



ELEVATE

Equity through climate action

Stove Electrification: Barriers and Opportunities

Elevate

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Objective of the Stove Electrification Project

Commercial and residential buildings in Chicago generate millions of tons of carbon emissions annually because of their reliance on natural gas. It's clear that for Illinois to achieve 100% renewable energy by 2050, buildings must discontinue relying on fossil fuel and move toward full electrification. Community-wide electrification will also require simultaneous expansion of renewable energy sources. While the climate-related benefits of such a transition are clear, the related health benefits of electrification are often less well known. Cooking with natural gas presents high concentrations of indoor air pollutants, especially when stoves are not vented outside.¹ In this regard, the City of Chicago is in the process of updating its construction requirements, which will include provisions that meet local code conditions as well as health and safety standards for buildings and structures.² However, according to the current provisions in Chapter 12, most buildings in the city still prioritize and refer to natural ventilation.

Gas stoves are household fixtures in the Chicago region and deeply rooted in the community's cultural cooking traditions. Their prevalence, and people's familiarity and ease with them, will create a major challenge to fully electrifying residential buildings. Conversion plans must center around helping home cooks adjust and adapt to cooking on electric cooktops. Preliminary qualitative research by Elevate has found that people tend to prefer to the types of stoves they grew up using. For low-income communities, this often means a mix of both gas and electric stoves. This dual cooktop competence suggests that electrifying small to mid-size rental buildings will be less daunting for residents. While it won't eliminate educational and technical support needs, residents may adapt more quickly.

While stoves may seem a minor piece of equipment to focus our attention on, they are imperative to successful residential building decarbonization programs. Cooking has deep cultural roots and gas cooking is the centerpiece in this story. To get cooks to embrace electric cooking, we need to understand how cultural norms, personal preferences, public health, and utility costs encourage them to, or dissuade them from, switching to electric cooking. Additionally, our quantitative understanding of the impact that cooking has on energy, climate, and indoor air quality is critical for lobbying policymakers, developing utility programs, and partnering with and supporting building owners as they transition to electric power.

Framework of Research

Despite the popularity of gas stoves, research has uncovered multiple health risks posed by gas cooking. A 2014 analysis by Lawrence Berkeley National Laboratory (LBNL) showed that "cooking gas exposes 12 million Californians to pollutant levels that would exceed ambient outdoor air standards in a typical winter week. Other researchers, along with LBNL, concluded that there is a significant, and solvable, health problem in plain view:

¹ Rocky Mountain Institute, *Gas Stoves: Health and Air Quality Impacts and Solutions*, 2020. <https://rmi.org/insight/gas-stoves-pollution-health/>

² City of Chicago, *Chicago Construction Codes – Chapter 12: Interior Environment*. <https://codes.iccsafe.org/content/CHIBC2019P2/chapter-12-interior-environment>

gas stoves may be exposing tens of millions of people to levels of air pollution in their home that would be illegal outdoors under national air quality standards.”³

In order to better understand the opportunities and barriers of moving away from gas stoves, Elevate researched the health and safety, performance, and cost effectiveness of different stove types to create a detailed comparison for decision makers who are considering converting to electric stoves from gas. Elevate interviewed and surveyed building owners and operators, health and safety professionals, and Elevate staff members to understand stove preferences. Elevate would like to thank the Mayor & Morris Kaplan Family Foundation their support of this project. These efforts are not only helping and educating the public environment, they give Elevate an opportunity to extend its research on various projects focusing on building decarbonization.

Overview of Cooking Stove Types

There are two key decision makers who will determine the success of electric cooking: landlords and homeowners. The stoves that will appeal to them will depend on numbers of factors, some that overlap, and some that are more personal. To best support our two decision makers, we need to understand the different features of the three residential stove types: gas, electric, and induction. The most common and affordable stoves are gas and electric. Induction is the most expensive, but technically the most compelling equivalent to gas.

Gas Stoves

Gas stoves are the most common stove type in the Chicago area – Peoples Gas, the natural gas utility in Chicago, reports that 84% of its customers have a gas stove.⁴ The durable design of these stoves withstands heavy use, and a fair amount of abuse, with little to no physical damage. One of the most cited reasons for people preferring gas cooking is its responsiveness; dropping or increasing temperatures happens instantaneously giving cooks better heat control than electric cooktops. Gas stoves are compatible with all types of cookware, although studies have shown that if the gas flame extends beyond the base of the cookware, there is a significant loss of energy, making gas cooking less efficient than electric or induction.

From a health standpoint, gas cooking diminished indoor air quality. Toxic gases, including carbon monoxide, nitrogen oxide, nitrogen dioxide, and formaldehyde, are discharged from gas stoves during combustion or leakage. Studies have found that respiratory issues, learning deficits, cardiovascular effects, increased susceptibility to allergen, and potentially more serious side effects, can impact vulnerable populations when exposed to these toxic gases.⁵

³ Rocky Mountain Institute, *Gas Stoves: Health and Air Quality Impacts and Solutions*, 2020. <https://rmi.org/insight/gas-stoves-pollution-health/>

⁴ Seventhwave, *Peoples Gas Light & Coke Energy Potential Study*, March 2016. https://ilsag.s3.amazonaws.com/Peoples_Gas_Potential-Study_March-2016.pdf

⁵ Seals, Brady, and Andee Kranser. Rep. *Gas Stoves: Health and Air Quality Impacts and Solutions*, May 2020. <https://rmi.org/insight/gas-stoves-pollution-health/>

Electric Stoves

Electric stoves traditionally come in two designs: coil top and ceramic-glass top. Both are popular throughout the Chicago area. Since electric cooking uses electric current instead of combustion, indoor air quality is not degraded. According to a study from Peoples Gas, master metered multifamily units are more likely to have electric stoves than other building types in Chicago.⁶ Electric stoves are easier to install than gas as long as there is a 220-volt outlet available. For households shifting from gas to electric that need to install a 220-volt outlet, fuel switching can be an expensive obstacle. As Texas experienced during a recent winter storm, electric stoves don't work when there's a power outage.⁷ Communities that experience frequent power outages are more likely to struggle with electric stoves.

COIL TOP

Coil stoves are a tried and true, cost-efficient, low maintenance, option synonymous with, though not limited to, rental properties. They are easy to fix, but frustrating to clean. Like gas stoves, coil tops are compatible with all cookware. Electric stoves, both coil and ceramic-glass top, are less responsive than gas or induction and take longer to heat up and to cool down. The coil design heats cookware more efficiently and with less energy loss than gas, and its stable, consistent heat, delivers even cooking. Like gas burners, coil burners are most efficient when the cookware base is similar in size to the burner. The efficient energy transfer to the cookware helps to prevent the area surrounding the coil from becoming over heated and unsafe. The exposed coil element is prone to damage if mistreated, so extra care must be taken.

