

From: [Donna Leban](#)
To: [PSD - Comprehensive Energy Plan](#); [David Farnsworth](#); [McNamara, Ed](#); [ctdonovan](#)
Cc: [Lauder, Kelly](#); [Walter Poor](#); [Richard Cowart](#)
Subject: Comment on Comprehensive Energy Plan also pertaining to the Climate Action Plan
Date: Wednesday, December 1, 2021 4:01:45 PM
Attachments: [All electric homes - city analysis RMI.pdf](#)

EXTERNAL SENDER: Do not open attachments or click on links unless you recognize and trust the sender.

Dear CEP reviewers- A new comment not mentioned at any meetings I have thus far attended:

An effective method of providing builders with a good reason to consider installing efficient heat pump technology in new homes and buildings is to eliminate Vermont Gas's ability to charge all rate payers for the cost of hooking up new buildings to their gas lines.

I did not know until recently that VT Gas installs gas lines in new developments at no charge to the builder. This is completely out of line with rational energy policy at this time, and should be disallowed as soon as possible.

A recent Rocky Mountain Institute study looked at cost effectiveness of installing air source heat pump heating in all US climate zones and found that even for colder climates, all electric homes make sense. See attached.

However, they assumed that a \$2100 cost per home was being charged to the builder for gas hookup. You can see why it is so hard to get builders to not use gas when in an area served by their ratepayer-subsidized expanding system. What can be done to change this?

Thank you,

Donna Leban, AIA LC

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Light/Space/Design 7 Iris Lane South Burlington, VT 05403 802-862-1901
www.lightspacedesign.biz

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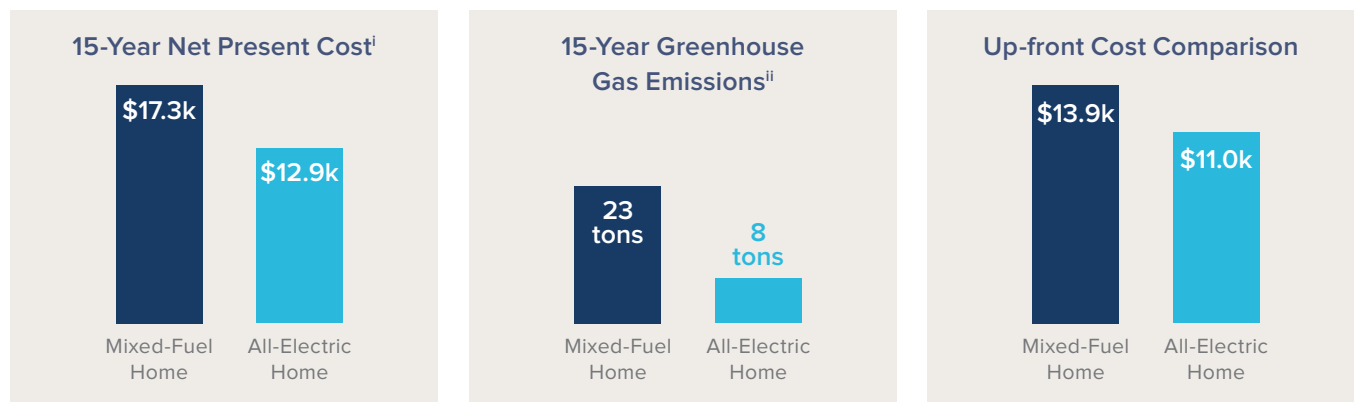
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RESIDENTIAL NEW CONSTRUCTION

AUSTIN: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In Austin, the all-electric home saves \$4,400 in net present costs and 15 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, presenting **savings on both up-front costs and utility bills.**

- A mixed-fuel home (with gas furnace, water heater, air conditioning, and new gas connection costs) has a higher up-front cost than the all-electric home, which uses the heat pump system for both heating and cooling.
- The all-electric home has **7% lower** annual utility costs. There are significant energy savings with a heat pump space and water heater over corresponding gas appliances, even though electricity is significantly more expensive than gas per unit energy in Austin.
- Carbon emissions from heating, water heating, and cooking are **65% lower** over the appliance lifetime in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$ 2,070	\$1,920	-\$150 (-7%)
Electricity Usage (kWh)	15,460	17,210	1,750 (+11%)
Gas Usage (kWh equiv.)	7,750 (260 therms)	n/a	-7,750 (-100%)

