URBAN GREEN

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Cool Switch

Replacing central ACs with heat pumps in New York State's single-family homes.

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Table of contents

Note: This is a downloadable PDF of the *Cool Switch* report. For the best viewing experience and to explore the interactive graphics, view the report on our website.

Executive summary

Replacing central air conditioners (ACs) with heat pumps is a sleeper electrification opportunity for many New York State homes.

About 45 percent of the state's 5.3 million single-family homes have a central AC distributing cold air through ducts. When an AC fails in those homes, replacing it with a new central heat pump will deliver both cooling and heating through the same ductwork. That new heat pump provides more efficient cooling and can also displace oil, propane or gas used for heating—a win for homeowners and the climate alike.

This "cool switch"—replacing an AC with a cold-climate central heat pump—can be straightforward and strategic. California and Colorado are already pursuing policies to drive central-AC-to-heat-pump swaps. Around 120,000 central ACs capable of cooling single-family homes are sold each year in New York State. Every new AC installed is a missed chance to decarbonize, locking in outdated equipment for 15 years or more. The benefits and barriers in New York State depend on a range of factors, like the climate, the condition of the home, the size of the heat pump and more. But if every New York homeowner replaced their central AC with a heat pump, electrifying winter heating could cut on-site residential sector emissions by up to 30 percent annually.

New York's Scoping Plan outlines ambitious steps to cut building sector emissions through electrification. The state's vision to quadruple heat pump sales and achieve two million climate-friendly homes by 2030 is a call to action. In this report, we examine the opportunity, retrofit considerations and costs associated with AC-to-heat-pump swaps. We also detail the policy steps needed to advance this electrification pathway in New York homes so that as all central ACs age or fail, they are replaced with cold-climate heat pumps.

Highlights

- **2.4 million:** The number of single-family homes in New York State with central ACs that could be replaced by heat pumps as units age or fail.
- **2 for 1:** Central heat pumps cool and heat a home using the same space and ductwork. Some envelope, duct or electric panel work could allow homes to use one piece of equipment for year-round heating and cooling instead of two.
- **30% reduction:** AC-to-heat-pump swaps could reduce on-site GHG emissions from New York's residential sector by up to 30 percent by eliminating fossil-fuel heating.
- **Big incentives:** Thousands of dollars in incentives can offset all upfront costs for some New Yorkers. For many others, they make AC-to-heat-pump swaps less expensive than the combined cost of an AC and furnace replacement.

The AC replacement opportunity

Every year, New York State homeowners replace tens of thousands of central AC units. By switching to a cold-climate central heat pump, each replacement could accelerate the transition to heating electrification.

Anything ACs can do, heat pumps can do better

Central heat pumps are similar to ACs but operate year-round to provide both cooling and heating.

In warmer months, both central heat pumps and ACs use refrigerant to cool air before delivering it to a home through a series of ducts. The technology is the same, and the equipment looks similar and uses about the same space and electrical capacity.

But heat pumps also provide heat. In shoulder seasons and winter months, central heat pumps operate like a central AC in reverse, using the same refrigerant to capture heat from outside air—even when it's well below freezing—and move it inside through the same ductwork. That means in addition to replacing ACs, central heat pumps can replace fossil fuel-based heating, keeping residents comfortable while slashing greenhouse gas (GHG) emissions.

An abundance of cold-climate heat pumps are suitable for homes and temperatures in every area of New York State. Many are listed on NEEP's Cold-Climate Air Source Heat Pump List. They're tested to perform well at 5°F, with some models providing dependable heat at temperatures below -20°F.

The benefits of switching from a central AC to a highly efficient cold-climate central heat pump are substantial and include:

- More efficient cooling than typical ACs;
- Big potential energy and carbon savings in winter;
- Straightforward retrofits that oftenuse the same equipment footprint and ductwork;
- Quiet operation and increased resident comfort; and
- Lower maintenance costs with just one system for both heating *and* cooling.

AC-to-heat-pump swaps support New York's climate progress

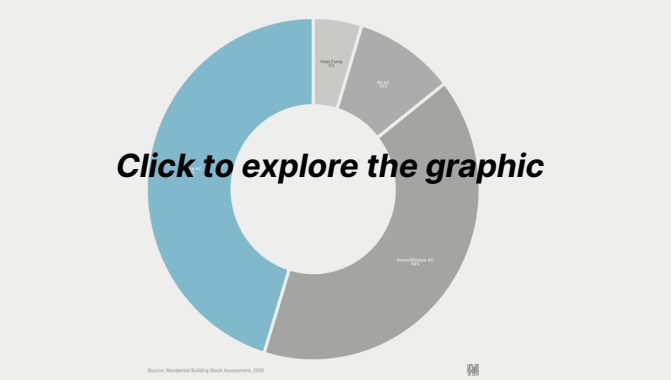
New York State's landmark Climate Act sets nation-leading decarbonization targets. For buildings, the state's Scoping Plan outlines a phased ban on the replacement of fossil fuel combustion equipment to reach 2050 GHG reduction targets—but central ACs don't combust fossil fuels, so AC replacements are a largely unaddressed opportunity.

