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# CONNECTICUT'S HIDDEN AIR POLLUTION PROBLEM: FOSSIL FUELS IN BUILDINGS

How Air Quality Standards for HVACs and Water Heaters Can Tackle One Of Connecticut's Largest Sources of Lung-Damaging Nitrogen Oxide Pollution

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# Executive Summary

Connecticut's strategy for curbing harmful air pollution largely focuses on vehicles and industry, but there's another major source of emissions that's received far too little attention — space and water heating systems.

Many of the state's 3.6 million residents, particularly low-income people of color, routinely breathe hazardous air due to a persistent failure to meet federal standards for ozone, a major component of smog.

While ozone levels have improved substantially in recent decades, the state still hasn't achieved legally binding standards set by the U.S. Environmental Protection Agency (EPA).

Unlike some air pollutants, ozone isn't emitted directly into the atmosphere. It forms when two common air pollutants, nitrogen oxides ($NO_x$) and volatile organic compounds (VOCs), react in the presence of sunlight.

Burning gas, oil, and propane in building equipment like heating equipment [also referred to as heating, ventilation, and air conditioning (AC) equipment] and water heaters generates a staggering 23% of Connecticut's total $NO_x$ pollution. That's roughly eight times more than all of the state's power plants combined.

In addition to generating lung-damaging $NO_x$, fossil fuel HVACs and water heaters also generate dangerous fine particulate matter ($PM_{2.5}$), formaldehyde, carbon monoxide (CO) and climate-warming greenhouse gases (GHGs).

Exposure to these pollutants carries significant health risks, which disproportionately impact communities of color. Fossil fuel equipment in buildings, for example, caused an estimated 116 premature deaths in Connecticut in 2017, according to public health researchers at Harvard University. [1]

This pollution is as insidious as it is costly. Analysis using EPA's Co-Benefits Risk Assessment tool suggests that it's responsible for about 1,300 cases of respiratory symptoms and 2,500 lost work days per year, with total health impacts valued at $520 million annually. [2]

Fortunately, there are zero-pollution alternatives, most notably electric heat pumps. Heat pump HVAC and water heater technology is not only cleaner but also up to four times more efficient than fossil fuel and traditional electric counterparts. Heat pump HVACs provide cooling as well as heating, replacing traditional air conditioners and offering two core benefits with a single appliance.

[1] Based on RMI analysis using median estimates from the results of 3 reduced complexity models used in: Jonathan J. Buonocore et al., A Decade of The U.S. Energy Mix Transitioning Away from Coal: Historical Reconstruction of the Reductions in the Public Health Burden of Energy, 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c, as well as additional analysis from the study's lead author.

[2] Analysis using EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) with selected subsectors: commercial gas, commercial oil, and residential other.



*Hartford, Connecticut*

Electric heat pumps are also, perhaps surprisingly, cheaper to operate. RMI analyzed utility bill impacts and found that most households in Connecticut could save up to 35% on their utility bills if they upgrade to a heat pump for space heating or up to 10% by upgrading to a heat pump water heater. State and federal incentives also help make the upfront cost of heat pumps more affordable.

Connecticut could accelerate the transition to clean electric heat pumps by adopting zero-pollution air quality standards for HVACs and water heaters after a target date. This standard would ensure that newly installed space and water heating equipment does not exacerbate the state's challenges with public health and smog.

The Connecticut Department of Energy and Environmental Protection (DEEP) should recommend the development of such zero-pollution air quality standards for HVACs and water heaters through the agency's Comprehensive Energy Strategy. This would signal to manufacturers that a transition to pollution-free space and water heating equipment is on the horizon, allowing industry to ramp up production of heat pumps to meet anticipated demand.

DEEP should affirm its commitment to zero-pollution standards in its State Implementation Plan (SIP) for ozone, then partner with communities, industry, advocates and legislators in the coming year to develop HVAC and water heater standards that will best serve Connecticut residents.

# Key Findings

- **Fossil fuel building equipment is an underrecognized driver of air pollution in Connecticut.**
  - Fossil fuel building equipment is responsible for roughly 23% of Connecticut's health-harming $NO_x$ pollution — more than eight times the emissions from all the state's power plants.