CERAMIC GLASS/FLAT TOP

Ceramic-glass stoves are a hybrid of coil and induction stove types. They have a smooth surface like an induction stove and are easier to clean than coil cooktops. They are electric resistance, using thermal radiation to heat cookware, with the burner elements concealed beneath a sheet of ceramic glass which can be scratched or broken if not treated with care. The elements retain more heat than induction tops (4-5 times more) and can result in safety concerns. Some of the newer ceramic-glass tops contain heat indicators to let the user know if it is safe or not to touch. Because of their design, they can require a technician to make repairs increasing the long-term cost of the stove. The burners response is delayed both when heating and cooling due to multiple elements needing to be heated (coil and glass). Because of these features, cooks who are unfamiliar with these cooktops will have a minor learning curve to ensure the best outcomes. As an electric source, ceramic-glass cooktops are a healthier alternative to gas stove top with no toxic fumes from indoor fossil fuel combustion.⁸

Induction Stoves

Ceramic-glass and induction stoves look similar because of their ceramic-glass tops, but that's where the comparison ends. When induction burners are turned on, magnetic resistance creates a closed circuit when they come in contact with a highly ferrous cooking pan, like stainless steel. This closed circuit of magnetic resistance generates heat in the pan itself, instead of in the cooktop. The speed at which the pan heats up is something that cooks new to induction stoves need to adjust to, and is often a topic in cooking forums. Because induction cooktops do not create heat on the stove surface, they are not hot to the touch unless there is residual heat left on the surface from a pan. Induction, like coil or electric flat top, does not degrade indoor air quality and is

⁶ Seventhwave, *Peoples Gas Light & Coke Energy Potential Study*, March 2016.

⁷ Livchak, Denis, Russell Hedrick, and Richard Young. Rep. *Residential Cooktop Performance and Energy Comparison Study*. Sacramento, CA: Frontier Energy, 2019.

⁸ Universal Appliance and Kitchen Center. The Pros & Cons of Ceramic Cooktops. Universal Appliance and Kitchen Center, January 8, 2018. <https://www.uakc.com/blog/the-pros-cons-of-ceramic-cooktops/>

significantly safer than either gas or traditional electric because the burners stay cool. Their energy efficiency is slightly better than coil or electric flat top. Not all cookware can be used on induction stoves – only highly ferrous pans will work, while aluminum, copper, and glass pans do not close the magnetic circuit, so no heat is created.

The efficiency of induction stoves is apparent with its zero-energy loss, as well as the speed at which cookware heats up and cools down. Induction stoves deliver heat directly to the cookware, offering the best temperature control of the three types, and the quickest heating response. Due to the method of heating, induction does not heat the surrounding areas of the stove, minimizing the energy loss of the range. Some issues that have been noted with induction stovetops include potential interference with pacemakers,⁹ the need for highly ferrous cookware, and specialized repair and maintenance from a certified technician since the technology is relatively new. The cost of induction stoves is still high in comparison to other stove types, but the prices are trending downward and are becoming more affordable and accessible, which is a step in the right direction for a green economy.¹⁰ As with most emerging technologies, induction stoves are indeed the best performing but still the most expensive option.

Preference Indicators for Cooking Stoves

Homeowners and tenants who put more value in having a healthy and safe living space prefer having a reliable stove over one that is efficient or economical. In contrast, building owners tend to prioritize the cost and energy efficiency of a stove over performance and reliability.

Health and Safety

“I had electric for 10 years until my current apartment, which has a gas stove. I find I get lightheaded every time I use it ... and I miss having electric a lot. I've checked with my personal CO monitor that I have for work as well, because I think my building has pretty bad ventilation.”

- Chicago renter

People who have gas stoves and inadequate ventilation are at greater risk of exposure to dangerous toxins when cooking gas doesn't fully ignite; pollutants can include nitrogen dioxide (NO₂), carbon monoxide (CO), formaldehyde, and a complex mixture of organic and inorganic material called particulate matter (PM).¹¹ The presence of these toxins disproportionately occurs in lower-income households since their living quarters are typically in older rental stock that has smaller square footage with more roommates. As renters, they have little to no control over the building maintenance or ventilation.

Per a Rocky Mountain Institute report on the health and air quality impacts of gas stoves, “a robust body of scientific research shows the pollutants released by gas stoves can have negative health effects, often

⁹ Pooley, Matthew, Benjamin R.T. Cotts, and James F. Brennan III. “Compatibility of Medical Devices with Electromagnetic and Wireless Signals.” Exponent. Exponent, February 26, 2018.

<https://www.exponent.com/knowledge/alerts/2018/02/compatibility-of-medical-devices/>

¹⁰ Livchak, Denis, Russell Hedrick, and Richard Young. Rep. *Residential Cooktop Performance and Energy Comparison Study*. Sacramento, CA: Frontier Energy, 2019.

¹¹ American Lung Association, American Medical Association, Consumer Product Safety Commission, and US EPA; “Indoor Air Pollution: An Introduction for Health Professionals.” 2015 https://www.epa.gov/sites/production/files/2015-01/documents/indoor_air_pollution.pdf

exacerbating respiratory conditions like asthma.”¹² These findings become more concerning when combined with a 2001 study that determined Americans spend about 90% of their time indoors.¹³ While the U.S. Environmental Protection Agency (EPA) and other institutions are determining the relationship between long-term NO₂ exposure and compromised respiratory health, also present are the more well-known dangers of CO. According to the California Air Resources Board (CARB), carbon monoxide is responsible for 13-36 deaths from non-fire related CO poisoning in California every year since 2000.¹⁴

Ventilation is frequently cited as the solution to these health risks, but not all kitchens have exhaust hoods, and those that do are often ductless/recirculating and not regularly used. Based on the compiled research, converting stoves from gas to electric is the surest option for permanently eliminating these indoor air pollutants.

Resident Health and Safety Interviews:

While quantitative data can provide relevant insight as to why certain stove choices are or could be made from a health standpoint, it’s equally important to consider qualitative findings since they can highlight underlying or underrepresented factors.

To better understand stove preferences, we surveyed homeowners and renters, who were fielded from Elevate staff members, and interviewed building owners and managers. The homeowners and renters were given a brief presentation about stove types before responding to survey questions. Key excerpts from the survey responses are included in the following sections, and a compendium of the building owner/operator interviews is included later in the report.

INDOOR AIR QUALITY

Q: How concerned are you when you hear that gas stoves elevate indoor nitrogen dioxide levels?