AC-to-heat-pump swaps could help New York reach the dual goals of two million climate-friendly homes and a quadrupling of heat pump sales by 2030, putting us on the way to 85 percent fewer GHG emissions by 2050.

But how big is this AC replacement opportunity in New York?

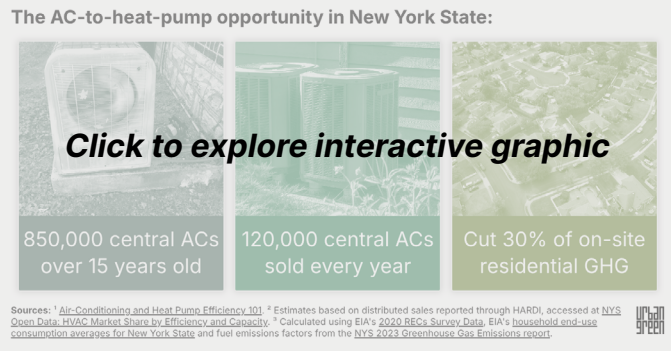
Figure 1

45% of single-family homes in New York have central ACs



2.4 million homes are primed for a central heat pump

New York State has 5.3 million single-family homes, and about 2.4 million of them currently use central AC for cooling. That means about 45 percent of the state's single-family homes have the existing equipment space and ductwork for an AC-to-heat-pump swap when a homeowner replaces an aging or failed central AC. This enormous market opportunity to switch out central ACs has the potential to shift home heating from on-site fossil fuels to an increasingly renewable electricity grid. If every home with central ACs replaced their aging and failed units with a heat pump that eliminates fossil fuel heating, New York could cut up to 30 percent of on-site residential GHGs.[1]



Every new central AC is a missed opportunity to get heat pumps into homes

The potential in New York State is clear: AC-to-heat-pump swaps are a largely untapped opportunity and represent a compelling pathway toward meeting the state's climate goals. With Central ACs lasting up to 15 years or longer, the opportunity is significant: 2.4 million New York homes need to replace central ACs in the years ahead, and an estimated 850,000 old central ACs are due for replacement today. Every new AC installed is a missed chance to decarbonize that will lock in outdated equipment for another 15 years or more.

AC-to-heat-pump retrofits in New York

New York State has a colder climate and older buildings than much of the country. These realities shape the path to scaling central AC-to-heat-pump swaps across the state.

For any given project, three interrelated factors determine the size of the heat pump and the complexity of the retrofit, which in turn affect cost and feasibility: **1) how much of a home's heating a heat pump will provide, 2) how cold it gets, and 3) the condition of the building.**

1. Heat pump share of heating

A larger heat pump can turn a cooling replacement into heating system replacement.

When a homeowner replaces a central AC with a heat pump, the retrofit work and future benefits—such as carbon savings—depend in part on the portion of winter heating the heat pump will support.

A heat pump installed to replace an air conditioner is likely a simple drop-in replacement that requires little to no additional work. But in most New York State homes, a heat pump sized only to meet cooling needs won't meet full winter heating demand. A larger heat pump that offers more heating capacity presents an opportunity to transition the home mostly or completely off a fossil fuel heating system.

That transition will entail higher upfront costs and may require some additional retrofit work like air sealing (as detailed below). But the state has generous incentives for key envelope improvements and heat pump installations that can handle a home's full heating load, which in many cases can offset most or all of the additional cost.

2. New York State's cold climate

The colder the winter, the bigger the heat pump.

While almost any central heat pump could meet a home's summer cooling needs, newer-generation cold-climate air source heat pumps are the equipment of choice for efficient winter heating in climates like New York State. But not all New York winters are created equal, and the local climate will affect the necessary equipment size and retrofit work.

The International Energy Code Council (IECC) designates climate zones based on local weather patterns to inform building design and heating and cooling needs. New York State spans Climate Zones 4, 5 and 6—which are all generally colder—with Climate Zone 4 downstate being the warmest of the three and Climate Zone 6 being the coldest.

Winter heating—and the demand that heat pumps must support—varies significantly across these climate zones. In particular, how often homes experience extremely cold temperatures matters a lot for heat pump size and performance, and for the potential need for backup heating on the coldest days. Generally, AC-to-heat-pump swaps in New York's warmer climate zones will require a smaller heat pump, a simpler retrofit and no backup heating—all making it easier and less costly to size for full heating replacement.

