



**OUT OF GAS,
IN WITH JUSTICE**

THE RESULTS ARE IN



OVERVIEW

The Out of Gas, In with Justice pilot is the first study to focus on the effects of residential cooking electrification with tenants in-place in a public housing setting. The pilot confirms that **decarbonization**, the shift from fossil-fuel powered to zero-emission electric appliances, in our residential buildings is key to realizing a healthy home. Our pilot took place at 1471 Watson Avenue, a New York City Housing Authority (NYCHA) building in the Bronx.

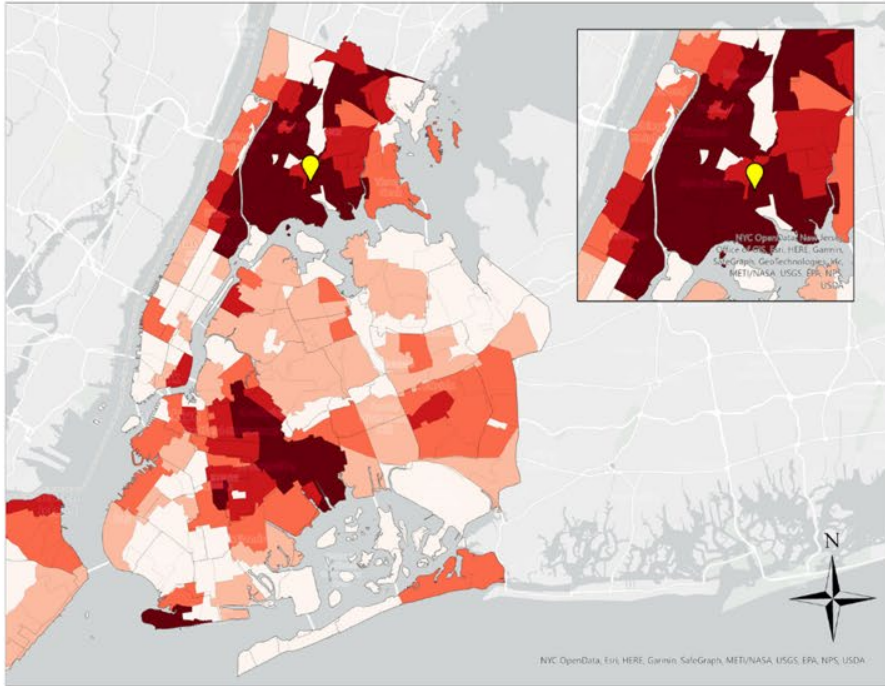


MOTIVATION

An aerial view of the New York City skyline, featuring numerous skyscrapers and buildings. The image is slightly hazy, suggesting a clear but bright day. A solid yellow horizontal bar is positioned at the top right of the image, partially overlapping the skyline.

- Emissions from buildings are responsible for 70% of NYC's greenhouse gas emissions.
- Air pollution from these buildings leads to nearly 2,000 premature deaths each year across New York State.
- In New York City, nearly 10% of the population has a current asthma diagnosis (which is higher than the national average of 7.8%).
- In New York State, 18.8% of childhood asthma is attributable to gas stoves in homes.
- Living in a home with a gas stove can increase a child's risk of developing asthma by 42%.

ASTHMA BURDEN



Child (0 -17 y/o 2012-2014) and Adult (2014 - 2016) asthma hospitalizations rate per 10,000 people

In New York City, 17% of children have experienced asthma-like symptoms at some point in their lives, while children living in low-income neighborhoods are 3x more likely to be hospitalized for asthma as children who live in wealthy neighborhoods, bearing the heaviest burden of the disease.

80% of hospital visits for asthma in children and young adults are Black and Latinx in New York City.