A: *“Extremely. Personally, my spouse, dog, extended family, and myself all suffer from allergies, breathing conditions, etc. Also, my spouse works with underserved populations dealing with respiratory issues and there is a clear skew that these issues are more likely to effect underserved populations, the last thing I want is people from those populations to breath unnecessary gas emissions.” - Renter (gas stove)*

A: *“I am far more concerned with CO (carbon monoxide levels). NO₂ is an issue but in my view less publicized so from a public perspective likely not as much of a concern. Just my perception really – no great basis for this, however from a public side we have broad use and knowledge with CO detectors but no NO₂ detectors complicated by the many know useful aspects of it.” - Homeowner (gas stove)*

A: *“This concerns me. Ideally, I can have a range hood ducted to the exterior to exhaust these pollutants.” - Renter (electric stove)*

¹² Brady Seals, Andee Krasner; “Gas Stoves: Health and Air Quality Impacts and Solutions.” Rocky Mountain Institute, 2020. <https://rmi.org/insight/gas-stoves-pollution-health/>

¹³United States Environmental Protection Agency, “Importance of Indoor Air Quality.” <https://www.epa.gov/report-environment/indoor-air-quality#:~:text=Americans%2C%20on%20average%2C%20spend%20approximately,higher%20than%20typical%20outdoor%20concentrations>

¹⁴ Research Division- California Air Resources Board. “Carbon Monoxide and Health.” <https://ww2.arb.ca.gov/resources/carbon-monoxide-and-health>

SWITCHING FROM GAS TO ELECTRIC STOVE

Q: Does the research around gas stove health impacts change your perception of gas stoves and is it enough to consider switching to electric?

A: *“Yes, more testing, more public awareness I think is the only way to change hearts, minds and perceptions.” - Homeowner (gas stove)*

A: *“It does impact my perception of gas stoves. It’s more having the extra funds to invest in something new/different.” - Homeowner (gas stove)*

A: *“Safety does impact my perception of pros and cons of gas and electric stoves. I generally prefer electric even without these health concerns.” -Renter (electric stove)*

A: *“If I wasn’t renting and had the ability to own property, I would never choose to have a gas stove. I would always choose electric even if it was a model that was cheaper and less effective than a gas model.” -Renter (gas stove)*

EXISTING CONDITIONS

Q: Do you know if your stove has safety valves or if your kitchen/home has a carbon monoxide detector?

A: *“No and no, I’ve never been provided with that information and have only ever rented so I would have needed to install a CO detector if it was not already in place. Most apartments I’ve lived in did not have a CO detector. Also, to my knowledge CO detectors only catch spikes in CO but do not detect lower concentrations of CO.” - Renter (gas stove)*

A: *“My stove has the standard pilot safety and local pressure regulation as most are mandated. Proven pretty safe for many years. CO is an issue but installing them in the kitchen has been frowned upon for nuisance trips. Elevated levels of CO have been tolerated for many years because the appliance was a necessity and most economical optional for many.” - Homeowner (gas stove)*

Q: Have you ever experienced a time where you felt unsafe or been harmed while using your stove?

A: *“Yes, as a kid we had to call the fire department due to a CO detector going off, we have the stove checked and confirmed it was fine. The appliance person told us to run the vent above the stove even though it was only recirculating and did not actually vent to the exterior.” - Renter (electric stove)*

A: *“Our old stove which was electric ended up being replaced because it wouldn’t shut off. That was concerning.” - Homeowner (electric stove)*

Cost Effectiveness

“The cost benefit of using existing infrastructure drove my decision to go with gas again.”

- Chicago Homeowner

Stove choices, of course, have costs beyond the price of the appliance, and some of these costs may make switching to electric stoves more prohibitive for some households, at least in the short run. For example, while new homes designed as all-electric avoid the cost of running gas lines, homes that don’t have the electric infrastructure in place will incur the added cost of installing a 220-volt outlet and capping their gas line.

As for energy prices, current electricity costs are trending about four times higher than natural gas. But according to some economic forecasts, gas prices will more than double by 2030¹⁵ while electricity prices will stay the same or even decline,¹⁶ leading to a greater demand for electricity and a likely rise in natural gas delivery charges to offset financial losses. The big question is whether the cost of natural gas will rise faster than electricity over the life of an appliance, which can be anywhere from 10-40 years, and how much less energy the electric stove will use.

Gas appliances typically cost more than electric appliances, but the cost to run them is cheaper over time. Rocky Mountain Institute’s report on electrification costs shows that natural gas has a price advantage over electric in most cases.¹⁷ Energy efficiency is another cost factor – a recent Frontier Energy study found that although natural gas is the cheapest energy currently available, electric stoves are more energy efficient than gas stoves (see table below).¹⁸

Table 8: Results Summary

Cooktop	Induction A (Frigidaire)	Induction B (GE)	Induction C (Samsung)	Resistance Ceramic (Whirlpool)	Resistance Coil (Frigidaire)	Gas Burner (Samsung)
Large Hob Input Rate	3.6 kW	3.7 kW	3.3 kW	2.5 kW	2.4 kW	17 kBtu/h
12-lb water heat up time (min)	9.8	9.3	11.6	17.8	15.5	18.6
Heat-Up Efficiency	85.2%	86.1%	83.0%	75.5%	79.3%	31.9%
Production Capacity (lb/h)	73.5	77.2	62.2	40.4	46.5	38.6
Large Pot 200°F Overshoot (°F)	0.8	0.8	0.8	7.1	4.9	1.7
Large Pot Cooldown to 190°F (min)	18.8	20.6	18.8	38.1	26.5	23.9
Sauté Input Rate	523 W	585 W	515 W	507 W	758 W	4.4 kBtu/h
Sauté Efficiency	52.5%	47.8%	54.0%	54.8%	38.0%	22.8%
12-lb Pot Simmer Energy Rate	952 W	910 W	1000 W	907 W	976 W	6,702 Btu/h
Estimated Energy Cost Per Year	\$40.55	\$41.62	\$42.35	\$43.89	\$45.48	\$33.06

This table summarizes the findings from Frontier Energy’s “Residential Cooktop Performance and Energy Comparison Study,” where the cost and energy efficiency of the different stove types were tested and evaluated.¹⁹

¹⁵ Natural Gas Price Forecast 2020, 2021, and Long Term 2030: <https://knoema.com/ncszerf/natural-gas-price-forecast-2020-2021-and-long-term-to-2030>

¹⁶ Annual Energy Outlook 2020: <https://www.eia.gov/outlooks/aeo/>

¹⁷ Billimoria, Sherri, Guccione, Leia, Henchen, Mike, Louis-Prescott, Leah, “The Economics of Electrifying Buildings.” Rocky Mountain Institute, 2018.

¹⁸ Livchak, Denis, Russell Hedrick, and Richard Young. Rep. *Residential Cooktop Performance and Energy Comparison Study*. Sacramento, CA: Frontier Energy, 2019.