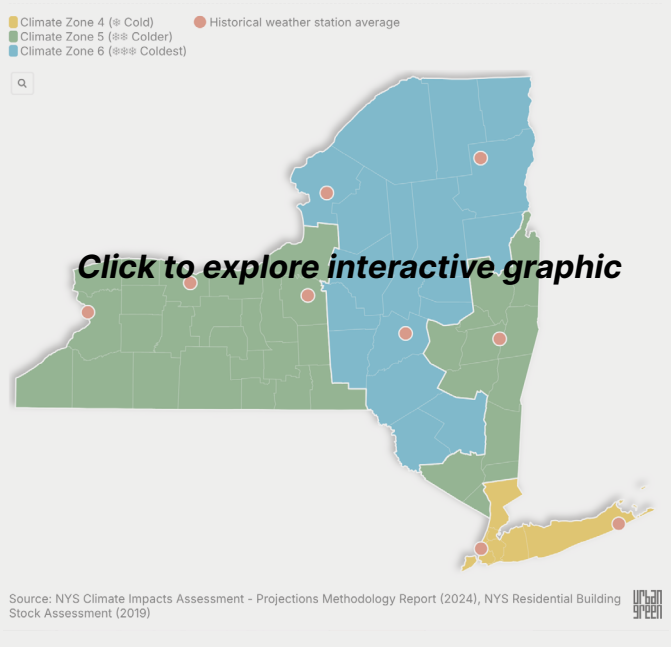
The map in Figure 2 shows New York's climate zones, how cold they get, and the total number of homes with central AC in

each. It reveals that despite New York's cold winters, 93 percent of the 2.4 million homes with central AC are located in the warmer zones of the state, making them good candidates for AC-to-heat-pump swaps that can cover most or all of a home's heating load.

Explore Figure 2 for a deeper dive.

Figure 2

Over 2 million homes with central ACs are in Climate Zones 4 and 5, where AC-to-heat-pump swaps are most straightforward.



3. Necessary building improvements

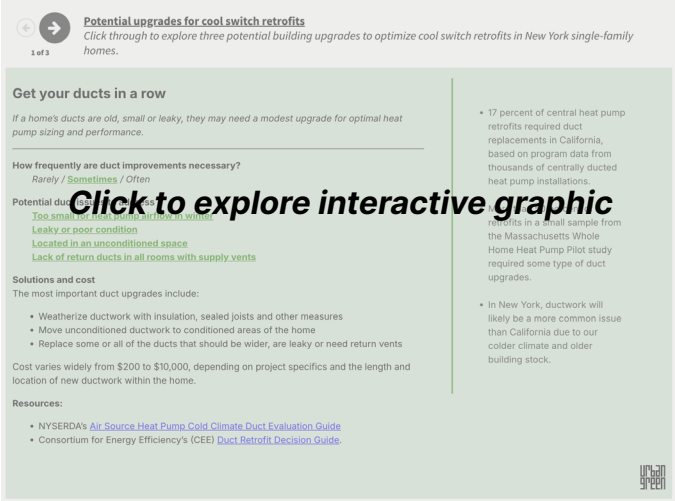
Some homes may need weatherization, duct or electrical upgrades.

In homes built or renovated to a modern energy code—and those in the warmest parts of the state—a cold-climate central heat pump may be a drop-in AC replacement that can meet full summer and winter demand. In other homes, AC-to-heat-pump swaps may need to be paired with targeted home improvements so that the new system can meet most or all of a home's heating needs.

Highest-priority home improvements will ensure that the building envelope is tight and insulated, ducts are adequate and well sealed, and the electrical panel and wiring are sufficient. While these upgrades add time and cost to a retrofit, NYSERDA offers many resources for installers to optimize heat pump performance. Targeted home improvements also save homeowners money by reducing total heating demand, enabling smaller-capacity equipment and lowering winter heating bills.

Figure 3

Potential upgrades for cool switch retrofits



Tying it all together with the right size heat pump

The three factors above—the share of heating provided, how cold it gets and the building condition—all influence the heat pump size needed to heat and cool a particular home. But there is no reliable rule of thumb. The right size for a heat pump depends on many other site-specific factors, including square footage, orientation, layout, building systems and more. And experts caution against oversized heat pumps, which can be costly and reduce comfort.

A typical 1,750-square-foot home in New York State requires a cooling system (whether a central AC or heat pump) with a capacity between 1.5 tons and 3 tons, depending on the climate and condition of the home. But in many New York homes, heating demand on cold winter days will outpace what a heat pump sized for cooling can provide. A bigger heat pump with more capacity (higher tonnage or BTUs) will likely be needed.