- **Fossil fuel HVAC and water heating equipment is also a key driver of climate-warming carbon emissions.**
  - Burning fossil fuels in buildings is responsible for roughly 30% of Connecticut's total climate-warming greenhouse gas emissions – more than three times the emissions for the entire industrial sector. The state of Connecticut cannot achieve its legally-binding state climate targets without tackling pollution from homes and businesses.
  - According to analysis from RMI, replacing a gas furnace with a heat pump lowers operational GHG emissions from building space heating by 27% in the first year alone and 51% over the heat pump's fifteen-year lifespan, in the average Connecticut home.
- **Homes with fossil fuel water heaters can save money on their utility bills by upgrading to a heat pump water heater.**
  - According to RMI analysis, an average household in Connecticut can save up to 10% on their utility bills by switching from a fossil fuel water heater to a heat pump water heater. Homes with propane and heating oil water heaters can save 5-10% on their bills, and homes with a gas water heater can save 2-5% on their bills, by upgrading to a heat pump water heater.
- **Most homes with fossil fuel HVAC equipment can save money on their utility bills by upgrading to an air-source heat pump space heater.**
  - Homes with heating oil and propane furnaces or boilers can save up to 35% on their utility bills by switching to an air-source heat pump. Most homes with gas could see bill savings or achieve bill parity, though older homes with ducting may need weatherization measures to achieve bill savings under the current assumptions.
- **The Connecticut Department of Energy and Environmental Protection can secure clean-fueled, healthy homes and businesses by pursuing adoption of zero-pollution air quality standards for HVACs and water heaters.**

## WHAT IS AN ELECTRIC HEAT PUMP?

Electric heat pump equipment exists for both HVAC systems and water heating (commonly referred to as "heat pump" for space heating and "heat pump water heater" for water heating).

Heat pump technology works by transferring heat from one place to another. In heating mode, the equipment extracts heat from the outside air (even in cold temperatures) and transfers it indoors to warm the space. In cooling mode, the process is reversed, and heat is taken from the indoor air and expelled outside, cooling the indoor environment and replacing the function of traditional air conditioning. This is similar to how refrigerators operate.

Across the country, heat pumps and heat pump water heaters are rapidly becoming the preferred heating appliances due to their incredible efficiency – **two to four times** more efficient than fossil fuel water heaters and furnaces and traditional electric resistance equipment. In 2022, heat pump sales **surpassed gas furnace sales** for the first time, and this trend is likely to continue in the future. Plus, **leading products** are capable of performing well in below-freezing temperatures, offering an effective heating option for Connecticut homes.



There are several types of heat pumps.

### Heat pumps to replace furnaces and boilers:

**Air-Source Heat Pump (ASHP):** Extracts heat from the outdoor air and transfers it indoors for heating. ASHPs can also provide cooling by extracting heat from indoor air and releasing it outside. They are relatively easy to install and cost-effective, making them a popular choice for residential and commercial applications.

*Air-Source Heat Pump (ASHP)*

**Ground-Source Heat Pump (GSHP) or Geothermal Heat Pump:** GSHPs use the relatively stable temperature of the ground or groundwater as a heat source in the winter and a heat sink in the summer. They require more extensive installation involving buried pipes (ground loops), which can make them more expensive initially than ASHPs, though they are cheaper to operate over the long run and provide the most efficient form of heating available today.

**Ducted Heat Pumps:** Heat pumps can also be categorized based on their distribution systems. Ducted heat pumps use common home heating ducts often found in homes with fossil fuel furnaces to distribute heated or cooled air throughout a building. Ground-source heat pumps are ducted and air-source heat pumps may be ducted.

**Ductless Mini-Split Heat Pump:** This type of air-source heat pump is ductless and consists of an outdoor unit (compressor/condenser) and one or more indoor units (evaporators). They are ideal for heating or cooling individual rooms or zones in homes where ductwork is not feasible or desired.

**Packaged Rooftop Unit (RTU):** This type of air-source heat pump can be used for commercial buildings. This HVAC system sits on a building's rooftop and connects to ductwork to provide heating and cooling.

*Packaged Rooftop Unit (RTU)*

**Packaged Terminal Heat Pump (PTHP):** This is a ductless air-source heat pump that is usually used in multifamily and commercial buildings. PTHPs are a decentralized system of single heating units often found below windows.

**Heat pump water heaters to replace traditional water heaters:**

**Unitary Heat Pump Water Heater (240-volt):** This is a common option for single family homes, as it offers a 50-100 gallon storage tank with an integrated heat pump. Heat pump water heaters also dehumidify their surrounding area, making them a valuable addition to damp basements.

**"Plug-in" Unitary Heat Pump Water Heater (120-volt):** This emerging technology offers an easy replacement option for homes by plugging into a standard outlet. This can benefit residents who have limited panel capacity for a 240-voltage unitary system by avoiding the need for an electrical panel upgrade. Four manufacturers are offering or developing 120-volt heat pump water heaters.

**Central Heat Pump Water Heater:** This is a centrally located water heating system often used for multifamily and commercial buildings.

*Unitary Heat Pump Water Heater*

# Section One: Health and Air Quality Impacts from Fossil Fuel Heating Equipment

Burning fossil fuels in space and water heating equipment is an underrecognized source of pollution in Connecticut that has led to poor air quality and disproportionate health burdens falling on communities of color. Connecticut must work to reduce pollution from buildings to protect the health and safety of its residents.

Burning fossil fuels in space and water heaters generates many of the same pollutants as car exhaust, including health-harming nitrogen oxides ($NO_x$), particulate matter ($PM_{2.5}$), and carbon monoxide (CO). Exposure to pollution from fossil fuel space and water heating equipment comes at a significant health cost for Connecticut residents.