¹⁹ Frontier Energy, Residential Cooktop Performance and Energy Comparison Study, July 2019. <https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf>

Resident Cost Interviews

Q: Are you satisfied with the performance of your stove? Why or why not?

A: *"Yes, I have gas stove. I do feel I have good control with gas cooking, and the stove is in working order, etc., so I am satisfied with my gas stove's performance."* - Renter (gas stove)

Q: Would you be willing to pay more upfront for a more efficient/lower maintenance stove? Why or why not?

A: *"Yes. I typically factor those variables into my purchase. However, I am an active cook, so I also focus on functionality and design for usability and execution of preparing food."* - Homeowner (gas stove)

A: *"Yes, but only if I were planning to buy a stove. I would rather pay for one product that will last longer and do a better job."* - Renter (gas stove)

Q: If gas were more expensive, would you consider switching to electric?

A: *"Yes, if the functionality is equivalent or better. Cost will also matter for the purchase of the unit, e.g., if the cost of using electricity over gas is lower but the cost of the unit is higher and it takes a very long time to recoup those costs, it's possible that a gas stove would still win out over an electric stove, all else being equal."*
- Homeowner (gas stove)

A: *"If I owned, I would not get rid of a gas stove for that sole reason, but I would consider switching as a part of other home/kitchen updates."* - Renter (gas stove)

A: *"It depends how expensive. Gas is pretty cheap now. I would switch to electric if I move and my new dwelling has a plug ready to go."* - Homeowner (Gas stove)

Q: Does your kitchen include a ventilation hood with your stove? Do you know how to check its effectiveness?

A: *"Yes, very effective since I designed and installed. This is in my technical wheelhouse. But the trend in the last 20 years has been to replace with simple recirculating, especially with the advent of the over stove microwave. My personal opinion is very few folks have adequate exhaust."* - Homeowner (gas stove)

A: *"It does include a ventilation hood. I don't know how to check if it's effective. It turns on automatically."*
- Homeowner (gas stove)

A: *"Yes, but it only works marginally because of venting issues. We have tested it."* - Homeowner (electric stove)

Performance

"[Performance is] very important, probably the number one reason I like my gas stove. I don't know that it affects the outcome, but it affects the experience which is nearly as important to me."
- Chicago Renter (gas stove)

An adequate performance comparison (see Appendix) of stove types indicated the clear superiority of induction cooktops, while gas and electric cooktops varied in their respective advantages. This was to be expected, as emerging technologies are often higher-performing and more expensive. Performance evaluations including a 2014 study by the Electric Power Research Institute via the American Council for an Energy Efficiency Economy

(ACEEE) assessed the speed, efficiency, and precision of gas, coil, and ceramic top stovetops.²⁰ While induction excelled beyond the competition at virtually every metric, gas and electric performed similarly when it came to the 12 lb. water heat-up test and production capacity. While the gas stove won the large pot overshoot, cooldown, and sauté tests, its heat-up efficiency was less than half that of the electric options.

Resident Performance Interviews:

Q: Are you satisfied with the performance of your stove? Why or why not?

A: *“Overall, yes. It heats quickly and evenly and responds quickly to temperature adjustments while cooking. I wouldn’t change anything performance-wise. I just wish it was easier to clean.” - Homeowner (gas stove)*

Q: What would you change about the performance of your stove and how would you improve it?

A: *“My only complaint is the time it takes to ignite, and the fact that it’s easy to think it’s ignited when the flame actually didn’t catch and it’s just spewing gas.” - Renter (gas stove)*

Q: Does the research around gas stove health impacts change your perception or raise concerns with gas stoves?

A: *“Not really, I’ve known about the combustion residues gas stoves emit for quite some time. I guess I’m somewhat concerned ... I use my stove mainly for stove top cooking. If I was a heavy oven user, I would be more concerned. My biggest barrier is running the electric power needed to install an electric stove.”
- Homeowner (gas stove)*

Electric Stove Challenges and Opportunities

The information in this section is based off research conducted throughout the project period and is complimentary to the findings identified within interviews Elevate completed. Building decarbonization and electrification has been a challenging discussion within the building energy industry, but in recent years some progress has been made by regional city leaders despite resistance in the energy and building industries. City leader have made progress establishing or even considering building codes that would address the barriers like low perceived customer value and misaligned policy.²¹ In recent years, city leaders throughout the state of California²² have introduced building codes that encourages electrification by incentivizing electric building mechanics and gas stoves and at least 42 municipalities across the U.S have discouraged gas hook ups in new construction by strengthening building codes.²³

²⁰ Micah Sweeney, Jeff Dols, Brian Fortenbery, and Frank Sharp. *Induction Cooking Technology Design and Assessment*. Electric Power Research Institute (EPRI), 2014. <https://www.aceee.org/files/proceedings/2014/data/papers/9-702.pdf>

²¹ Building Decarbonization Coalition, A Roadmap to Decarbonize California Buildings, 2019.

²² Rocky Mountain Institute, California Can’t Wait on All-Electric New Building Code, July 2020. <https://rmi.org/california-cant-wait-on-all-electric-new-building-code/>

²³ Leeber, Rebecca, “How the Fossil Fuel Energy Convinced Americans to Love Gas Stoves.” Mother Jones, 2021.

https://www.motherjones.com/environment/2021/02/how-the-fossil-fuel-industry-convinced-americans-to-love-gas-stoves/?utm_source=Energy+News+Network+daily+email+digests&utm_campaign=e8c7b2f3d7-EMAIL_CAMPAIGN_2020_05_11_11_46_COPY_01&utm_medium=email&utm_term=0_724b1f01f5-e8c7b2f3d7-89244483

Challenges

Public perception of stoves favors the performance of gas stoves and the gas industry is pushing anti-electric cooktop campaigns.

- In the Midwest, gas is the culture default, which helps reinforce the “gas is better” perception. It’s also easy to find local celebrities or influencers who will back that without hesitation. This strongly impacts the efforts of electrification and installation of electric appliances and products, such as stoves. The gas industry is employing emotion, culture, lifestyle, and status to further entrench gas cooking.²⁴
- According to the American Gas Association, “Builders know that a kitchen can sell a house. But smart builders know that natural gas appliances can sell the kitchen. Just as most professional chefs insist on cooking with natural gas, everyday cooks recognize that natural gas offers even heat, excellent temperature control and instant on/off settings for cooking and baking. Today’s natural gas ranges, ovens, cooktops and grills feature high efficiency, easy cleaning and the reliability that natural gas equipment is known for.”²⁴
- Gas cooktops offer users the ability to adjust the heat to the pan based on visual reference to the size/height of flame. Many home cooks prefer the immediate response of the flame adjustment to the delayed response associated with electric resistance coils.²⁵ Ultimately, the type of stovetop, specifically gas stoves, generates deep attachment. Selling gas over electric is a harder sell for cooktop if converting from gas. It is considered a downgrade (coil, flat top) or a risk (induction) in some circles.
- Representatives and advocates within the gas industry have made it priority to aggressively promote gas stoves. “As more municipalities have moved to phase gas lines out of new buildings to cut down on methane emissions, gas utilities have gone on the defensive, launching anti-electrification campaigns across the country.”²⁶

The higher upfront cost is concerning for building owners/operators who aim to budget for (or prioritize) making a fuel switch for a different stove type.