Table 1 shows how fully-sized heat pump capacity may vary for a 1,750-square-foot home across the state, even within the same climate zone, depending on those site-specific factors mentioned above.

Pairing heat pump installations with measures that bring down a home's total heating load is crucial to enable smaller-sized heat pumps, reduce energy use and lower utility bills. For example, air infiltration of the envelope is often the biggest culprit for a home's heat loss. In many cases, a knowledgeable service provider can cut that infiltration by up to 50 percent or more. Improving infiltration can help avoid more costly and invasive duct improvements, and deeper measures like adding heat recovery ventilation to the HVAC system can lower total heating loads even more. Equipment needs will vary for each home, and resources like the Pacific Northwest National Labs and federal Department of Energy offer expert guidance on cold-climate heat pump sizing and selection.

Table 1

Estimated heat pump size needed to fully heat and cool a 1,750-square-foot home with a semi-tight envelope and ductwork in conditioned spaces of the home.[2]

Climate Zone	Estimated heat pump size for year-round heating needs in a 1,750-SF New York State home
Zone 4 (❄ Cold)	2.5 - 4 tons
Zone 5 (❄❄ Colder)	3.5 - 5 tons
Zone 6 (❄❄❄ Coldest)	4 - 5 tons

Most HVAC equipment sizes are measured in the energy per hour it takes to heat or cool a space, either expressed in tons or British thermal units (BTUs). One ton is equal to 12,000 BTUs.

The cost of AC-to-heat-pump swaps

While the opportunity is clear, the prospect of upgrading New York State homes with central heat pumps rests largely on the cost to homeowners. Those costs—and the potential benefits—depend on the size (i.e. capacity) of the heat pump and the nature of the retrofit.

A heat pump will cost a little more than a similarly sized AC, but offers a lot of benefits

New York State homeowners could replace a failed or aging central AC with a like-size central heat pump—one with the same tonnage or BTUs—to meet their cooling needs, with the bonus of some additional heating capacity. For some homes in New York City and Long Island (Climate Zone 4), a heat pump with the same capacity as the old AC might even be enough to meet all heating needs.

While heat pumps are more expensive to buy and install than ACs, a $2,000 federal IRA tax credit for eligible ENERGY STAR cold-climate heat pumps applies to any size heat pump and will offset some of the cost. The equipment and installation of a typical 3-ton cold-climate heat pump might cost about $1,000 more than a similarly sized central AC, as noted in Table 2 below.[3]

Table 2

It costs roughly $1,000 more to pick a cold-climate heat pump instead of a central AC for cooling.

Cooling System Type (3-ton)	Estimated Installed Cost* (Equipment and installation)
Traditional Air Conditioner	$5,500 - $5,700
Cold-Climate Air Source Heat Pump (including -$2,000 IRA incentives)	$6,600 - $6,900
Extra cost for a heat pump	+ $1,100 - $1,200

** Installed costs assume no supplementary weatherization, duct or electric panel upgrades are performed for a simple replacement where the heat pump is the same capacity as the old AC.*

Source: ACEEE, 2024 and EIA 2023.

This drop-in central heat pump wouldn't likely require other building upgrades, like envelope, duct or electric panel improvements—though efficiency work will always improve system performance. And the extra cost of the heat pump brings additional benefits, including:

- More efficient cooling and lower summer utility bills;
- New, highly efficient electric heating during spring, fall and warmer winter days;
- A more resilient home, with a second heating system and reduced urgency when an oil or gas furnace fails.

For most New York State homes, a heat pump with the same capacity as the old AC won't meet full winter heating demand. When the existing oil or gas furnace fails, that central heat pump could be upgraded to full heating through targeted building improvements and additional central or ductless mini-split heat pumps. But a more forward-looking—and potentially more cost-effective—approach will be to move to just one system for year-round heating and cooling by weatherizing the home and installing a larger heat pump.

It's costly to maintain and replace two separate heating and cooling systems

Homes primed for this AC-to-heat-pump opportunity use a central AC in summer and a furnace in winter. The costs of installing, operating, maintaining and eventually replacing these two different systems add up. If a homeowner is considering making the leap to a fully sized central heat pump, they should compare the cost of a heat pump against the combined cost of these two systems that the heat pump will replace.

In a cold climate like New York State, the combined cost to replace a central AC and a typical gas or oil furnace ranges from about $9,000 to $11,000.[4] While costs will vary depending on a home's specific circumstances, this range is reasonably representative of what a typical 1,750-square-foot New York homeowner might pay to replace both systems. This combined system replacement cost allows homeowners and policymakers to better see how central heat pumps stack up.