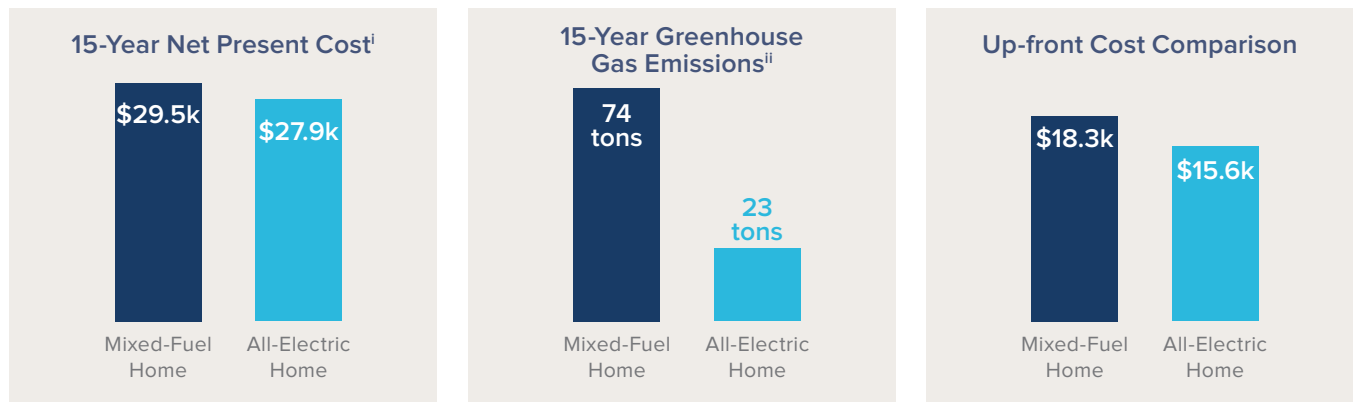
i. Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.
 ii. CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).
 iii. Results are rounded.
 iv. Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.



RESIDENTIAL NEW CONSTRUCTION

BOSTON: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In Boston, the all-electric home saves nearly \$1,600 in costs and 51 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, with **savings on up-front costs and nearly equivalent annual energy bills.**

- A mixed-fuel home (with gas furnace, water heater, air conditioning, and new gas connection costs) has a higher up-front cost than the all-electric home, which uses the heat pump system for both heating and cooling.
- The all-electric home has **3% higher** annual utility costs. There are significant energy savings with heat pump space and water heater over corresponding gas appliances, which outweigh the high cost of electricity in Boston.
- Carbon emissions over the 15-year period from heating, water heating, and cooking are **69% lower** in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$3,700	\$3,820	\$120 (+3%)
Electricity Usage (kWh)	10,640	17,410	6,770 (+64%)
Gas Usage (kWh equiv.)	24,650 (840 therms)	n/a	-24,650 (-100%)

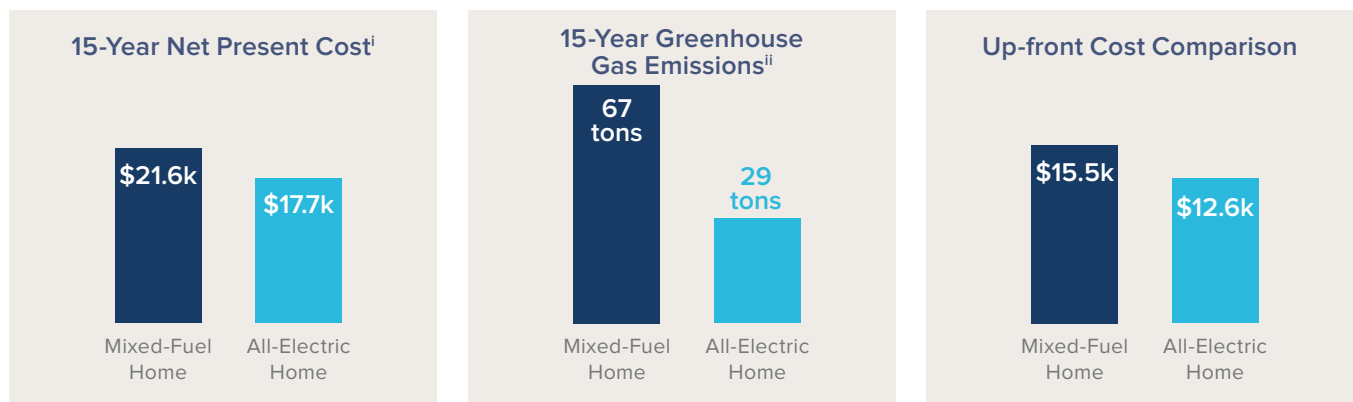
i. Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.
 ii. CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).
 iii. Results are rounded.
 iv. Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.