- Most people don’t choose their stoves, they inherit what they use. For example, a rental property might have different motivation to switch, but few low- or middle-income homeowners can afford this luxury.
- Induction is marketed as a high-end option, just like dual fuel stoves, making it seem out-of-reach for some homeowners.
- The majority of building owners and operators in this study reported that switching is not worth the investment or feasible to install electric stoves.
- Identifying financial solutions to help customers manage up-front costs is limited.

²⁴ American Gas Association, Cooking with Natural Gas: Precise Control in A Stylish Package. <https://www.aga.org/natural-gas/in-your-home/cooking/>

²⁵ Livchak, Denis, Russell Hedrick, and Richard Young. Rep. *Residential Cooktop Performance and Energy Comparison Study*. Sacramento, CA: Frontier Energy, 2019.

²⁶ Leeber, Rebecca, “How the Fossil Fuel Energy Convinced Americans to Love Gas Stoves.” Mother Jones, 2021. https://www.motherjones.com/environment/2021/02/how-the-fossil-fuel-industry-convinced-americans-to-love-gas-stoves/?utm_source=Energy+News+Network+daily+email+digests&utm_campaign=e8c7b2f3d7-EMAIL_CAMPAIGN_2020_05_11_11_46_COPY_01&utm_medium=email&utm_term=0_724b1f01f5-e8c7b2f3d7-89244483

- The costs that can be associated with the transition can vary greatly. Induction range tops, however, are more expensive. For instance, hardware stores like the Home Depot price a gas range and oven set at around \$550, while a similar induction set is found to be priced at no less than \$1,000. Some even are as high as \$3,000 for certain induction stoves. To this point, several restaurant owners have expressed their concerns with cost of induction ranges and believe them to be cost prohibitive, saying “it would be worthwhile for cities and utilities to offer programs to ease the transition, like subsidies to make induction equipment more affordable.”²⁷

A lack of awareness, education, and consumer demand exists to invest in electric appliances and products such as stoves.

- From a contractor, building owner, and customer perspective, there is an educational barrier of understanding the health as well as financial factors of investing in electric stoves.
- There is a lack of coordination among organizations when it comes to collaboration efforts with policymakers, local governments, research institutions to prioritize electrification. The majority of the participants in our interviews were not familiar with the incentives, rebates, or weatherization support programs that exist because these resources are not currently offered in their market.

Opportunities

Consumers that prefer natural gas stoves will continue invest and promote these stove types. However, the health factors that exist within this stove type have become a national concern. The change in environmental policy, the emergence of new technologies, and the increased efficiency of electric appliances and products could potentially takeover the popular demand. According to the Consumer Reports, of the top 10 cooktops rated in 2018, nine were electric.²⁸

Electric stoves are a more cost-effective technology than a traditional gas stove and are easier to clean.

- Electric coil cooktops are a cost-efficient choice for rental properties since repairs don’t require a service call, and parts are inexpensive. Replacing all the burners on a coil cooktop costs \$100 and can be done by anyone.
- Homeowners and renters who switched from gas to electric reported in interviews that they were happy with the performance of electric stoves: *“Super easy to clean the flat glass surface, best, most even heating I’ve ever had because the largest coil was like 12” diameter which distributed the heat very well across the bottom of a giant fry pan.”*

Installation of electric stoves could lower indoor air pollution levels and put those with respiratory illnesses at less risk.

- Homes with gas stoves have approximately 50% to over 400% higher average nitrogen dioxide concentrations than homes with electric gas stoves. Individuals with respiratory illnesses are at higher risk to nitrogen dioxide exposure. The U.S. EPA states that strong evidence exists for a relationship between long-term exposure to nitrogen dioxide and development of asthma in children.²⁹
- Investing in electric stoves lowers the potential of health risks from a short- and long-term perspective.

²⁷Philpott, Tom, *Can Chefs Learn to Love Cooking Without Fire?* <https://www.motherjones.com/food/2019/07/can-chefs-learn-to-love-cooking-without-fire/>. Mother Jones, 2019.

²⁸ Consumer Reports, Cooktop Ratings. <https://www.consumerreports.org/cro/cooktops.htm>

²⁹ Seals, Brady, and Andee Kranser. Rep. *Gas Stoves: Health and Air Quality Impacts and Solutions*, May 2020. <https://rmi.org/insight/gas-stoves-pollution-health/>

Investing in electric stoves can lead to educational and training opportunities for both the consumer and manufacturer addressing environmental health and safety standards, building energy efficiency, and incentive and rebate programs (see section Best Practices – Rebates and Programs in report).

- Electric cooperatives are working to define beneficial electrification and actively enabling programs and policies of which stoves are a key piece.
- According to Keith Dennis from NRECA Business and Technology Strategies,³⁰ “beneficial electrification is the use of electricity for end-uses that would otherwise be powered by fossil fuels (natural gas, diesel, propane, fuel oil, or gasoline), where doing so reduces (GHG) emissions and saves consumers money.”

Qualitative Analysis – Building Owner Interviews

In late 2020, the project team conducted several interviews with for-profit and non-profit developers, building owners, and building operators in charge of affordable multifamily housing properties, as well as community development organizations. The interview questions focused on potentially switching from natural gas stoves to electric, if not already installed. This portion of the analysis provides an understanding of the existing inventory and property portfolio, the living conditions and maintenance, motivation for change of electrifying building and installing all-electric appliances, and awareness of the shift in the market as well as existing programs and rebates. The owners interviewed were:

1. Nicole Redding, CPM, ARM, RCM, Managing Broker/General Manager for London Towne Homes, a housing cooperative located on the South Side of Chicago
2. Michael Burton, Asset Management Director for Bickerdike Redevelopment Corporation, a member-based nonprofit community development corporation on the Northwest side of Chicago
3. Sandeep Sood, Founding Principal/Managing Broker for Nautilus Investments, a local property management company for affordable apartments throughout the Chicagoland area
4. Nate Dick, Director of Energy and Capital Products at POAH (Preservation of Affordable Housing)
5. Charlene Andreas, Director of Building Development at LUCHA (Latin United Community Housing Association)
6. Brandon Pieczynski, Energy and Sustainability Analyst at Pangea

Building Owner/Operator Responses:

NICOLE REDDING, LONDON TOWN HOMES

Of the 800+ units that they manage in around 200 buildings, the majority have electric (coil) stoves, primarily because there aren't accessible gas hookups. Some tenants have asked about whether installing a gas range stove is possible, but there have been very few complaints, and therefore, very little tenant-related motivation to convert.