Big incentives can make it affordable to install a fully-sized heat pump instead

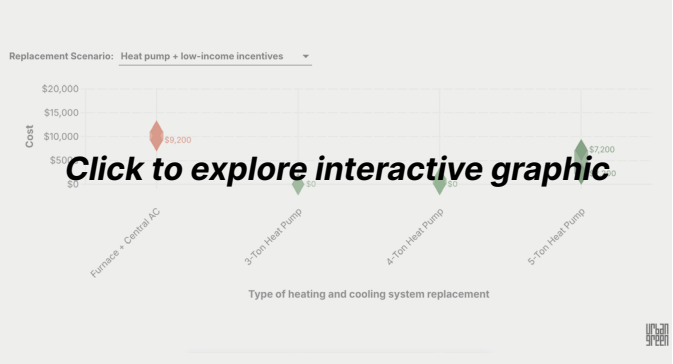
When New York homeowners make the leap to central heat pumps sized for full heating, upfront costs are often higher due to a larger heat pump and the potential ancillary envelope retrofits, duct improvements or electric upgrades. We estimate that before incentives, typical project costs for a fully sized ducted heat pump retrofit in New York range from about $5,000 to $6,000 per ton, including equipment, installation and ancillary upgrades.[5]

But *enormous* New York State incentives kick in when heat pumps are fully sized to meet all of a home's heating needs.[6] These incentives offset the costs of equipment and related retrofit work, and they can be stacked with federal incentives to eliminate much or all of the additional cost—especially for low-to-moderate (LMI) New Yorkers.

While exact incentives vary by local utility, Figure 4 offers a general breakdown of total project costs in New York State—including equipment and retrofit work—to install a fully-sized heat pump in a typical 1,750 square-foot home after incentives, and how those costs might compare to traditional heating and cooling replacements across different income brackets.

Figure 4

Estimated total project costs to install a fully-sized heat pump in a 1,750 SF New York home compared to typical heating and cooling replacements[7]



Winter heating bills may vary depending on current fuel source

How and when to make the leap to a fully-sized electric heat pump may also depend on a homeowner's utility bills. Summer cooling costs will be similar or lower, but changes to winter heating costs will depend on the price of the home's current heating fuel.

Heat pumps are incredibly efficient compared to any other space heating alternative. They use less energy to heat the same space as fossil fuels, and that efficiency can sometimes—but not always—make up for any difference in the price of heating fuels.

For homes currently heating with expensive delivered fuels like oil and propane, switching to heat pumps will save money on winter heating bills right away. Almost 20 percent of homes statewide, and 26 percent in Climate Zone 4, use fuel oil for heating.[8] For example, an AC-to-heat-pump swap may be attractive on Long Island, where it costs about 1.5 times more per kBTU to heat with fuel oil (about 4 cents per kBtu) than with a heat pump (about 2.7 cents per kBtu).[9]

And for homes heating with an electric resistance heater—which is more common in northern regions of the state—heat pump utility costs will be much lower because heat pumps use two to three times less electricity than a resistance heater.

On the other hand, for homes switching from natural gas to heat pumps, low residential gas prices in New York State could mean that the cost of winter heating may increase in some homes without careful planning. Heating with natural gas can cost 10 to 40 percent less per kBtu than heating with a heat pump, but it varies depending on the utility region of the state.[10] For example, in New York City, heating with residential natural gas costs about 2.7 cents per kBtu, while heating with a cold-climate heat pump costs about 3.3 cents per kBtu—a 20 percent difference. In Rochester, that difference is nearly 38 percent, where heating with gas costs roughly 1.2 cents per kBtu, while heating with a heat pump costs about 1.9 cents per kBtu.

The possibility of increased heating costs is a particularly important consideration for lower-income homes, where residents are likely already energy burdened. Policy and program design must navigate these risks and ensure equitable electrification for all New Yorkers. One potential way to navigate this challenge is to pair AC-to-heat-pump swaps with impactful building improvements that lower heating demand. Envelope upgrades and proper heat pump sizing can mitigate and even eliminate any potential utility cost gap. A recent NYSERDA analysis found that basic shell upgrades in single-family homes can reduce space heating loads by 27 percent, and the EPA estimates typical homes in New York's climate zones could save 16 to 18 percent on energy bills with air sealing and insulation.

Accelerating the cool switch in New York

With major benefits and low or feasible costs, AC-to-heat-pump swaps are a compelling pathway for carbon savings to help meet the state's CLCPA goals. Four policy steps can accelerate these swaps and advance heating electrification in the 2.4 million homes with central AC in New York State.