THE PILOT

The Out of Gas, In with Justice pilot reported on the health and social impacts of transitioning from a gas to induction stove through three tests:

Long-term Kitchen Air Monitoring



Controlled Cooking Test



Stove Usability Focus Groups



RESULTS

LONG-TERM AIR MONITORING

- Households with induction stoves had a **35% reduction in daily nitrogen dioxide (NO₂)** concentrations compared to households with gas stoves.
- The highest concentrations of NO₂ exposure are virtually eliminated when transitioning to an induction stove. Households with gas stoves are exposed to **NO₂ concentrations above what is considered safe for outdoor exposure** set by the EPA's Air Quality Index.
- Households with an induction stove experienced a **significant decrease in carbon monoxide (CO)**, with an average of 1.4 ppm in households with gas stoves compared to 0.8 ppm in households with induction stoves

Air Quality Index		
AQI Category and Color	Index Value	Description of Air Quality
Good Green	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Moderate Yellow	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups Orange	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Unhealthy Red	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy Purple	201 to 300	Health alert: The risk of health effects is increased for everyone.
Hazardous Maroon	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

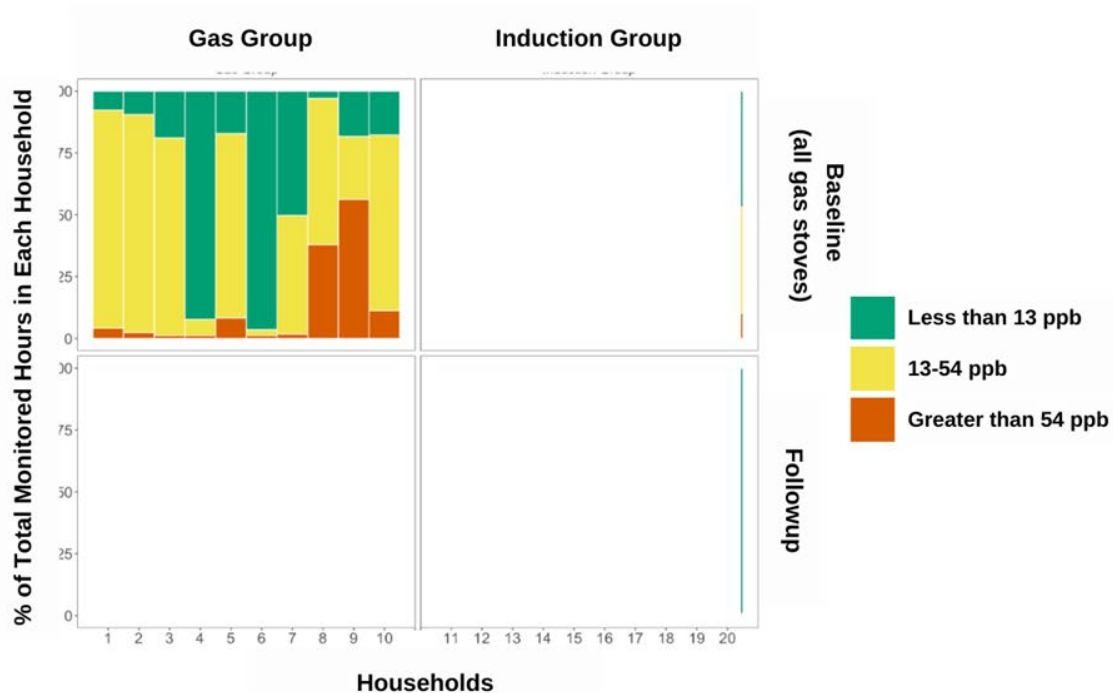
HOW DO IMPROVEMENTS IN AIR QUALITY IMPACT HEALTH?

The World Health Organization sets 24-hour guidance for indoor air quality.

The United States does not have guidelines for indoor air quality; however the U.S. Environmental Protection Agency has guidelines for outdoor exposure to air pollutants like NO₂.

Our analysis looks at how often indoor air is more polluted than what is allowed outside due to the use of gas stoves.