MICHAEL BURTON, BICKERDIKE

Their portfolio is made up of about 1,100 units, and most, if not all, have gas stoves and no related ventilation (only fans). They have not received many, if any, complaints about them. However, they are currently running a pilot program to convert to electric in three of their smaller, older “La Paz” buildings. The buildings contain a total of 44 units that all have gas stoves and are in need of a rehab project anyway, which presents an

³⁰ Dennis, Kevin, *Understanding Beneficial Electrification*. NRECA Business and Technology Strategies, April, 2019. <https://www.cooperative.com/topics/beneficial-electrification/Pages/Understanding-Beneficial-Electrification.aspx>.

opportunity for conversion. Elevate was one of the inspiring forces behind this pilot idea, as well as more than a decade of low-cost improvements, that also always improve the living conditions of the tenants.

Pilot programs like this are notably attractive to larger developers like Bickerdike, as they represent a chance to mitigate risk while demonstrating value for a potentially larger reward. The new electric stoves are coil, and it was noted that as electrification is adopted, central air conditioning has been made “standard” in some places for the first time. Gas is often the standard building spec, depending on location, as it is in Logan Square where Bickerdike is developing 100 units of affordable housing. That spec can evolve with technology – it just needs to be proven credible, which is the purpose the pilot project serves. The level of credibility that is needed can also be achieved with at least one of three things: a pilot to test (preferably without major commitment), data-driven metrics, or peer validation (groups like Chicago Rehab Network, Preservation Compact, or simple but trusted word of mouth), and ideally, all three.

SANDEEP SOOD, NAUTILUS INVESTMENTS

Stove maintenance issues have arisen, especially when pilot lights go out, which often leads to complaints about the smell of gas. Therefore, the more recently renovated units have hoods that circulate the air (but admittedly, don’t ventilate). There haven’t been any requests from tenants to switch to electric stoves, though they have considered the conversions. Their main reservation lies with cost, as they have yet to see a proven cost-benefit analysis and services to add the necessary electrical capacity obviously add to already limited renovation budgets.

Currently, they own and operate four large buildings (50+ units each). About half of those units are smaller studio spaces that are outfitted with half-sized stoves (20” wide) that use gas and are just as expensive as full-sized stoves (\$400-500), but are necessary to maximizing space and preserving the highest unit count possible. Understandably, this keeps them financially viable, and they are open to hearing more about the long-term options and incentives via webinar or other format, since that specific education has not been presented to them before. It was also noted that their biggest concern right now is actually the cost of water, which is really cutting into margins with a 40% increase or more!

NATE DICK, POAH

In their 11-12,000 units nationally, most (if not all) are outfitted with electric (coil) stoves, and for those with gas, there is not ventilation above, only recirculating fans. Incentives are always welcome, and any information regarding the health and safety of tenants is considered. However, managing the electricity load and capacity of their buildings has presented challenges in the past, and they are in New England, where the cost of electricity is near double that of the Midwest. Where there is gas infrastructure it is often also the source used for heat, and there have not been any complaints about its cost, which again, is less than electricity. However, the operating costs and financial trends have never been compared and mapped out, so they expressed interest in learning more.

POAH has a website dedicated to their basis of design (poahbod.org), which highlights appliance and building specs and recommendations. Nate works in this field and is involved in energy efficiency and envelope-focused retrofits, noting that “passive house has burgeoning development focus.” Another point of notice was that one of their partners, Slipstream, monitors their passive house and other “code-based” buildings and noted that as they minimized the amount of air leaking in and out of the home, indoor air contaminants became more highly concentrated – a risk that has to be accounted for.

CHARLENE D. ANDREAS, LUCHA

All of the nearly 200 units in 27 properties operated by LUCHA use gas stoves, and though none have ventilation, they would certainly be receptive to accommodating any tenants vulnerable to respiratory discomfort. They

have an interest in using passive building principles³¹ because of the 20% savings they expect, and although ComEd commissioned the conversion for some buildings, the City of Chicago was not on board. Moving forward, they are still looking at rehabbing in the direction of a passive house design, but funding is limited, and the COVID-19 pandemic put the brakes on potential projects like a new office building. And as a part of future rehab projects, induction cooktops are being tested.

LUCHA has also been conducting a “single resident occupancy” or SRO pilot, in coordination with Elevate staff, where fuel-switching is a possibility. This would have a significant impact on their buildings’ electric capacity, and though conversions are not a common request from tenants, they are capturing feedback as a desired product of the pilot. Best practices and designs like passive house have been sought via seminars, green build presentations, organizations like IHDA, and resources including health action plans. They are also implementing a Resident Service Program, where presentations and interactive activities have had a much greater impact on participation. They have noticed that when it comes to stoves, the performance of the appliance and quality of the food it produces is regarded much more highly than the safety or efficiency, at least according to their immediate feedback.

BRANDON PIECZYNSKI, PANGEA

Gas stoves are installed in the majority of Pangea’s Chicago properties (about 8,150 out of the 9,500 units), and the only reason some are electric is because of existing infrastructure, which is the greatest determining factor thus far. They have received some inquiries about fuel-switching due to some units receiving more or less heat than desired, but that has usually led to investigations into emerging technologies that allow individuals to control radiant heat. Heating is the largest source of energy consumption and cost, so there would need to be an economic advantage with regard to maintenance, cost of service, etc., and even then money would likely be spent on making current systems more efficient rather than converting. The cost barrier is not just the physical conversion and updating the electric capacity, but covering all associated costs since the majority of buildings are master-metered.

They have, however, heard stories demonstrating clear signs of resident discomfort, such as the use of the oven as a supplemental heating source, so they are willing to weigh all the options that are available. This does lend credence to the importance of ventilation and hoods, but again, unless it is mandated or the situation becomes more serious, the massive expense makes it unlikely to be considered. They are indeed interested in hearing about programs and incentives, as Brandon himself has sought financial and maintenance-related information on stoves and other appliances, to no avail. He said that the details (operational intensity, appliance longevity, maintenance frequency and cost, etc.,) are of paramount importance to these considerations.

Overall, a majority of the responses reflected common themes when discussing the possibility of switching from gas to electric stovetops:

- Resident discomfort
- Cost barriers and feasibility
- Rehabilitation projects and potential installation of building appliances
- Customer resource availability
- Existing conditions and maintenance
- Education and training opportunities involving stove electrification.