RESIDENTIAL NEW CONSTRUCTION

COLUMBUS: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In Columbus, the all-electric home saves \$3,900 in net present costs and 38 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, presenting **savings on both up-front costs and utility bills.**

- A mixed-fuel home (with gas furnace, water heater, air conditioning, and new gas connection costs) has a higher up-front cost than the all-electric home, which uses the heat pump system for both heating and cooling.
- The all-electric home has **6% lower** annual utility costs. There are significant energy savings with a heat pump space and water heater over corresponding gas appliances, even though electricity is significantly more expensive than gas per unit energy in Columbus.
- Carbon emissions from heating, water heating, and cooking are **57% lower** over the appliance lifetime in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$1,940	\$1,830	-\$110 (-6%)
Electricity Usage (kWh)	10,930	16,420	5,490 (+50%)
Gas Usage (kWh equiv.)	22,360 (760 therms)	n/a	-22,360 (-100%)

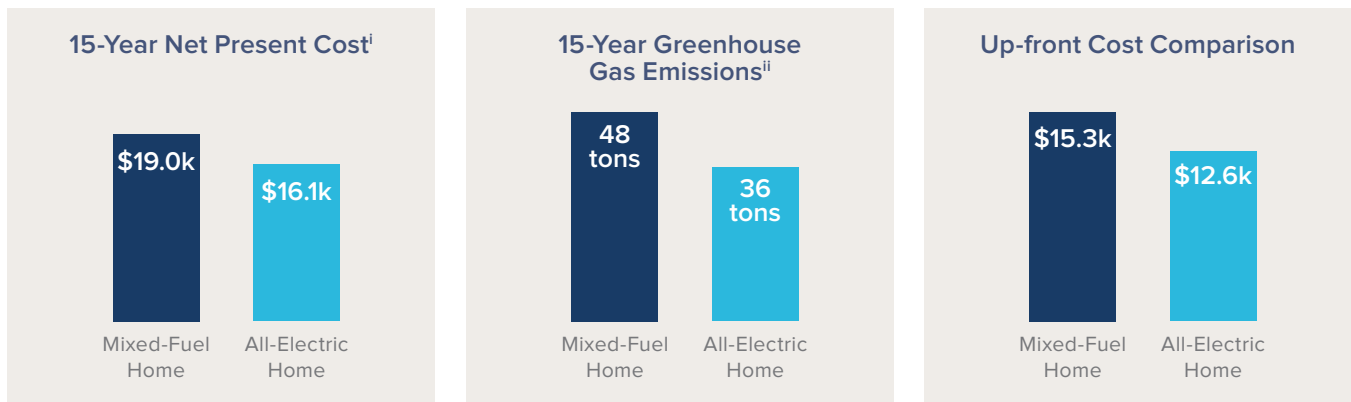
i. Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.
ii. CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).
iii. Results are rounded.
iv. Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.



RESIDENTIAL NEW CONSTRUCTION

DENVER: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In Denver, the all-electric home saves \$2,900 in net present costs and 12 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, presenting **savings on both up-front costs and utility bills.**

- A mixed-fuel home (with gas furnace, water heater, air conditioning, and new gas connection costs) has a higher up-front cost than the all-electric home, which uses the heat pump system for both heating and cooling.
- The all-electric home has **2% lower** annual utility costs. There are significant energy savings with a heat pump space and water heater over corresponding gas appliances, even though electricity is significantly more expensive than gas per unit energy in Denver.
- Carbon emissions from heating, water heating, and cooking are **25% lower** over the appliance lifetime in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$1,590	\$1,560	-\$30 (-2%)
Electricity Usage (kWh)	11,350	15,900	4,550 (+40%)
Gas Usage (kWh equiv.)	16,160 (550 therms)	n/a	-16,160 (-100%)