LONG-TERM AIR MONITORING: NITROGEN DIOXIDE

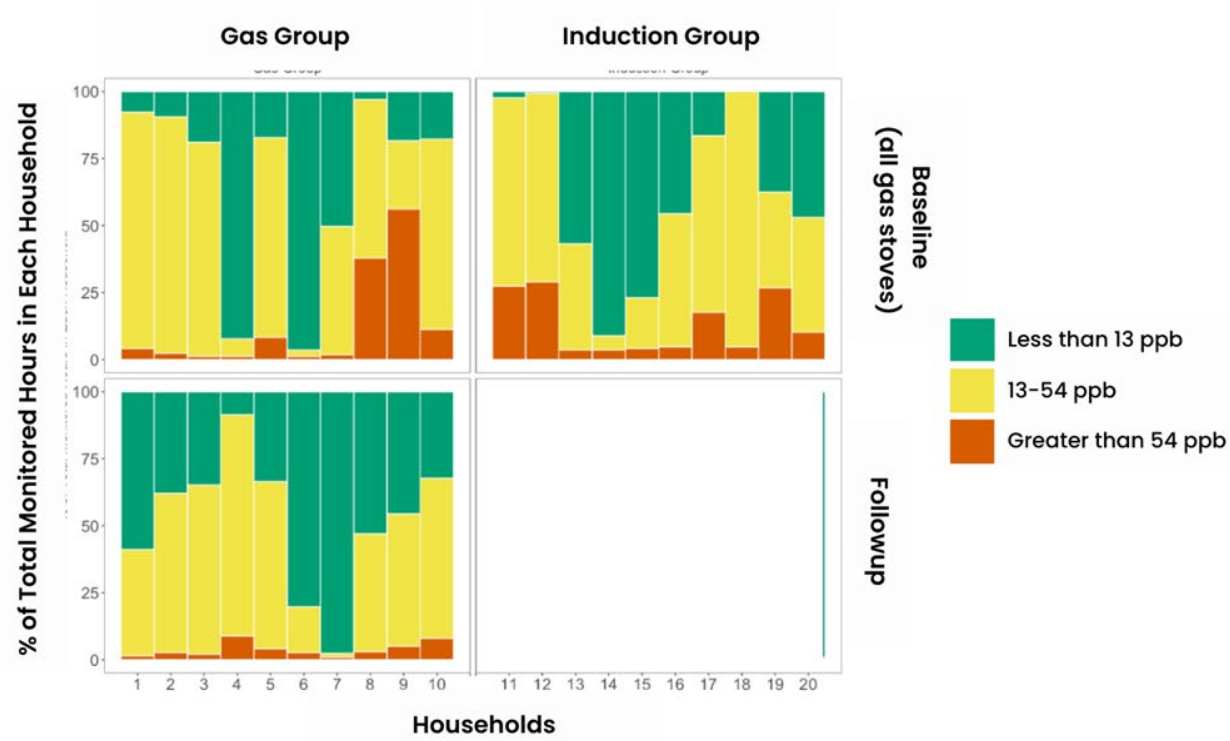


*Results show data from each individual household

13 ppb is the WHO 24-hour average guidance for indoor NO₂ exposure and 54 ppb is the one-hour outdoor NO₂ exposure threshold at which EPA's Air Quality Index transitions from "Good" to "Moderate"