³¹ “Passive House Principles” Passive House Institute, US. 2018. <https://www.phius.org/what-is-passive-building/passive-house-principles>

A key takeaway from this qualitative analysis is that we were unable to identify tenant preference from each of the interviewees. Several questions revolved around the existing conditions and if it impacted the building owner/operator's decision on appliance installation. On the contrary, our survey with Elevate staff was mainly focused on preference and performance. As referenced in the challenges related to stove electrification, most tenants and customers are not given a choice in stove type and it is common that they inherit what they use. Increasing building owner, landlord, or operator and tenant/customer interaction can help with educational and training purposes if installation of stove electrification is considered an option in the future.

Best Practices – Rebate and Incentive Programs

Depending on the regional market, incentive and rebate programs can be scarce and hard to come by. However, various municipalities throughout the U.S., particularly in California, have taken initiative toward building electrification and changing their environmental policy and regulations when it comes to electric appliances and products. However, the trend has started to increase and other states across the country are buying in on programs that support stove electrification and efficiency of electric appliances.³²

From a manufacturer and consumer perspective, there are various types of incentive and rebate programs that exist for energy efficiency within single-family and multifamily properties. Energy incentive programs are designed to encourage the development of clean energy projects with the overall goals of enhancing energy security and efficiency, improving living conditions, and reducing carbon footprints. Through implementing such programs, it encourages property owners and developers to reevaluate what appliances they select when making updates to their homes and take into consideration more energy efficient practices. Although these programs exist and there is an effort to broaden the spectrum of offerings, there are many that will not do fuel-switching because of current laws or common practice. Stove programs that are coming to fruition need to take that into consideration and address this limitation in the necessary regions.³³

Existing programs distribute funds generated by local utility ratepayers that can supplement the costs associated with energy efficiency upgrades for eligible participants. Enrolling makes sustainable practices more accessible and creates a healthier standard of living.³⁴

- According to the U.S. Department of Energy, “public purpose incentives are administered by utilities, state agencies, or third parties, and are paid by utility ratepayers to promote energy efficiency and renewable energy, most often funded out of general tax revenues. Utility programs administered by local utilities and paid for by utility ratepayers through bundled rates. Loans and grants provide financing options for energy efficiency property improvements and can subsidize the purchase of new

³² Cortez, Nadia. Issue brief. *State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching*. American Council for an Energy-Efficient Economy, April 2020. https://www.aceee.org/sites/default/files/pdfs/fuel_switching_policy_brief_4-29-20.pdf.

³³ ACEEE State Policy Program and Nadia Cortez. “State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching” April 2020 https://www.aceee.org/sites/default/files/pdfs/fuel_switching_policy_brief_4-29-20.pdf

³⁴ “Financing Energy-Efficient Homes.” Energy.gov. Accessed January 17, 2021. <https://www.energy.gov/energysaver/incentives-and-financing-energy-efficient-homes/financing-energy-efficient-homes>.

appliances and contractor fees. They are funded by state agencies, affordable lenders, and other third parties.”³⁵

Benefits

There are many benefits associated with energy efficiency upgrades. Improved efficiency can lower greenhouse gas emissions, utility bills, and create jobs. Energy efficiency can also help stabilize fuel prices by stabilizing demand.³⁶ Improved returns on investments, indoor air quality, and increased property values³⁷ are additional benefits associated with creating a more efficient home environment.

Energy efficiency program benefits may also include: accessible and affordable energy audits; rebates for efficient lighting or heating, ventilation, and HVAC; reduced costs for any number of efficient or renewable energy measures; and water conservation equipment.³⁸

Existing Incentive Programs for Stove Electrification

These, as well as a number of other energy efficiency programs, can be used as models when developing new stove-related programs.

- [BayREN Home+](#) provides rebates for building weatherization and high efficiency equipment upgrades.³⁹ Participants of Electrification Appliance Rebates can receive a \$300 rebate towards conversion from gas to induction stoves, as well as \$300 towards an upgrade from a natural gas dryer to an Energy Star efficient heat pump dryer.
- [Sacramento Municipal Utility District](#) (SMUD) offers appliances, heating and cooling, recycling, and instant rebates. The induction cooktop/range rebate program offers between \$100 and \$750 for replacing existing gas or electric stoves measuring 30 inches or larger. Participants can receive \$100 for electric to induction and \$750 for gas to induction.⁴⁰
- [Mass Save](#) helps residents and businesses in Massachusetts implement cost and energy saving practices through rebate and incentive programs. Residents can receive rebates for appliances including washers and dryers, dehumidifiers, water heaters, boilers and furnaces, and more. They run a separate incentive program for business owners who can receive rebates for commercial gas heating equipment, commercial gas kitchen equipment, and commercial electric HVAC and heat pumps.⁴¹
- [East Bay Community Energy](#) (EBCE) has a program in the East Bay area to help residents upgrade their home appliances to clean, energy efficient alternatives. Participants can get up to \$300 when converting

³⁵U.S. Department of Energy. "Utility Rebates and Incentive Programs," 2009.

<https://www.nrel.gov/docs/fy09osti/46311.pdf>

³⁶ "Local Energy Efficiency Benefits and Opportunities." EPA. Environmental Protection Agency, August 27, 2018.

<https://www.epa.gov/statelocalenergy/local-energy-efficiency-benefits-and-opportunities>.

³⁷ "Why Conserve Energy: the Top Benefits of Energy Efficiency." EnergySage. Accessed December 2020.

<https://www.energysage.com/energy-efficiency/why-consume-energy/>.

³⁸ *Utility Rebates and Incentive Programs* [Pamphlet]. (2009). U.S Department of Energy.

³⁹ "Rebates for Home Energy Improvements." BayREN Residential. Accessed January 2021.

<https://www.bayrenresidential.org/get-rebates>.

⁴⁰ "Start Fresh..." Rebates for my home. Accessed November 2020. <https://www.smud.org/en/Rebates-and-Savings-Tips/Rebates-for-My-Home>.

⁴¹ "Massachusetts Energy-Saving Rebates." Mass Save. Accessed January 2021. <https://www.masssave.com/rebates>.

their gas stoves to induction. This program also offers the ability to test run an induction stove top before committing to the change.⁴² EBCE also offers a water heater upgrade incentive program through a partnership with BayRen Home+. By combining these two programs, participants can get up to \$2,000 off a heat pump water heater installation when replacing an old water heater.⁴³

- [Multi-Unit Dwelling \(MUD\) Electrification Grant Program](#) run by [Central Coast Community Energy](#) in California supports housing developers with incentives to choose all-electric residential building design.⁴⁴ The program's funds are broken into two pools: affordable housing incentives and market-rate housing incentives. Applicants must apply online to be approved and reserve funds towards their project and can be eligible for up to \$240,000 for each all-electric housing development project depending on the number of units and type of development.
- [The Kitchen Electrification Group \(KEG\)](#) is a free forum for program administrators and electric cooking stakeholders to share information on current programs and initiatives and collaborate on joint efforts to accelerate kitchen electrification. Much of the existing effort is confined to just a few states. The hope is to expand the availability of these programs throughout the country to maximize the impact.