## FOSSIL FUEL BUILDING EQUIPMENT RELEASES HEALTH-HARMING POLLUTION

Approximately 85% of Connecticut homes burn fossil fuels for space heating: 45% use heating oil, 35% use methane gas, and 5% use propane. Over 60% of Connecticut homes burn fossil fuels for water heating: 24% heating oil, 33% gas, and 4% propane.

This fossil fuel equipment generates the following air pollutants linked to poor health outcomes:

- **Nitrogen oxide pollution ($NO_x$)** contributes to premature death, reduced lung function, increased asthma attacks, cardiovascular harm, lower birth weight in newborns, and greater likelihood of ER and hospital admissions.
- $NO_x$ is also a precursor to **ozone pollution**, which is linked to shortness of breath, wheezing and coughing, asthma attacks, increased risk of respiratory infections, and even death.
- **Fine particle pollution ($PM_{2.5}$)** contributes to premature death, decreased lung function, increased hospital admissions for cardiovascular disease, increased risk of stroke, higher likelihood of children developing asthma, and possibly increased risk of dementia.
- **Formaldehyde** contributes to eye, nose, and throat irritation at low levels, and is linked to cancer with prolonged exposure to high levels.
- **Carbon monoxide (CO)** can cause headache, nausea, dizziness, weakness, confusion, and disorientation when breathing low levels. Prolonged exposure to low levels can cause permanent mental and physical problems. Very high levels can cause loss of consciousness and death.

Outdoor pollution from fossil fuel appliances caused an estimated 116 premature deaths in Connecticut in 2017, according to Harvard public health researchers. [3] Analysis using EPA's Co-Benefits Risk Assessment tool indicates that this pollution is responsible for additional negative health and economic effects, including about 1,300 cases of respiratory symptoms and 2,500 lost work days per year, with total health impacts valued at $520 million annually. [4]

The health impacts from exposure to air pollution more generally, and residential gas combustion specifically, fall hardest on communities of color in Connecticut. Nationally, people of color are 64% more likely than white people to live in a county with a failing grade for air pollution from the American Lung Association, and this trend is true in Connecticut too.

The city of New Haven, for example, which has a population of roughly 60% people of color, routinely experiences ozone levels so high that it received an "F" grade for ozone in the American Lung Association's 2023 State of the Air report.

[3] See footnote 1

[4] See footnote 2

$NO_x$ pollution from fossil fuel space and water heaters also contributes to Connecticut's decades-long failure to meet federal air quality standards for ozone. Fossil fuel building equipment is responsible for roughly 23% of Connecticut's health-harming $NO_x$ pollution — more than eight times the emissions from all the state's power plants.

RMI found that areas of the country with the highest $NO_x$ pollution from buildings, including Connecticut, coincide with areas that are in nonattainment with federal ozone limits. Recent modeling by Sonoma Technology confirmed that Connecticut's buildings alone are consistently driving levels of ozone pollution above the threshold used by the EPA to determine sources of pollution that require regulation in the cross-state pollution context, [5] indicating that $NO_x$ pollution from buildings is significant enough to warrant further regulation in Connecticut. [6]

## Section Two: Transitioning to Electric Equipment Can Reduce Pollution, Save Residents Money and Improve Climate Resilience

Burning fossil fuels in buildings is responsible for roughly 30% of Connecticut's total climate-warming greenhouse gas (GHG) emissions — more than three times the emissions for the entire industrial sector. Connecticut cannot achieve its legally binding state climate targets without tackling pollution from homes and businesses.

Transitioning homes from fossil fuel heat to highly efficient electric heat pumps is the most effective strategy to cut pollution from homes and businesses. According to analysis from RMI, replacing a gas furnace with a heat pump decreases operational GHG emissions from building space heating by 27% in the first year alone and 51% over the heat pump's fifteen-year lifespan, in the average Connecticut home.

The pollution savings from heat pump installation will only continue to grow as Connecticut ramps up the use of clean energy. In addition to GHG reductions, analysis from the Northeast States for Coordinated Air Use Management (NESCAUM) confirmed that Connecticut would reduce $NO_x$ and $PM_{2.5}$ pollution by upgrading HVACs and water heaters to heat pumps in homes.

Heat pumps can also make utility bills more affordable for residents in Connecticut. RMI analyzed the utility bill impacts for average homes in Connecticut and found that in most scenarios, households with fossil fuel furnaces and water heaters can reduce their utility bills today by upgrading to an air-source heat pump or a heat pump water heater.

[5] For example, in the Good Neighbor plan for the 2015 Ozone NAAQS, the EPA used a screening threshold of 1 percent of the NAAQS to determine if upwind states were linked to nonattainment or interference with maintenance in downwind states. States that meet or surpass the 1 percent threshold undergo further evaluation to determine whether additional regulations are required. See 88 FR 36654, Federal "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards, https://www.govinfo.gov/content/pkg/FR-2023-06-05/pdf/2023-05744.pdf.

