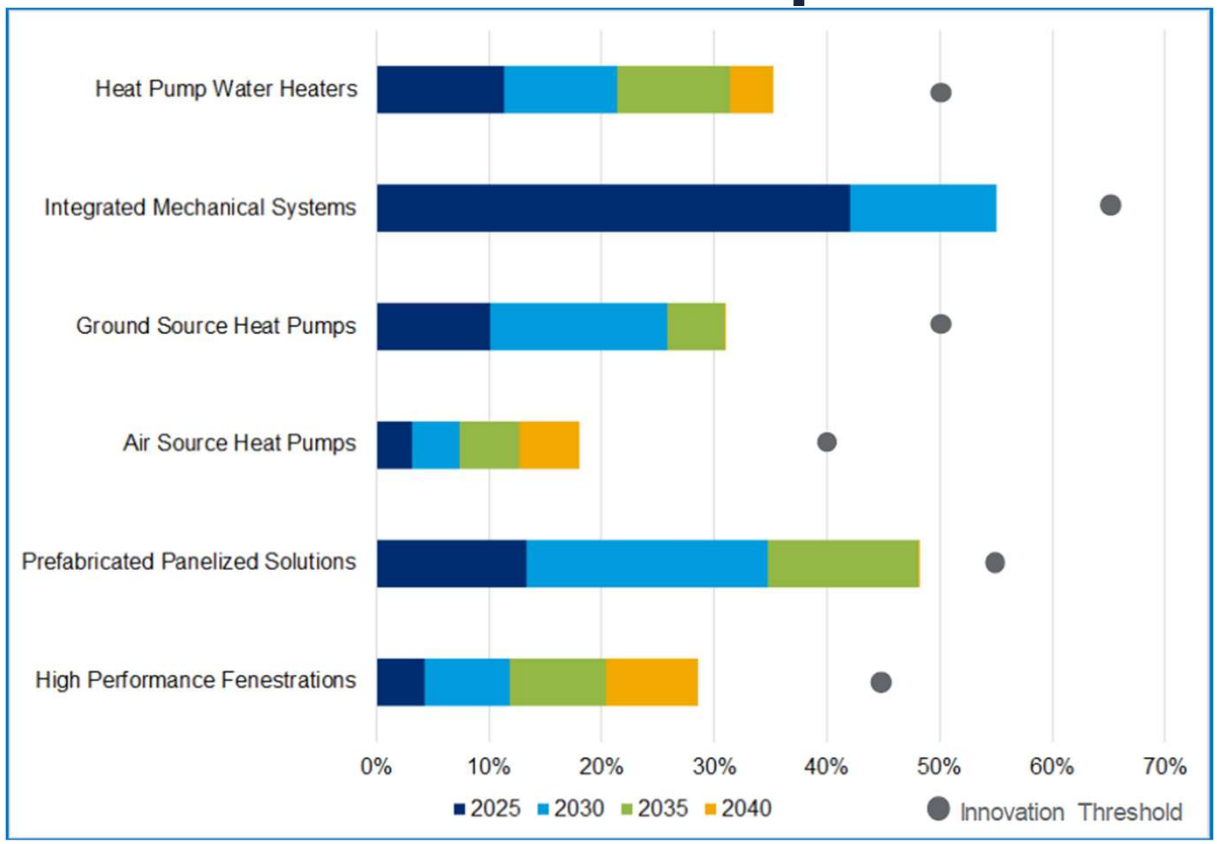
Source: NEEA, Washington State Commercial Energy Code Technical Roadmap Report, pg 4

FAQ: What about Operating Cost?



Source: OFM Cost Analysis Tool

FAQ: What about Capital Cost?



Source: NYSERDA, Carbon Free Buildings Roadmap, Day 1, https://www.nyserda.ny.gov/-/media/Files/Programs/Carbon-Neutral-Buildings/Day-1-Carbon-Neutral-Roadmap-Presentation.pdf

FAQ: What about Renewable Natural Gas?

- The potential supply of fossil gas alternatives (FGAs) are a small fraction of gas demand.
- Replacing fossil gas with FGAs is extremely costly.
- FGAs have a mixed environmental record.
- FGAs perpetuate the health impacts of combustion.