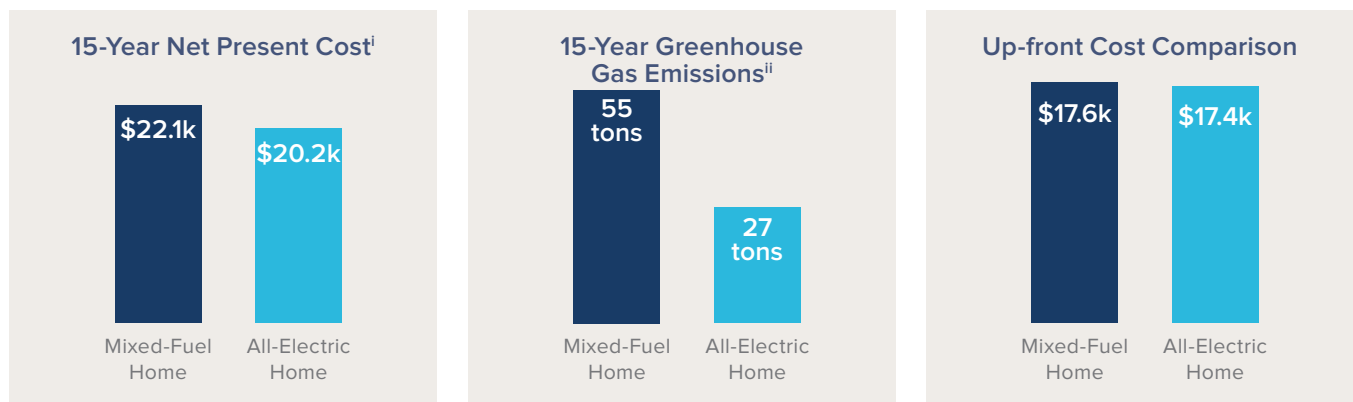
- Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.
- CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).
- Results are rounded.
- Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.



RESIDENTIAL NEW CONSTRUCTION

MINNEAPOLIS: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In Minneapolis, the all-electric home saves \$1,900 in net present costs and 28 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, with **roughly equivalent up-front costs and substantial annual bill savings.**

- Up-front costs for the all-electric and mixed-fuel homes are roughly equivalent. The Minneapolis climate requires a higher capacity heat pump than other cities in the study. This requirement comes at a higher cost, outweighing the equipment and labor cost savings seen with heat pump systems in milder climates.
- The all-electric home has **9% lower** annual utility costs. There are significant energy savings with heat pump space and water heaters over corresponding gas appliances, even though electricity costs more per unit energy than gas in Minneapolis. The all-electric home also benefits from a lower electricity rate during winter months.
- Carbon emissions from space heating, water heating, and cooking are **51% lower** in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$2,020	\$1,840	-\$180 (-9%)
Electricity Usage (kWh)	10,620	14,780	4,160 (+39%)
Gas Usage (kWh equiv.)	18,250 (620 therms)	n/a	-18,250 (-100%)

i. Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.

ii. CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).

iii. Results are rounded.

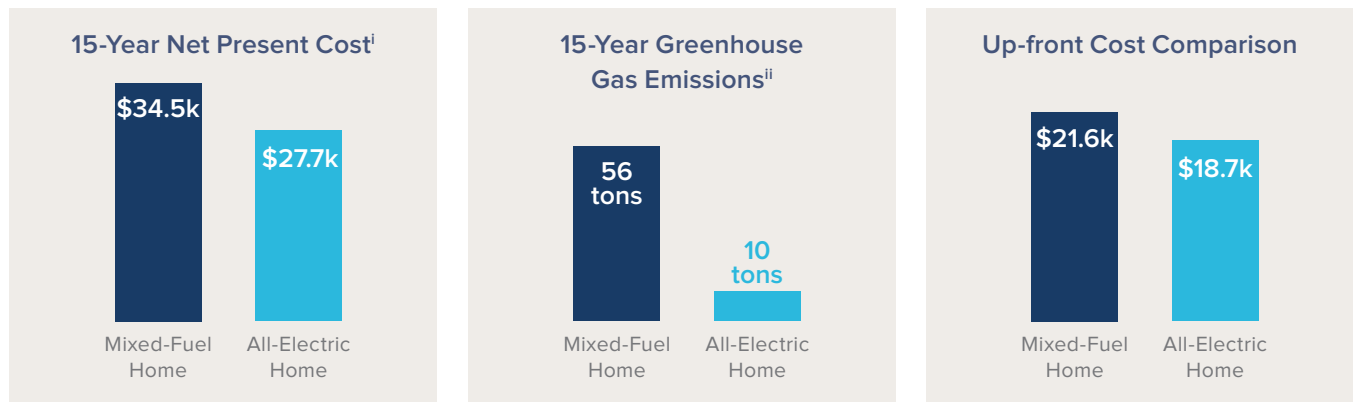
iv. Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.