[6] Sonoma Technology modeled the ozone impacts of buildings and boilers on Connecticut's nonattainment areas using the Comprehensive Air Quality Model with Extensions (CAMx) with Ozone Source Apportionment Technology (OSAT) for the 2016 ozone season (April to October). The source apportionment modeling simulations used EPA's 2016v2 (2016fj_6j) modeling platform, which relies on emissions data from the National Emissions Inventory, as well as EPA's 2023 projections platform.

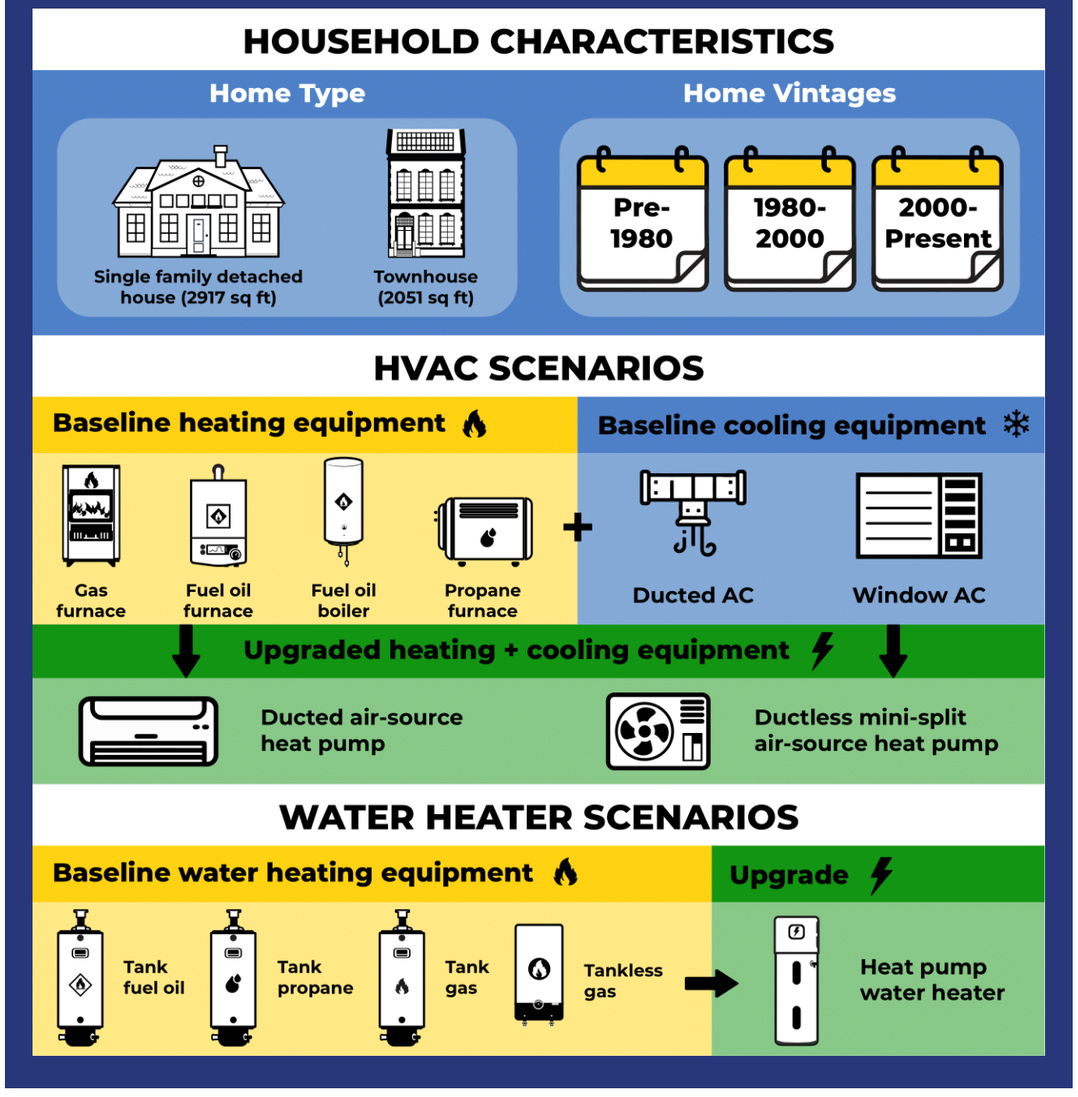


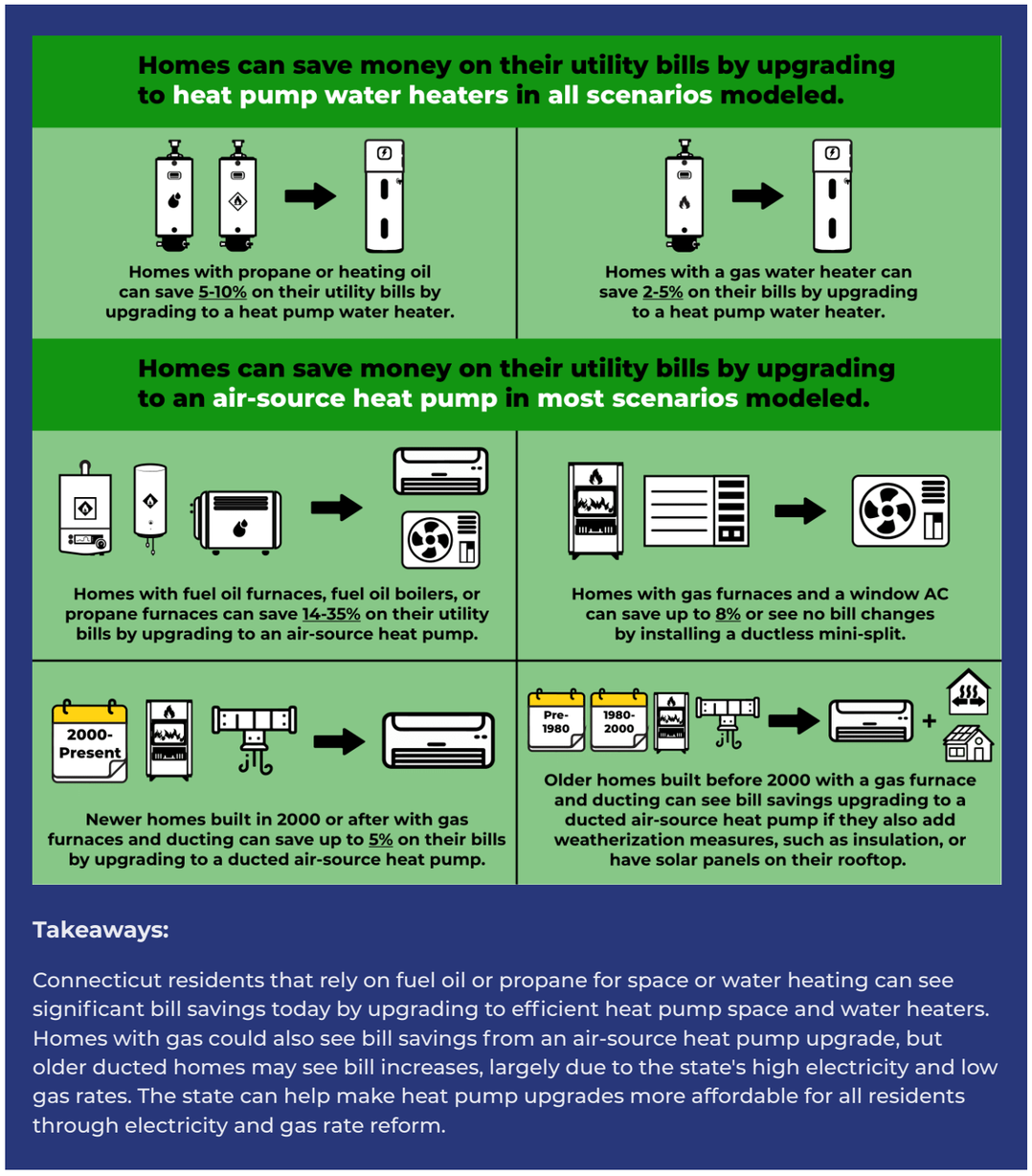
## MANY CONNECTICUT RESIDENTS CAN REDUCE UTILITY BILLS BY UPGRADING TO HEAT PUMPS

RMI analyzed the utility bill impacts for households in Connecticut that upgrade from a fossil fuel heater or water heater to a heat pump and found that most homes can save money today on their utility bills by installing an electric heat pump or heat pump water heater.

**Analysis Overview:**

The analysis explored scenarios where a home upgrades either an HVAC or water heating system powered by fossil fuels to an electric heat pump. The scenarios use the household typologies and equipment types below. Additional detail on the assumptions and methodology can be found in Appendix A.






**Takeaways:**

Connecticut residents that rely on fuel oil or propane for space or water heating can see significant bill savings today by upgrading to efficient heat pump space and water heaters. Homes with gas could also see bill savings from an air-source heat pump upgrade, but older ducted homes may see bill increases, largely due to the state's high electricity and low gas rates. The state can help make heat pump upgrades more affordable for all residents through electricity and gas rate reform.