RESULTS

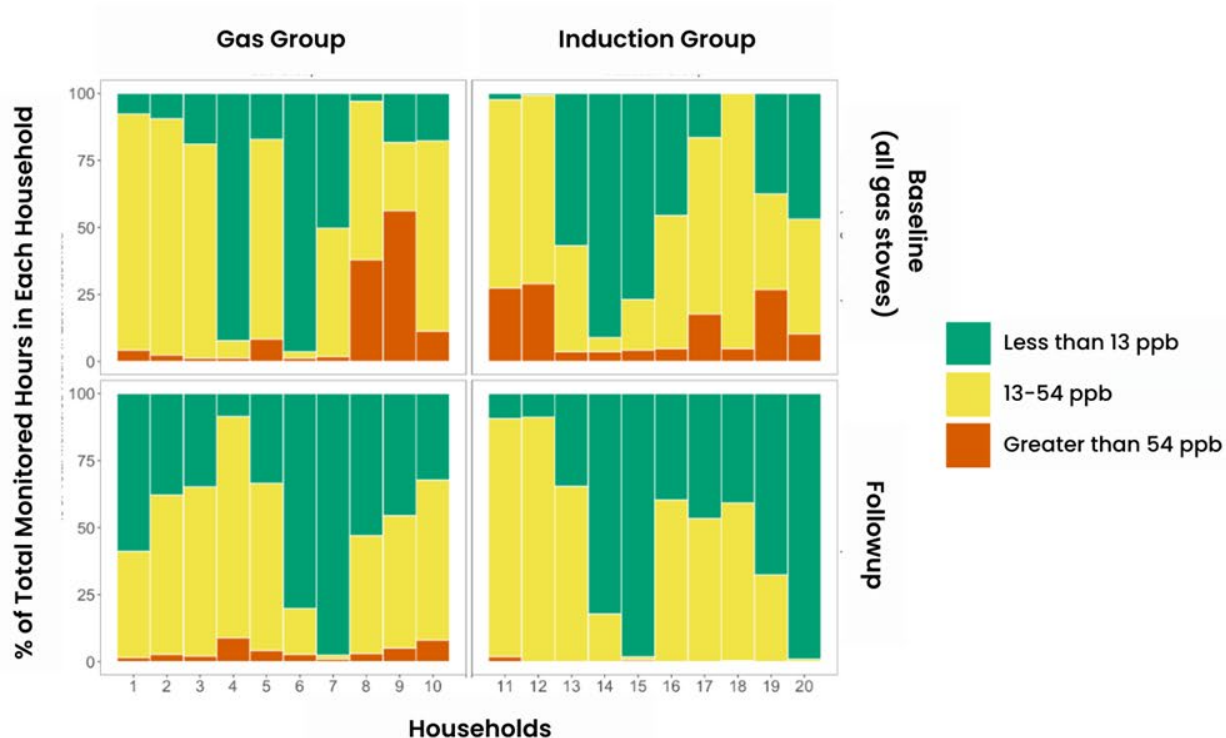
LONG-TERM AIR MONITORING



*Results show data from each individual household

We compared the amount of time air quality was over the WHO indoor air quality guidelines and the EPA outdoor air quality guidelines when everyone had a gas stove, and again after ten households received induction stoves.

LONG-TERM AIR MONITORING



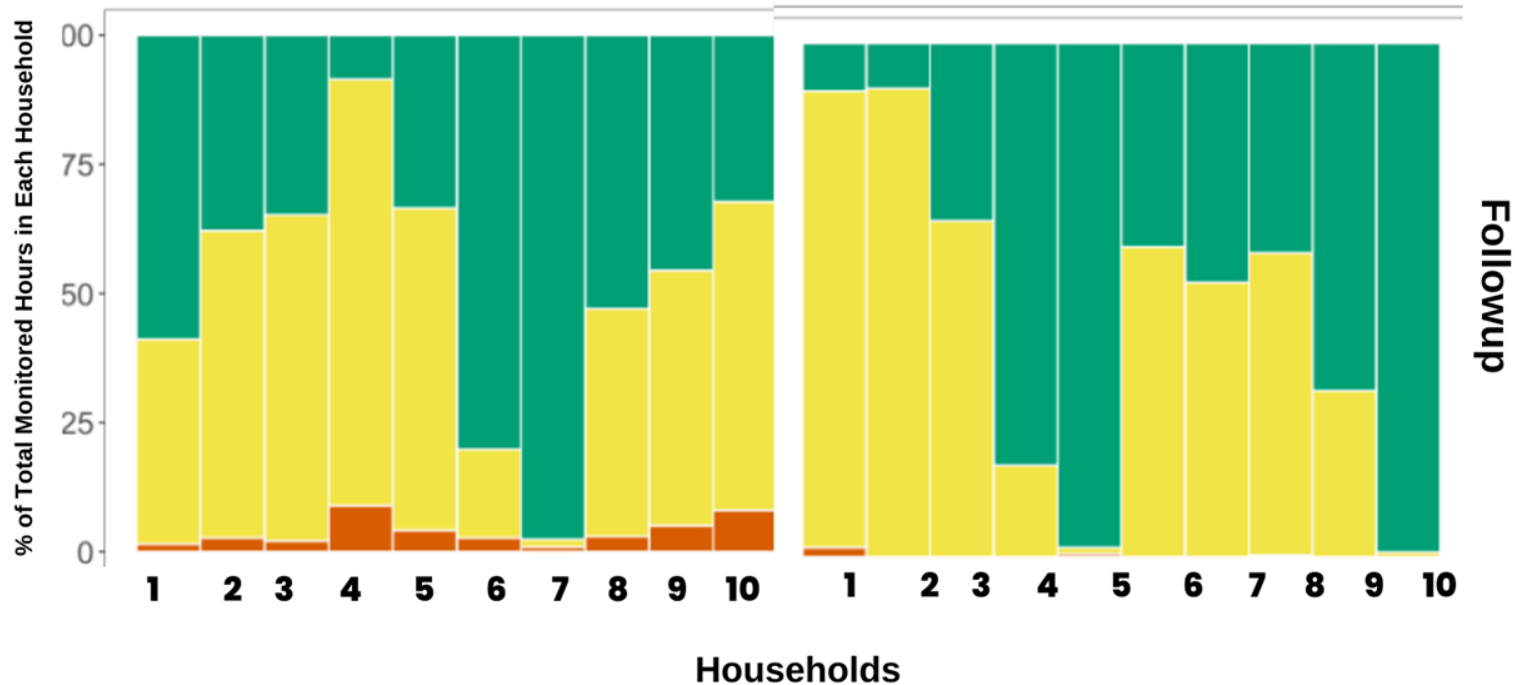
*Results show data from each individual household