RESIDENTIAL NEW CONSTRUCTION

NEW YORK CITY: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In New York City, the all-electric home saves \$6,800 in net present costs and 46 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, presenting **savings on both up-front costs and utility bills.**

- A mixed-fuel home (with gas furnace, water heater, air conditioning, and new gas connection costs) has a higher up-front cost than the all-electric home, which uses the heat pump system for both heating and cooling.
- The all-electric home has **10% lower** annual utility costs. There are significant energy savings with a heat pump space and water heater over corresponding gas appliances, which outweigh the high cost of electricity in New York City.
- Carbon emissions from heating, water heating, and cooking are **82% lower** over the appliance lifetime in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$4,310	\$3,880	-\$430 (-10%)
Electricity Usage (kWh)	12,210	16,800	4,590 (+38%)
Gas Usage (kWh equiv.)	18,780 (640 therms)	n/a	18,780 (-100%)

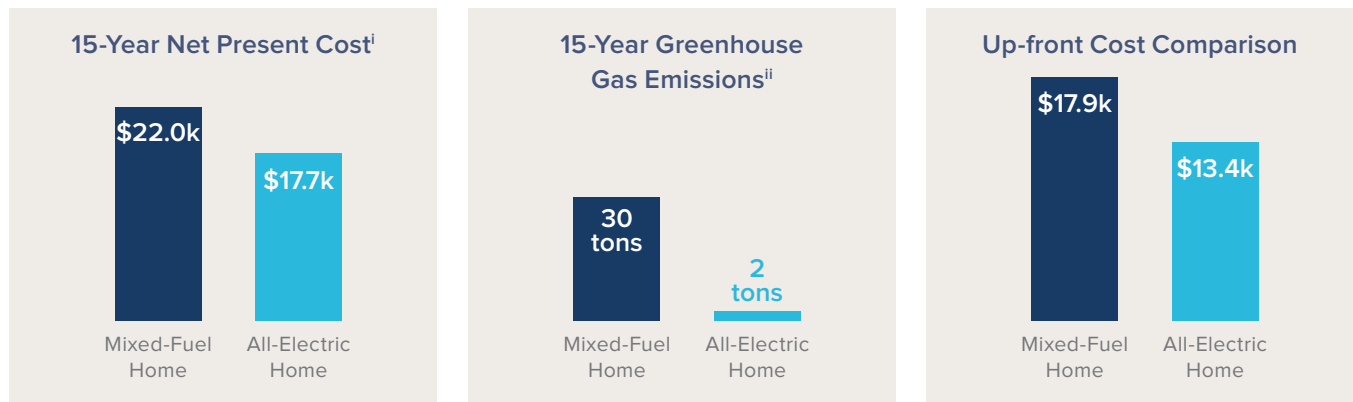
- Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.
- CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).
- Results are rounded.
- Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.



RESIDENTIAL NEW CONSTRUCTION

SEATTLE: SINGLE-FAMILY HOMES

RMI analyzed the costs of a new all-electric home versus a new mixed-fuel home that relies on gas for cooking, space heating, and water heating. **In Seattle, the all-electric home saves \$4,300 in net present costs and 28 tons of CO₂ emissions over a 15-year period.**



Key Findings

The new all-electric home has a lower net present cost than the new mixed-fuel home, presenting **savings on up-front costs and nearly equivalent annual energy bills.**

- A mixed-fuel home (with gas furnace, water heater, air conditioning, and new gas connection costs) has a higher up-front cost than the all-electric home, which uses the heat pump system for both heating and cooling.
- The all-electric home has **2% higher** annual utility costs. There are significant energy savings with a heat pump space and water heater over corresponding gas appliances, even though electricity is significantly more expensive than gas per unit energy in Seattle.
- Carbon emissions from heating, water heating, and cooking are **93% lower** over the appliance lifetime in the all-electric home, due to more efficient appliances and increasingly low-carbon electricity.