1. Replace every central AC with a heat pump when it breaks.

Issue

Central heat pumps have minimal market share, and AC replacements are often overlooked as a heating electrification opportunity. AC-to-heat-pump swaps could catalyze electrification in 45 percent of New York State's single-family homes, with straightforward retrofits and enormous incentives that make heat pumps cost-competitive or even lower cost than the alternative. While some program guidance promotes AC-to-heat-pump swaps, stronger policy levers are necessary to seize this largely untapped opportunity.

Recommendation

Explore the development of a mandate to accelerate central heat pump adoption when ACs are replaced in New York State's single-family homes. Options include time-of-replacement requirements in construction codes and prohibitions on sale and distribution that effectively mandate heat pumps in lieu of central ACs in most or all cases. Policy design should focus on equipment cost gaps and how to optimize heat pump sizing for heating capability while addressing feasibility and affordability concerns—potentially including requirements tailored to climate zones.

Even legislative language that only requires ACs to have a manufacturer-installed reversing valve to provide heating—in other words, requiring a heat pump sized at least for cooling—would bring enormous benefits at minimal cost, such as:

- More efficient cooling in the summer;
- More efficient, cleaner heating for shoulder seasons and warmer winter days—possibly year-round for homes in Climate Zone 4;
- Greater building resilience that reduces the urgency of a fossil-fuel heating system failure in winter;
- Increased familiarity with heat pumps for New Yorkers—a capable but new technology; and
- Lower carbon emissions to help New York State meet its climate goals.

Read more about other jurisdictions exploring the AC replacement opportunity:

1. ***Denver**: Denver, Colorado—a city with a similar cold climate to New York in IECC climate zone 5—already issued a ban on one-way ACs starting in 2025 through the city's Building Code. The law requires any replacement of an existing air conditioner to be electric equipment capable of also providing space heating, in effect mandating AC-to-heat-pump swaps at the time of replacement.*
2. ***Colorado**: Colorado state lawmakers introduced a bill in 2024 proposing to ban the sale and distribution of central ACs manufactured after 2027, with an exception for units with a manufacturer-installed reversing valve to also provide heating. A new law also requires*

Colorado's Energy Office to assess the feasibility of a technical standard for central ACs as a means to accelerate heat pump adoption. Study findings are due June 2025.

3. ***California**: California's new 2025 Green Building Standards Code (CALGreen) allows local governments to enact requirements when central ACs are replaced in existing single-family homes. While not a statewide mandate, the code enables jurisdictions to adopt rules that require either a) any replacement of a central AC to be a heat pump capable of being the home's primary heating source, or b) any new central AC installation to meet strict criteria. The voluntary code provisions include caveats for some climate zones and for homes that need significant equipment size or electric upgrades.*

2. Increase incentives for duct improvements to maximize year-round heating capacity.

Issue

Duct improvements and even outright replacements may be necessary for some central heat pump retrofits, particularly to meet the full heating load in old homes in New York State's colder areas. Limited incentives for duct improvements mean the cost of these upgrades may stand in the way of homeowners sizing a heat pump for year-round heating.

Recommendation

Maximize the number of homeowners who choose heat pumps sized for full heating load by increasing incentives for supplementary duct improvements. The Clean Heat program now provides a major driver for full electrification by limiting incentives to heat pumps sized for at least 100 percent of a home's heating load. Paired with air sealing improvements that lower peak load, additional incentives that scale with the higher costs for retrofits involving partial or full duct replacements will catalyze homeowners who might not otherwise make the leap to full electrification. And with about 850,000 central ACs due for replacement in New York State today, larger ductwork incentives could help seize a fleeting opportunity to maximize carbon savings and accelerate heat pump adoption in line with the state's 2030 targets.

Read more about the opportunity to expand incentives for duct improvements:

Recent updates to the EmPower+ program—available for low-to-moderate-income New Yorkers—included an extra $5,000 for projects that require the replacement of at least 50 percent of a home's ductwork. But few or no ductwork incentives appear to be available for market-rate homeowners in the Clean Heat utility program manuals.

In some cases, the repair, replacement or relocation of ductwork to support winter heating can quickly get expensive, with significant upgrades costing up to $10,000 or even more. This hurdle could make or break the decision to go from a traditional central AC replacement to a fully-sized central heat pump. Additional support for significant duct improvements, including for market-rate homeowners, could advance heating electrification in New York State.

3. Target homes best primed for AC-to-heat-pump swaps.

Issue

Consumers, contractors and HVAC installers will naturally default toward status quo AC replacements in the absence of a clear and compelling pathway to heat pumps. Program and incentive budgets are limited

and most efficiently spent targeting customers who are good candidates for a straightforward retrofit with a heat pump that can meet all heating needs and save money on utility bills.

