Characterizing Indoor Air Pollution from Gas Stoves: Baseline Data from City of Boston's Decarbonization Pilot

Poster Group: P36-01

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Background

- **Gas stove pollution**: Cooking with gas releases harmful pollutants including nitrogen dioxide (NO_2), carbon monoxide (CO), and fine particulate matter ($PM_{2.5}$).
- **Health impacts**: Exposure to these pollutants is linked to respiratory problems, cardiovascular disease, and other adverse health outcomes.
- **Advancing Equity**: Indoor air pollution disproportionately affects residents in environmental justice communities.
- **Boston's carbon neutral goal**: This work aligns with the city's broader efforts to remove emissions from large buildings to net zero by 2050, improving indoor air quality and public health in the process.
- **Public health relevance**: Findings will help guide municipal policy, inform appliance electrification programs, and protect vulnerable populations from harmful exposures.
- **Study Design:** Indoor air quality measured in kitchens before and after replacing gas stoves with induction, with monitors placed ~3–6 ft from stoves (away from windows/vents) and paired with resident activity logs to assess cooking behaviors and ventilation.

Objective: In this pilot study, we monitored IAQ in low-income multi-family housing in Dorchester using gas stoves prior to induction stove replacement.

Study Context

Project Plan/ Timeline

Fall 2024 - Summer 2025:
Recruitment & Planning
Partner with property managers, conduct home assessments, and educate residents.

Summer 2025:
Baseline Monitoring & Analysis
Install air monitors for 7 days, collect daily activity logs & analyze initial data on indoor activity & pollutants.

Fall 2025 - Winter 2026:
Intervention Implementation
Replace gas stoves with induction; provide training on safe use to residents in homes.

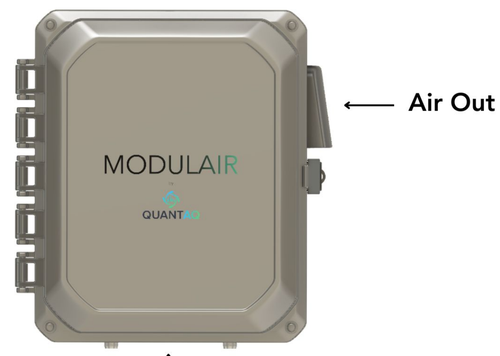
Summer 2026 - Spring 2026:
Post-Replacement Monitoring
Repeat monitoring and daily activity logs for comparison with the induction stove.

Fall 2026 - Summer 2027: Final Data Analysis & Reporting
Compare pre/post data analysis to use results to inform future policies programs and electrification initiatives.

* There are two multi-family housing developments within the study; this reflects the first one, and the second will have a similar structure with baseline monitoring in Fall 2025/Winter 2026

Field Methods

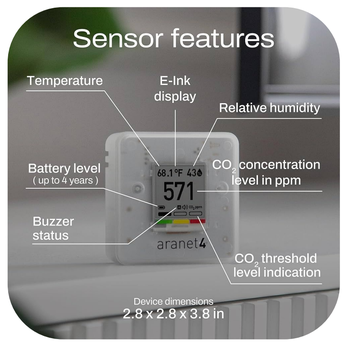
QuantAQ

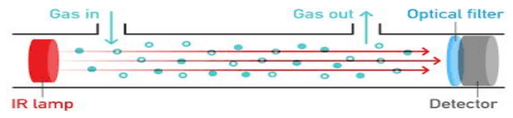


PM_1 $PM_{2.5}$ PM_{10} CO NO NO_2 O_3

- Portable monitor measuring **PM_1, $PM_{2.5}$, PM_{10}, CO, NO, NO_2, O_3**.
- Continuously monitors indoor air quality for 7 days in participant homes, along with outdoor reference monitor.
- Identifies pollutant spikes from cooking and other indoor source utilization, modified by ventilation patterns, before and after stove replacement.

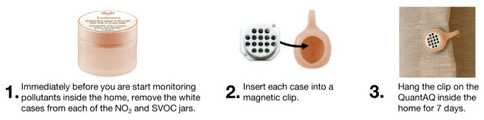
Aranet





- Portable monitor measuring **CO_2 (ppm)**, temperature, and humidity.
- Uses infrared sensing.
- Deployed in homes to track ventilation patterns, potential secondary indicator of stove usage.