The upfront cost of heat pumps is also becoming more affordable with federal and state incentives. Energize Connecticut offers up to $15,000 in combined incentives for a residential air-source heat pump, which could cover the entire cost of this heating and cooling system for some homes, as they estimate the average cost to range from $5,000 to $25,000. The program also offers $750 for residential heat pump water heaters, which they estimate to cost $1,700 to $3,000. Residents will also be able to access federal incentives and tax credits through the Inflation Reduction Act (IRA) starting later this year, supplementing state incentives. The residential rebates available to both single-family and multifamily residents will cover 100% of electrification project costs for low-income households and 50% of costs for moderate-income households.



## HEEHRA Rebate Levels

For Qualified Electrification Projects

| | |
|---|---|
| **Income Eligibility and % Costs Covered** | |
| **Low-income:** <80% Area Median Income (AMI)<br>% costs covered (including installation) | **100%** |
| **Moderate-income:** 80-150% AMI<br>% costs covered (including installation) | **50%** |
| **Overall Incentives** | |
| Max consumer rebate | **$14,000** |
| Max contractor rebate | **$500** |
| **Rebates for Qualified Electrification Projects** | |
| Heat pump HVAC | **$8,000** |
| Heat pump water heater | **$1,750** |
| Electric stove/cooktop | **$840** |
| Heat pump clothes dryer | **$840** |
| Breaker box | **$4,000** |
| Electric wiring | **$2,500** |
| Weatherization<br>insulation, air sealing, ventilation | **$1,600** |

***Income-eligible rebates from The High-Efficiency Electric Home Rebate Act (HEEHRA) Source: Rewiring America***
https://www.rewiringamerica.org/policy/high-efficiency-electric-home-rebate-act

For nonresidential buildings, Energize Connecticut offers $2,250 per ton combined incentives for commercial air-source heat pumps and up to $1,400 per unit for commercial heat pump water heaters. The federal IRA and Infrastructure Investment and Jobs Act (IIJA) also provide over $1 billion in programs and tax incentives to help commercial buildings reduce energy use and greenhouse gas pollution through upgrades such as heat pump installations.

Homes and businesses can make affordable upgrades to highly efficient and pollution-free heat pumps with these incentives.

## CLIMATE-READY HOMES USE HEAT PUMPS

Upgrading homes with highly efficient electric heat pumps will also help communities stay safer during periods of climate-fueled extreme weather by improving cooling efficiency and air filtration in homes. The heat pumps that are installed across the Northeast use an average of 29% less electricity to maintain the same level of cooling during periods of peak demand compared to traditional central air conditioning. These savings lock in more affordable energy bills and support improved grid resilience.

# Section Three: It's Time for Connecticut to Ramp Up Heat Pump Adoption

The transition from fuel-burning HVAC systems and water heaters to heat pumps is already underway in the U.S. Last year, heat pump sales exceeded gas furnace sales nationally. In the Northeast, Maine already surpassed its goal to install 100,000 new heat pumps by 2025 and set a new target for 175,000 more heat pumps by 2027.

In Connecticut, the state recognizes the need to accelerate the shift toward heat pump adoption. Earlier this year, DEEP approved an energy efficiency plan that ends incentives for fossil fuel equipment in new homes, phases out incentives for fossil fuel equipment in replacement programs, prioritizes cost-effective transitions to heat pumps, invests in consumer education and workforce development programs to promote heat pumps, and increases incentives for heat pumps. Though the state is moving in the right direction, DEEP admits that to achieve state climate goals reductions in heating-related pollution must be "far more rapid."

The transition to heat pumps is likely to happen gradually over time due to the long natural lifespan of equipment. Connecticut can dramatically accelerate this transition by requiring the installation of non-pollution equipment as soon as possible. Every time a piece of equipment breaks and needs replacement, the newly purchased equipment locks in a decades-long pollution decision. Space and water heaters tend to last 10 to 20 years and typically are not replaced until they break. Thus, it is critical to ensure heat pumps are installed upon replacement to avoid locking in another two decades of pollution.



# Section Four: DEEP Can Accelerate the Transition to Heat Pumps With Air Quality Standards for HVACs and Water Heaters

Connecticut policymakers can jumpstart the transition to heat pumps by adopting zero-pollution standards for HVACs and water heaters. These standards would require any furnace or water heater sold in or after 2030 to be pollution-free. When a furnace or water heater breaks and needs to be replaced or when a new building is built in or after this policy takes effect, only pollution-free options would be available for purchase. These standards will drive a gradual transition toward clean appliances like heat pumps as existing appliances reach the end of their natural lives and are replaced.

The federal Clean Air Act grants states broad authority to identify and enact regulations that limit pollution from stationary sources, and some states have already exercised this authority to limit pollution from space and water heaters. In fact, some states like Texas have had a low-$NO_x$ standard on the books for over 20 years.

- **TEXAS:**
  - First **adopted rules** requiring new water heaters, small boilers, and process heaters statewide to meet specific $NO_x$ emission limits in the year 2000, as part of the state's plan for meeting federal air quality standards for ozone.

- **UTAH:**
  - Air regulators **voted in 2015** to adopt a ultra-low $NO_x$ standard for water heaters, which went into effect in 2017.