Homes with induction stoves experienced practically no amount of time where NO₂ concentrations inside the home were above the EPA's outdoor threshold for "Moderate" exposure

NO₂ can cause damage to the human respiratory tract and increase the likelihood and severity asthma

RESULTS

While air monitoring showed clear improvements to indoor air quality when gas stoves were removed from apartments, there was still interference from other NO₂ sources that impacted air quality. These "confounders" could include the gas-powered boiler in the basement, cars on the street outside and gas appliances in other apartment units.



*Results show data from each individual household

CHALLENGE

EXPOSURE TO POSSIBLE CONFOUNDERS

Interference from other NO₂ sources (the basement boiler, cars outside, gas stoves in other apartments) impacted our daily readings.

These “confounders” - other potential sources of air pollution - were an important discovery, and highlight the limitations of individual interventions in apartments.



CONTROLLED COOKING TEST

A controlled cooking test allows researchers to compare the air quality impacts between cooking on a gas versus induction stove while controlling the food quantity, recipe, and cooking conditions.

We looked at how NO₂ concentrations change in a kitchen with an induction stove and a gas stove when cooking the same meal the same way 18 different times (9 times in households with gas and 9 times in households with induction).



FOOD	WEIGHT (g)	Power/Temp	StartTime	StopTime
5-minute baseline			12:03:00	12:07
Oven preheat / off		350 F	12:08	12:23:16
Salt	1/4 tsp			
Pasta Water	1695	high	12:08	12:23:57
Tomato sauce	326	2	12:08	12:24:38
Spaghetti	225	high	12:13:45	12:23:57
Broccoli Water	430	8	12:25:20	12:34:16
Broccoli	146	8	12:25:20	12:34:16
Cookies	116.75	350 F	12:13:08	12:23:16

Example CCT data entry



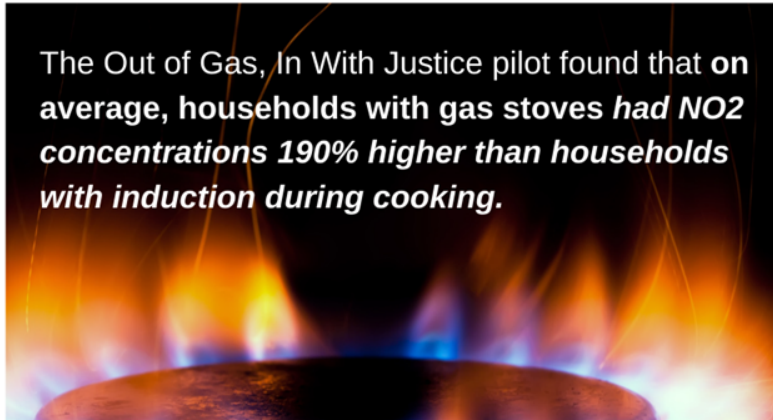
RESULTS

CONTROLLED COOKING TEST (CCT)