Source: EarthJustice & Sierra Club, Rhetoric vs Reality: The Myth of “Renewable Natural Gas” for Building Decarbonization

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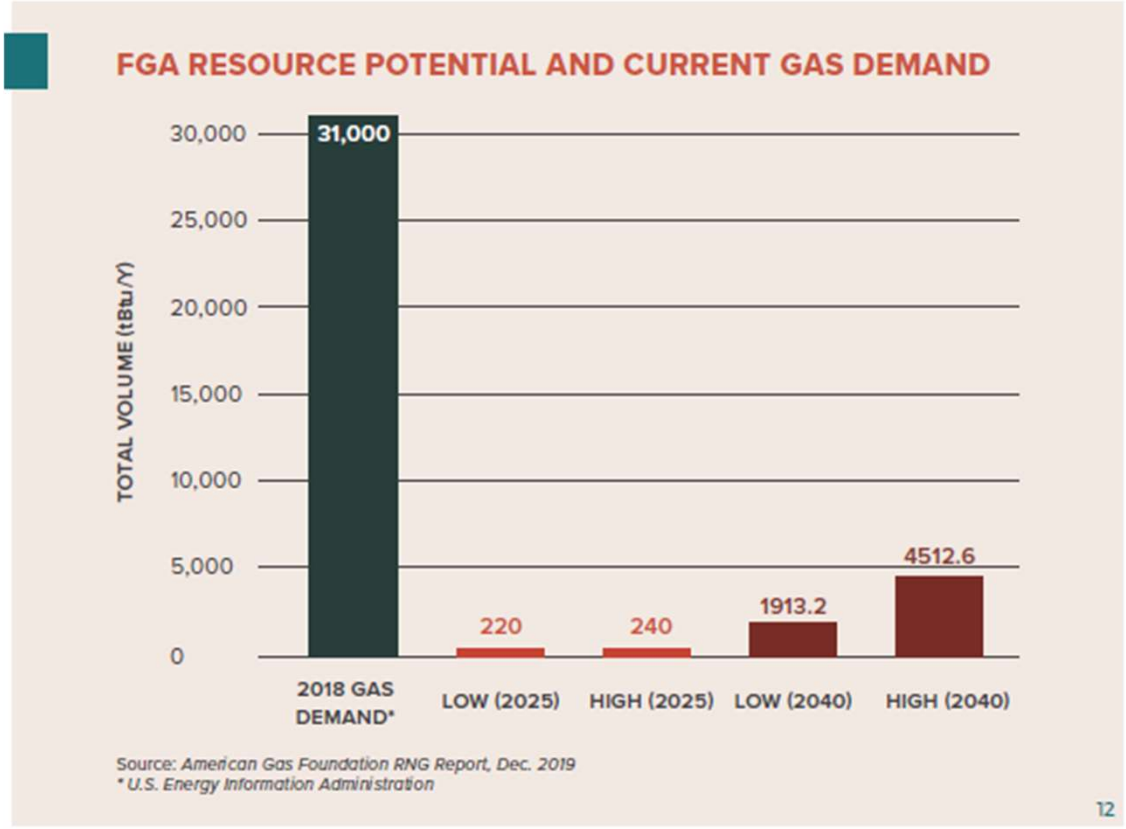

Source: EarthJustice & Sierra Club, Rhetoric vs Reality: The Myth of “Renewable Natural Gas” for Building Decarbonization

FAQ: What about Legionella?

- Heat pump water heaters apply temperatures that keep buildings safe from water-borne bacteria such as Legionella.
- Recent research indicates that heat pump technology for water heating is safe to use in high-risk locations for Legionella, such as hospitals.
- Heat pump water heaters are also capable of generating water temperatures as high as 140°F. Water heaters at this temperature can kill 90% of Legionella in 2 minutes. In fact, in most applications the recommended set point temperature for water heaters is 120°F to reduce risk of scalding occupants and stand by energy losses, while also minimizing Legionella growth.

Source: ASHRAE Handbook, HVAC Applications at 50.9 (2015)
Heat Pump Centre, Annex 46 Legionella and Heat Pump Water Heaters at 19 (2020) https://heatpumpingtechnologies.org/annex46/wp-content/uploads/sites/53/2020/10/hpt-an46-03-task-1-legionella-and-heat-pumps-1.pdf
U.S DOE, Measure Guideline: Heat Pump Water Heaters in New and Existing Buildings at 16 (2012), https://www.nrel.gov/docs/fy12osti/53184.pdf