- **CALIFORNIA:**
  - Multiple regional regulators have adopted low-$NO_x$ and ultra-low-$NO_x$ **space heater** and **water heater** standards, dating back to as early as **1978**.

- **COLORADO:**
  - In 2023, Colorado passed a **bill** enacting low-$NO_x$ limits for space and water heaters that will take effect in 2026.

As states continue to identify new strategies to meet federally binding air quality standards and support their climate targets, a growing number of regulators have adopted or are considering zero-pollution standards.

- **SAN FRANCISCO BAY AREA:**
  - Adopted the nation's first **zero-pollution standard** for space and water heating in March 2023. The new rules tackle pollution from gas water heaters and furnaces, which are responsible for **more nitrogen oxide** pollution than all passenger vehicles in the Bay Area combined.

- Regulators estimate that implementation of the rule will prevent **15,000 asthma attacks** and avoid up to **85 premature deaths** every year due to improvements in air quality. The standard will take effect in 2027 for residential water heaters, 2029 for residential furnaces, and 2031 for multifamily and commercial water heaters.

- **CALIFORNIA:**
  - **Committed** to zero-pollution space and water heater standards by 2030 in its **2022 ozone SIP**, recognizing these standards as an important control measure to achieve ozone reductions. In May of 2023, the agency kicked off development of statewide zero-emission standards.

- **MARYLAND:**
  - Included a recommendation for zero-pollution space and water heater standards in its **2022** and **2023** climate planning reports.

- **COLORADO:**
  - **Committed** to further strengthening its low-$NO_x$ requirements by 2030 to meet state climate and air quality goals.

To be effective, air quality standards for HVACs and water heaters must be part of a suite of policies that secure an equitable transition to clean, healthy homes and businesses. These standards guarantee the transition will begin by a certain date, and they send a clear signal that enables the heat pump market to scale up. But they must be accompanied by policies that guarantee that the transition will be affordable and equitable for all residents and business owners. Decision-makers should commit to passing zero-pollution air quality standards and creating the conditions necessary for their equitable and affordable rollout. In other words, developing the standards and preparing for equitable implementation are both critical parts of the solution.

## Developing Equitable Air Quality Standards for HVACs and Space Heaters

Connecticut regulators have an opportunity this fall to take the first step towards developing health-protective standards for HVAC and water heating equipment. DEEP is currently working on a Comprehensive Energy Strategy (CES) that will focus on the building sector and will guide state policy in the years to come. As part of the CES, DEEP should recommend the development of strong air quality standards that ensure only pollution-free HVAC and water heating equipment is installed beginning in 2030.

DEEP should then solidify its recommendation by including strong air quality standards for HVACs and water heaters in its State Implementation Plan (SIP). Due to the state's longtime failure to meet federal ozone limits, Connecticut must develop a SIP with ozone control measures and adopt regulations that reduce ozone pollution. The state can present a stronger SIP by including zero-pollution HVAC and water heater standards that will help meet federal ozone requirements and promote cleaner air and better health.



In developing air quality standards for HVACs and water heaters, DEEP should prioritize equity in both process and design. An equitable process involves early and frequent collaboration with environmental justice leaders and community members, especially those most impacted by furnace and water heater pollution. The rulemaking should also consider and incorporate equity design elements, such as the implementation working group and interim reports included in the Bay Area's zero-pollution furnace and water heater rules.

## Preparing for Equitable Implementation with Complementary Policies

At the same time that Connecticut is developing air quality standards for HVACs and water heaters, it should be creating the conditions necessary for equitable and affordable rollout of the standards through complementary policies.

Fortunately, the state has already made progress on this front by making heat pumps more affordable and supporting the transition for low-income households. In 2021 and 2023, the state passed legislation to provide funding for whole-home retrofits that prioritizes heat pumps among other efficiency and electrification measures for low-income residents and tenants in vulnerable communities. [7] The state's phaseout of fossil fuel incentives, its new heat pump program and the federal Inflation Reduction Act funding will further support an affordable and equitable transition to heat pumps.

But there is more that Connecticut can and should do before 2030 to support an equitable transition. For example, the state should seek regulatory solutions to redesign utility rates for an electrified future and ensure all residents can reduce their overall energy costs by installing heat pumps. The Connecticut Green Bank should develop financing programs, such as no- or low-interest loans for zero-emission heating equipment and necessary electrical upgrades to help accelerate the transition to electric heat pumps. The state should also invest in workforce training programs to ensure a high supply of well-trained workers to meet the installation needs of the heat pump transition. These efforts, along with other equity and affordability policies, will help ease the transition for residents when the standards take effect.