Ogawa



- Passive air sampler for pollutants like **NO_2** and **SVOCs**.
- Small, lightweight design clips inside the home for integrated sampling,
- Placed inside and outside of homes for 7 days to collect pollutant samples alongside continuous air monitoring.

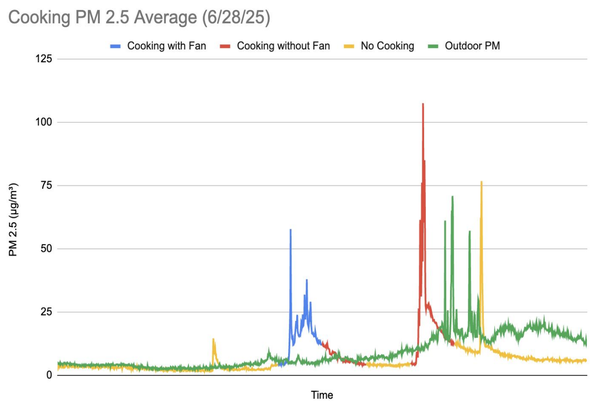
Participant Daily Activity Log

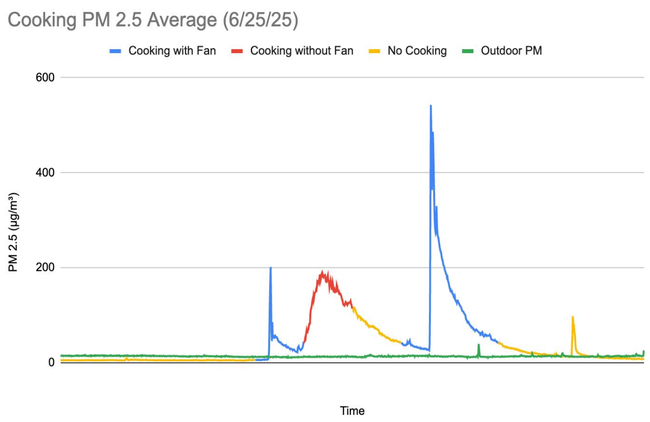
	6am-8am	8am-10am	10am-12pm	12pm-2pm	2pm-4pm	4pm-6pm	6pm-8pm	8pm-10pm	10pm-12am	12am-2am	2am- 4am	4am- 6am
Cooking using the **STOVE**	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?	How long did you cook? ____ min How did you cook?

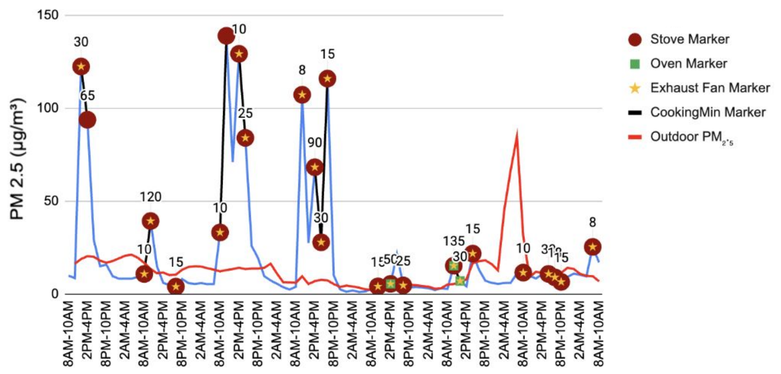
- Tracks participants' daily cooking habits, other indoor source use, and use of exhaust fans or open windows.
- Provides detailed, time-specific data to link pollutant levels with cooking and ventilation behaviors.

Descriptive Results

Participant 2







- Indoor $PM_{2.5}$ spikes are strongly linked to stove use with variations driven by cooking style, duration, and ventilation, while outdoor $PM_{2.5}$ remains consistently lower, confirming indoor sources as the primary driver.
- Cooking with the exhaust fan on sometimes has lower levels, consistent with increased ventilation, and sometimes has higher levels, potentially indicative of behavioral responses to smokier cooking styles.

Conclusions and Next Steps

- Initial findings reinforce the contribution of indoor sources to indoor $PM_{2.5}$ concentrations and the viability of field protocol with strong community partnerships.
- Pre-post study design will allow for evaluation of the air quality and health implications of gas stove replacements, isolating fuel type from cooking behaviors.

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