Recommendation

Develop policy, programs, marketing and outreach to prioritize homes where AC-to-heat-pump swaps are easiest and most financially beneficial. Homes that stand to benefit the most can be identified by factors like region, home size and age, heating fuel type, income eligibility, and previous participation in state clean energy and efficiency programs.

Read more about factors to guide policy and program design, marketing and outreach for AC-to-heat-pump swaps:

Key characteristics make fully-sized central heat pump retrofits more feasible and appealing. Policy and program targeting should prioritize some or all of the following factors:

- ***Region**: Over 90 percent of New York State's homes with central AC are in Climate Zones 4 and 5, where heating load is smaller and fully-sized heat pumps are more cost-effective.*
- ***Home size and age**: Upfront costs are typically lower in smaller homes because they require smaller, less expensive equipment to meet heating and cooling demand. And houses built to more recent energy codes are less likely to require ancillary work like panel upgrades or duct improvements.*
- ***Fuel type**: Utility savings pencil out best in homes currently using fuel oil, propane or other expensive heating sources.*
- ***Income eligibility**: Thanks to generous incentives, many LMI homeowners can install a fully-sized heat pump for less than the cost of a traditional central AC replacement, and some can do so at no cost at all after incentives.*
- ***Previous program participation**: Homes that have already undertaken weatherization will have lower heating loads, which translates to lower installed costs for heat pumps. Homes that have already installed solar panels will likely have lower electricity costs that translate to lower winter utility bills.*

Finding homes where these conditions overlap can help decision-makers target policy, programs, incentives and outreach to maximize heat pump adoption. For example, homes on Long Island that currently heat with fuel oil and were built to more recent energy code standards are ideal candidates for AC-heat-pump swaps from both a cost and carbon savings perspective.

4. Bring more data to the market.

Issue

Very limited data exists to guide the industry and policymakers seeking to strategically ramp up heat pump installations over time. More robust information on the baseline condition of New York State homes and on previous central heat pump installations would help inform the market and shape effective policy.

Recommendation

Add new queries to New York's Residential Building Stock Assessment to illuminate the baseline condition of electrical infrastructure and ductwork in New York State homes. Both can be crucial to understanding the cost of a central heat pump retrofit, which in turn will shape policy and programs.

Increase transparency of statewide program data from Clean Heat, Clean Energy Hubs and other relevant sources, either through utility filings or a centralized electrification tracking dashboard. Aggregated, anonymized data on central heat pump projects could help identify total retrofit costs as well as costs for equipment, labor, duct improvements, electrical work and weatherization. These costs could be differentiated by variables like home age and size, equipment size, climate zone and pre-retrofit heating source. Better data will help optimize policy and programs and inform decisions by homeowners, contractors and installers.

Endnotes

1. Estimated on-site emissions from space heating in New York's single-family homes calculated using EIA 2020 RECs Survey Data, EIA's household end-use consumption averages by state, and fuel emissions factors from New York State's 2023 Greenhouse Gas Emissions report.

2. Prevailing practice guards against using good rules of thumb to approximate heat pump sizing, and recommends Manual J sizing be performed. To arrive at heat pump size estimates, we performed Manual J calculations using CoolCalc on 5 random homes from each climate zone that are roughly 1,7500 +/= 100 square feet using Zillow listings. Each zone has one home that is from the 1920s, one from post-2000, and the remainder between the years 1950 to 2000.

   There is anecdotal evidence that Manual J sizing may recommend heat pumps that are larger than necessary, even for New York's cold climate. We examined limited data from the Massachusetts Whole Home Heat Pump Pilot Program, and found that despite being in Climate Zone 5—a cold climate—installed system sizes were all smaller than the high end range for heating mentioned above, despite larger or equally sized homes. Cadmus's research also suggests that Manual J estimates consistently oversize the necessary heat pump size, even for withstanding cold weather.

3. Based on 3-ton central AC compared to a 3-ton cold-climate heat pump. While equipment size needs vary for each home, a 3-ton system is a sufficient benchmark that represents enough cooling capacity to meet demand in most New York homes up to 1,750 square feet in Climate Zone 4, and more than enough for those in Climate Zones 5 and 6.

4. US EIA and ACEEE While the sizing of any equipment replacement and retrofit will vary depending on a home's specific circumstances, these combined costs of conventional systems represent what is typical for a 1,750-square-foot home in New York. Data from EIA and ACEE assumes the following equipment sizes and costs:
   - Central AC (36,000 BTU) + Oil Furnace (105,000 BTU): $10,700 – $11,100
   - Central AC (36,000 BTU) + Gas Furnace (80,000 BTU): $9,200 – $10,000

5. Estimated total retrofit project costs of $5,000 to $6,000 per ton to install ducted central air source heat pumps was derived from publicly available installation costs from heat pump programs and reports, including projects supported by NYSERDA's ASHP incentives (2017-2019), MASS CEC Whole Home Pilot Project, TECH CA incentives, ACEEE 2024 study on residential ccHP installation, and projects from NYSERDA's Hudson Valley Heat Pump Pilot Program. Estimated costs reflect an illustrative average for equipment, labor and includes available program data on potential ancillary work like weatherization, duct or electric improvements. Data filtered where possible for only ducted central air-source residential single family heat pump installations in homes ranging between 1,500 and 2,500 square feet.