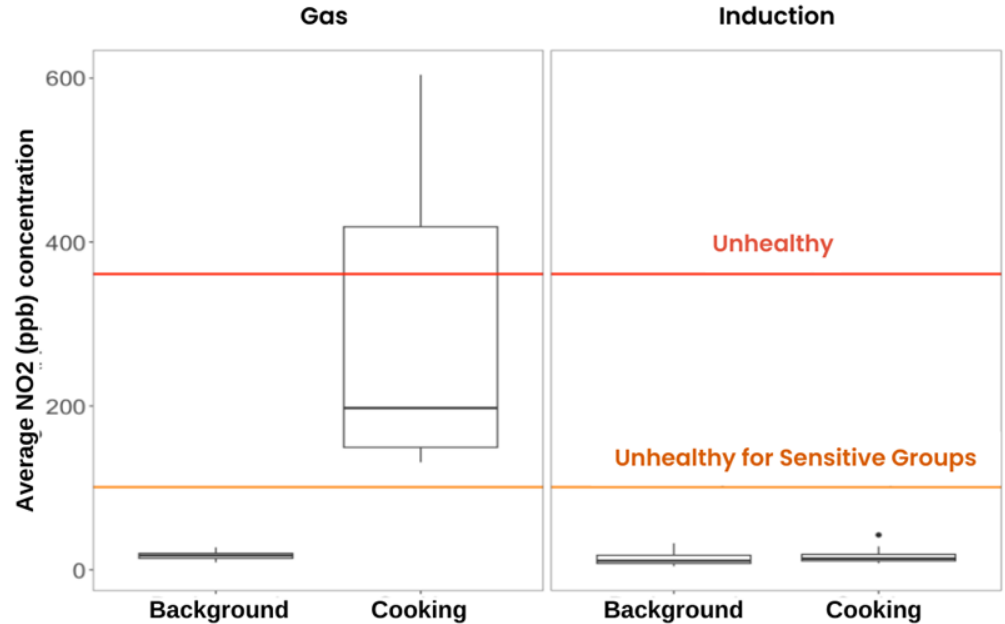
The CCT measured background NO₂ - NO₂ that is already present in the air. Then the CCT continued to measure NO₂ when cooking began.

In homes with gas stoves, NO₂ shot up from an average of 18 ppb to 197 ppb during the CCT.

In homes with induction stoves, NO₂ levels stayed the same.