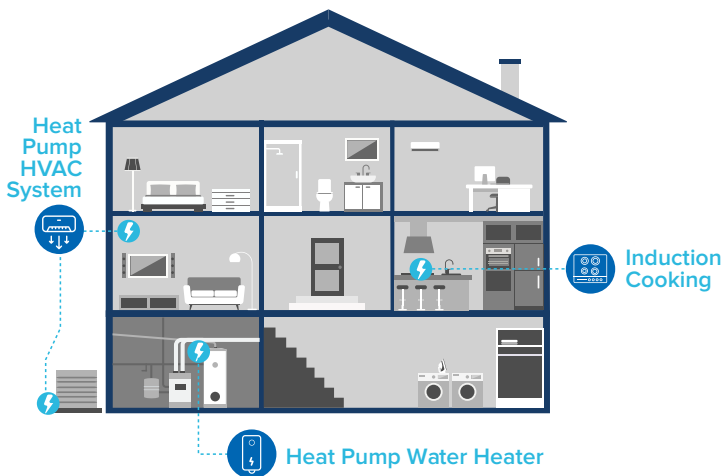
Annual Energy Usage and Utility Bill Impactsⁱⁱⁱ

	Mixed-Fuel	All-Electric	Difference
Annual Electricity & Gas Costs ^{iv}	\$1,630	\$1,660	\$30 (+2%)
Electricity Usage (kWh)	9,360	12,850	3,490 (+37%)
Gas Usage (kWh equiv.)	9,860 (340 therms)	n/a	-9,860 (-100%)

i. Net present cost calculation incorporates up-front costs and bill impacts, discount rate of 7%, and 15-year assumed equipment lifetime.
ii. CO₂ emissions are equipment lifetime projections and are conservative because these numbers do not include methane leakage. See [calculation methodology](#).
iii. Results are rounded.
iv. Annual utility cost includes electricity and gas costs, where present. Standard 2020 residential tariffs were used.

METHODOLOGY DETAILS

RMI analyzed the economics of a new all-electric single-family home versus a mixed-fuel home that relies on gas for cooking, space heating, and water heating. The following summarizes key home equipment and appliance characteristics for the study.



Annual Operating Cost Energy Modeling Methodology

Annual hourly energy modeling in EnergyPlus was conducted for each city using the following references:

- Department of Energy Residential Prototype Building Model for a single-family detached house (2,400 sq ft) used for building massing.ⁱ
- ASHRAE Standard 90.2-2019 used as reference HVAC system performance.ⁱⁱ Local building codes used as reference for thermal envelope performance.
- Energy modeling results for each scenario calibrated to end-use breakdown, EUI, and gas/electricity fuel split with the latest available Residential Energy Consumption Survey data by climate region.ⁱⁱⁱ



ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

Electrification Scenario Equipment Comparison^{iv}

Equipment	Mixed-Fuel	All-Electric
Heating	Ducted central gas furnace (AFUE 95)	Ducted multi-zone air source heat pump (11 HSPF, SEER 19)
Cooling	Central air conditioner (SEER 14)	
Water Heating	Gas water heater 80 gallon storage (EF 0.68)	Hybrid electric heat pump water heater 80 gal storage (EF 1.6)
Cooking	Gas cooktop Gas oven	Induction cooktop Electric oven

New Customer Gas Connection

We assume an out-of-pocket cost of \$2,100 for the gas connection of a new home, with scaling by a local construction cost factor. This estimate is conservative, as our research shows that the out-of-pocket cost range for a new customer gas connection per lot is \$0 to \$15k+. This cost varies widely depending on the extent of infrastructure upgrade required and the ratepayer-funded customer allowance from the utility in each location.

Appliance Costs

RMI compiled appliance cost data from cost studies reflecting invoice analyses, contractor surveys, and professional estimates. Costs were then scaled by city using RSMeans Construction Cost Indices. HVAC equipment costs were scaled on a per-ton basis depending on the capacity requirements of each climate.

- i. [DOE Residential Prototype](#)
- ii. Gas furnace and water heater equipment was specified at higher performance ratings than outlined in ASHRAE; efficiencies for that equipment were based on [Energy Star](#) specification to reflect consumer choice.
- iii. [EIA RECs Residential Energy Consumption Survey](#)
- iv. AFUE—Annual Fuel Utilization Efficiency; SEER—Seasonal Energy Efficiency Ratio; EF—Energy Factor; HSPF—Heating Seasonal Performance Factor

GET INVOLVED

Together, we can fulfill the promise of clean air, improved health and resilience, and economic opportunity that is rooted in our global shift to a clean energy future.

Learn more: www.rmi.org