   Cost estimates from relevant program data were adjusted for inflation on the average total cost per ton. For each source, the median year of data provided was chosen to calculate inflation from. Inflation from June of the data year to June 2024 was calculated by averaging the HVAC equipment cost inflation rate found from the Federal Reserve Economic Data's (FRED) Producer Price Index for HVAC and Commercial Refrigeration Equipment and the HVAC contractor labor cost inflation rate found from FRED's Producer Price Index for Plumbing, Heating and Air-Conditioning Contractors. The average HVAC equipment and labor inflation rate (20XX-2024) was applied to average installation cost per ton values, outputting inflation adjusted

values for total installation costs.

6. NYSERDA Clean Heat program rules require that heat pumps be sized for 100-120% of full home heating to be eligible for incentives.

7. Figure 4 assumptions and methodology:
   - Estimated gross installation costs (pre-incentive) range from $5,000 – $6,000 per ton after examining program data for similar equipment in California, Massachusetts, and New York, adjusted for inflation. Heat pump installations include the costs for typical ancillary upgrades like envelope, ductwork and electric panel improvements to accommodate a fully-sized heat pump. See Endnote 5 for details on estimates of pre-incentive project costs.
   - Market-rate refers to New York State residents that utilize the state's Clean Heat Program incentives but do not qualify for low-to-moderate income heat pump incentives. While exact market-rate incentives vary by utility, our statewide total project cost estimate of NYS clean heat heat pump incentives included $1,000/ton up to 4 tons and $500/ton for tons 5 and 6, and NYSERDA weatherization and insulation tax credits of $3,000 for the"Better" scenario under the state's Home Comfort weatherization and insulation package. Total project cost estimates include the application of federal IRA tax credit of $2,000, federal IRA weatherization and insulation tax credit of $1,200.
   - Moderate-income refers to total project costs incurred by residents that qualify for EmPower+ incentives, defined as households at or below 80% of the State or Area Median Income (SMI/AMI). Incentives applied for this level include a $2,000 federal IRA tax credit, the federal IRA weatherization and insulation tax credit of $1,200, an EmPower+ rebate of $5,000, a Home Electrification and Appliance Rebate (HEAR) rebate of $8,000 for heat pumps and $1,600 from HEAR for weatherization and insulation.
   - Low-income refers to total project costs incurred by residents that qualify for EmPower+ incentives, defined as households at or below 60% of SMI. Incentives applied for this level include a $2,000 federal IRA tax credit, the federal IRA weatherization and insulation tax credit of $1,200, an EmPower+ rebate of $10,000, a Home Electrification and Appliance Rebate (HEAR) rebate of $8,000 and $1,600 from HEAR for weatherization and insulation.
   - All estimates based on incentives available as of August 2024.

Reference data table for Figure 4:

Estimated total project costs to install a fully-sized heat pump in a 1,750 sq. ft. New York home compared to conventional heating and cooling replacements.

Heat pump fully sized	Estimated gross installation cost (pre-incentive)	Estimated total project costs with incentives		
		Market rate	Moderate-income	Low-income
36K BTU	$15K - $18K	$5.8K - $8.8K	$0 - $200	$0
48K BTU	$20K - $24K	$9.8K - $13.8K	$2.2K - $6.2K	$0 - $1.2K
60K BTU	$25K - $30K	$14.3K - $19.3K	$7.2K - $12.2K	$2.2K - $7.2K

8. New York Residential Building Stock Assessment (2019), p. 18.

9. NYSERDA New York Home Heating Oil Price Monitoring Program 2022-2023 average fuel oil costs compared to electricity costs for a cold-climate heat pump operating at 244% efficiency. Source: Calculated using fuel oil and electricity from NYSERDA's contractor support 2024 EmPower+ Energy Pricing sheet and heat pump COP from NYISO's 2022 Heat Pump Assessment Study.

10. Joint utilities 2021-2023 SC1 3-year average natural gas costs compared to electricity costs for a cold-climate heat pump operating at 244% efficiency. Source: Calculated using natural gas and electricity costs from NYSERDA's contractor support 2024 EmPower+ Energy Pricing sheet and heat pump COP from NYISO's 2022 Heat Pump Assessment Study.

Building solutions for climate change

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