Recommendations

Whether one is interested in improving indoor air quality and related health aspects, exploring efficient, cost-effective upgrades to a building or portfolio, or planning for the beneficial electrification of a given constituency, how we view and treat the most central kitchen appliance plays a role. As cities, states, and countries begin to take tangible steps toward addressing climate change, any discussion of building decarbonization includes the kitchen and its stove. We must consider the potential rebates and incentives to make such transitions fiscally sound, and the reshaping of policies regarding air, energy, and consumer protections must be carefully deliberated. Below are our calculated recommendations in approaching the path forward.

Implement rebates and incentive programs focusing on energy efficiency

- Emphasize that electrification is multifaceted and addresses energy consumption, usage, and health and safety, all of which are beneficial to energy efficiency program goals.
- Push for stoves to be included in the scope of work of energy efficiency programs, since they are a key piece of electrification.
- Provide fact-based education on the negative health impacts of gas appliances and existing infrastructure to close the gap in knowledge and encourage residents to move towards electrification due to these health hazards.
- For programs that promote energy efficiency, and/or electrification, provide abundant resources for potential and existing participants, including information for installing new technologies is essential so that residents to understand how their homes work.

⁴² Get Cooking with Induction." East Bay Community Energy. Accessed November 2020. <https://ebce.org/induction/>.

⁴³ Get Cooking with Induction." East Bay Community Energy. Accessed November 2020. <https://ebce.org/induction/>.

⁴⁴ "Multi-Unit Dwelling Electrification Grant Program ." 3CE, September 28, 2020. <https://3cenergy.org/mud-electrification-program/>.

- Advocate for policy that revokes fuel switching bans that limit electrification measures from receiving more funding.

Construct health-driven policy and regulation guidelines

STATE AND LOCAL

- Adopt health-based indoor air quality guidelines that protect vulnerable populations.
- Ensure building codes for new and renovated buildings have adequate stove hood ventilation.
- Require manufacturers and installers to certify that any new gas stove installed will not expose residents to harmful levels of gas stove pollution and will include warning labels and ways to mitigate indoor air pollution.
- Require elimination of gas stove pollution in all publicly funded buildings.
- Provide financial incentives, such as tax credits or rebates, that will enable low-income homeowners to eliminate gas stove pollution and require landlord to provide notice of associated risks.
- Update state Quality Action Plans (QAP) to incentivize all-electric and passive house construction that includes gas stoves.

FEDERAL (CONSUMER PRODUCT SAFETY COMMISSION (CPSC))

- Set science-based indoor air quality guidelines.
- Set safety requirements for manufacturers and installers.
- Open a docket to explore protections strategies for gas stove owners.
- Ensure federal weatherization programs and monies include proper air quality control and ventilation.

Enhance training and educational seminars/workshops addressing health, maintenance, and cost for contractors, builders, and consumers.

It is essential to acknowledge that an approach consisting of only information and health warnings is inadequate and unlikely to be effective on its own. Demonstrations and marketing techniques to exhibit the advantages of electrification and associated emerging technologies are equally important to their proliferation. Similarly, outreach strategies and widespread communications campaigns are needed to advertise incentives and sales opportunities in order to promote the economic and long-term financial viability of a decarbonized transition.

Conduct assessments to improve indoor air quality conditions and health outcomes.

It is common in older building structures to have unvented gas stoves, and as we have shown gas stoves are inextricably linked to higher indoor air pollutant concentrations. Municipal health departments or environmental servicing organizations can provide assessments to address an ongoing concern related to high concentrations of indoor air pollutants. To this point, successful interventions can be beneficial to improving health outcomes, especially for individuals with asthma and other respiratory health concerns. The City of Baltimore conducted a home intervention assessment targeting homes with unvented gas stoves to target the feasibility of the assessment by identifying a decrease of indoor nitrogen dioxide concentrations.⁴⁵ Each home that participated received the following:

- Replacement of existing gas stove with electric stove or

⁴⁵ Paulin, Diette, Scott, McCormack, Matsui, etc., Home Interventions are Effective at Decreasing Indoor Nitrogen Dioxide Concentrations, August, 2014.

- Installation of ventilation hood over existing gas stove and/or
- Placement of air purifiers with high-efficiency particulate air and carbon filters

Elevate collaborated with the organizations Healthy Homes Initiative, the Breathe Easy Project, and the Illinois Institute of Technology to conduct a three-year longitudinal, randomized, crossover study, which aims to improve indoor air quality and asthma-related health outcomes by installing mechanical ventilation systems in existing homes in Chicago. The present work focuses on a pre-intervention phase to investigate associations between exposure to indoor air pollutants and adult asthma outcomes.⁴⁶

⁴⁶ Elevate and Illinois Institute of Technology, HUD Health Homes Technical Study – Year 1 Data Analysis, May, 2020.
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Appendix

Questionnaire Template for Interviewees:

- 1) Knowing that the price of natural gas is rising and that gas stoves have negative health impacts that electric stoves don't, at what point in time and/or price point would you consider switching to electric stoves in your building(s)?
 - a) Now, when gas is cheaper but a limited resource and therefore projected to become more expensive within 10 years: [Gas prices could go from \\$2.33/mmbtu today up to \\$4-\\$5/mmbtu by 2030](#), while [electricity prices are expected to stay the same or decline](#).
 - b) Soon, but only once I have more disposable income or program incentives to cover the cost of replacement
 - c) In ~10 years, when gas prices make the switch economically feasible
 - d) The next time I need to replace appliances or renovate/build new
 - e) Never
- 2) Have any of the tenants complained about the performance of any of the stoves? If so, which types and why?
- 3) Do prospective tenants often ask what is the existing stove types? Does it affect their decision?
- 4) Do stove types differ by buildings? If so, do issues arise more from a different stove type?
- 5) Does your kitchen include a ventilation hood with your stove? Do you know how to check its effectiveness?
- 6) Have you received more requests to switch from electric to gas or the opposite?
- 7) What reasons have stopped you from converting to all electric stoves? Are there multiple?
- 8) Would you promote cooking electric to your tenants if it resulted in savings on utilities?
- 9) Do your tenants have any safety concerns cooking with gas?
- 10) How well do tenants take care of the stove? Level of familiarity - would some education help?

Internal Survey Results

The project team conducted a survey in Fall 2020 with 43 participants that submitted responses. The survey focused on the type of stove they had their home, preference, and prioritization.