While some of these complementary policies are outside DEEP's authority, the agency can play a key role in advancing these actions by developing health-protective standards for HVACs and water heaters as soon as possible, signaling the equipment transition to come. This early market signal can help transform the HVAC and water heating market and advance supporting policies more quickly. From a market perspective, the standards guarantee demand for pollution-free equipment, giving manufacturers the signal they need to increase heat pump supply. Greater supply should lead to lower prices and further demand for pollution-free technologies. From a policy perspective, the standards increase the urgency for equity and affordability protections by setting a date by which the protections need to be in place. Having an established date can help bring stakeholders to the table to engage in transition plans and can help accelerate adoption of the necessary equity-focused policies. The sooner Connecticut commits to zero-pollution equipment standards, the better positioned it will be to achieve equitable and affordable implementation of the policy by 2030.

[7] PA 21-48 and PA 23-25 (sections 90 and 91)

## Conclusion

Communities across the state urgently need cleaner air, and Connecticut can deliver it by adopting strong air quality standards for HVACs and water heaters. Starting in 2030, when a fossil fuel furnace or water heater burns out, it should be replaced by a pollution-free technology like a heat pump. Upgrading homes with this superior technology will help lower energy bills for many households and improve both access to and efficiency of cooling in homes — all while ensuring consumers and builders avoid installing equipment that will lock in decades of additional health-harming and climate-disrupting pollution.

*New Haven, Connecticut*



## APPENDIX A

RMI analyzed the utility bill impacts for households in Connecticut that upgrade from a fossil fuel heater or water heater to a heat pump. The analysis models hourly energy usage and utility bill costs for average households in Connecticut both with a fossil fuel baseline and with a heat pump upgrade. Utility bill impacts are estimated by taking the difference between the total operating cost for a given household's baseline scenario (home with a fossil fuel space or water heater) and the same household's upgrade scenario (home with a single heat pump upgrade).
The assumptions and methodology are detailed below.

***Home Type and Energy Load***

- The analysis uses average household typologies in Hartford, Connecticut based on state data from Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) for a single family detached home (2917 square feet) and a townhome (2051 square feet). Modeling scenarios look at both home types built in three time periods: pre-1980, 1980-2000, and 2000-present.

- Household energy consumption is based on hourly energy load profiles from the NREL ResStock tool that estimate hourly energy usage for each end-use type.

- Hourly air-source heat pump performance is based on: a) the hourly home heating or cooling load sourced from NREL ResStock; b) the air-source heat pump capacity and efficiency curves averaged from common air-source heat pump in the NEEP database; and c) hourly outdoor air temperature for climate zone 5A sourced from NREL ResStock.

- Hourly heat pump water heater performance is based on: a) the hourly home water heating load sourced from NREL ResStock; and b) the heat pump water heater capacity and efficiency curves averaged from reported data from two common electric hybrid water heater manufacturers as found in Ecotope's HPWHSim model.

***Utility Rates***

- Current electric and gas volumetric utility rates are based on the EIA 2022 Connecticut average and a $10 fixed charge.

- Fuel oil and propane rates are based on the EIA 2022 New England regional average.

- The analysis modeled bill impacts in year one under current rate conditions.

***Technology Details***

**Space Heating**

- The baseline analysis looks at four fossil fuel space heaters: gas furnace, fuel oil furnace, fuel oil boiler, and propane furnace. The baseline fossil fuel furnace is assumed to have an efficiency of 80% AFUE.

- The upgrade analysis looks at two air-source heat pumps with electric resistance backup: a ductless mini-split and a ducted air-source heat pump. Both have a listed heating efficiency (HSPS2) of 9.5-10.5 and listed cooling efficiency (SEER2) of 17-18. The heat pump coefficient of performance varies with hourly ambient air temperature from NREL ResStock.

- All homes are assumed to have an air conditioner in the baseline scenario and use the heat pump for air conditioning in the upgrade scenario. Baseline air conditioning is ducted when the home upgrades to a ducted air-source heat pump and a window air conditioner when the home upgrades to a ductless mini-split heat pump.
- Furnace size is assumed to be four tons for both single-family detached homes and townhomes. Air-source heat pumps are assumed to be four tons for single-family detached homes and two tons for townhomes to meet the vast majority of home heating load with the heat pump and minimize use of the electric resistance backup.
- In space heater scenarios, all other household equipment is assumed to be the most commonly found equipment in the state according to EIA: tank electric resistance water heating and electric resistance stoves.

**Water Heating**

- The baseline analysis looks at four fossil fuel water heaters with the following uniform energy factors (UEF): tank gas and propane (0.70), tankless gas (0.90), and tank fuel oil (0.65).
- The upgrade analysis looks at a single upgrade to a heat pump water heater with 3.68 UEF.
- All fossil fuel water heaters are assumed to be 50 gallons and heat pump water heaters are assumed to be 65 gallons to meet household hot water needs and minimize electric resistance backup for heat pump water heaters.
- In water heater scenarios, all other household equipment is assumed to be the most commonly found equipment in the state according to EIA: fuel oil furnace water heating and electric resistance stoves.

***Hartford, Connecticut skyline***



## Report authors:

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