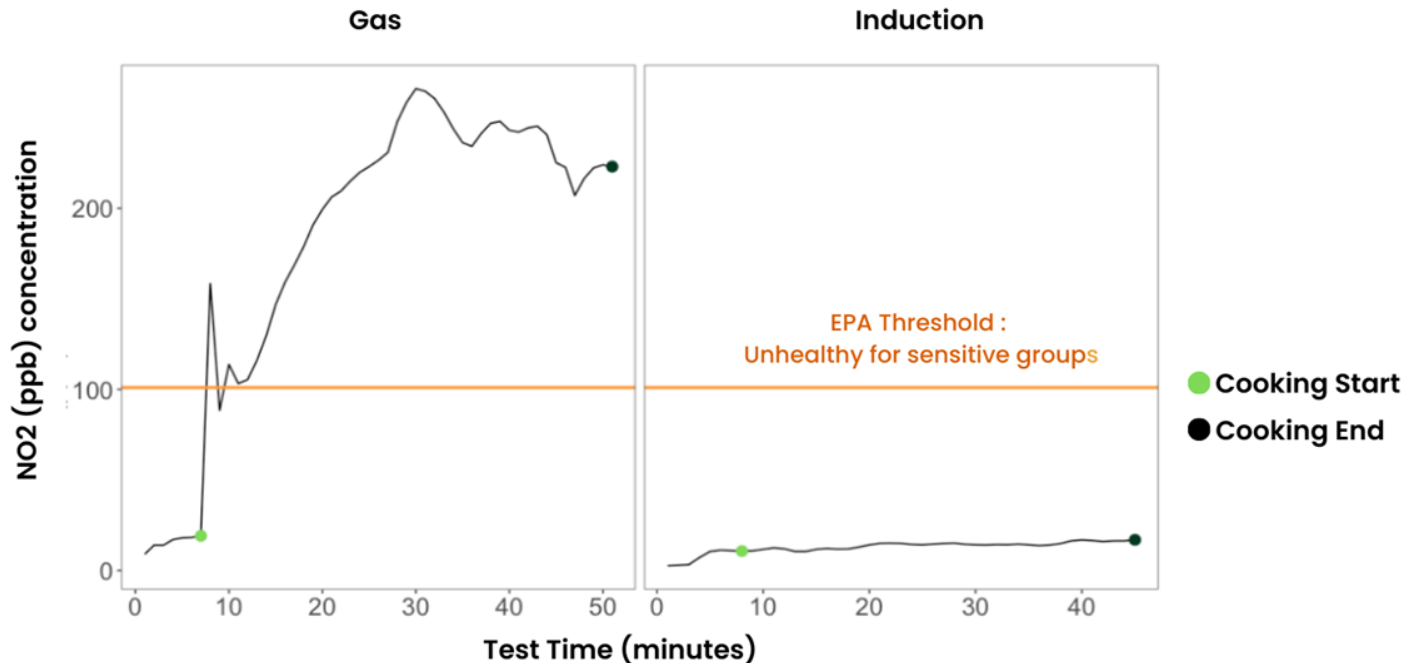


The Out of Gas, In With Justice pilot found that **on average, households with gas stoves had NO₂ concentrations 190% higher than households with induction during cooking.**



*Results show data from each individual household

CONTROLLED COOKING TEST



For 43 of the 45-minute cooking test, NO₂ concentrations were well above the EPA's threshold for one-hour NO₂ averages deemed "Unhealthy for Sensitive Groups."

**Results from one gas and one induction household Controlled Cook Test*

RESULTS

STOVE USABILITY FOCUS GROUPS

Coded transcriptions from the focus groups where long-term air monitoring participants shared their experiences with the pilot revealed observed outcomes related to satisfaction and improved cooking experience, as well as mental health improvements due to increased sense of safety.

Satisfaction and improved cooking experience:

"I love the stove entirely, everything about the stove, [it] cooks fast, [I] don't have to worry about the smell of gas, [it] cleans easier than the other stove. I'm not using the air fryer that had, I'm using the air fryer that fits in the stove. Also, [I'm] not using my microwave that much, I'm using my stove. I just love everything."

"I am like a kid in a candy store. I wanted to learn. I tested everything. I don't even eat meat anymore, but I've been cooking steak, pork chops, crab legs for my family to practice."

Mental health improvements due to increase sense of safety:

"What's important to me is that the stove is a lot safer and when I cook, I don't have to worry about a fire in the apartment. The rest doesn't matter."

KEY TAKEAWAYS

FROM THE OUT OF GAS, IN WITH JUSTICE PILOT

- Cooking with a gas stove results in acute indoor NO2 concentrations that are harmful to one's health, particularly for sensitive groups
- Induction stoves are a welcome and viable electrification solution for low-income households. Every single household that received an induction stove in our pilot preferred it over their gas stove.
- One-to-one appliance exchanges of gas for induction stoves in multifamily housing will improve indoor air quality. However, other sources of pollution in buildings will continue to impact air quality, and transitioning entire buildings will likely have the greatest impact on improving indoor air quality.
- Government programs that package interventions into a whole-building retrofit can maximize benefits to residents' health and expand resources for more equitable and efficient delivery.
- Low-income communities are more likely to live in older housing with structural deficiencies and are more likely to need significant investments and robust tenant protections to reach the electrification starting line.

QUESTIONS?