air partners

Olin College of Engineering

Community-driven Air Justice in Boston, MA

Scott Hersey + Francesca Majluf

Our Model

	01 Identify Stakeholder Priorities	02 Plan Project	03 Collect Data	04 Generate Insights	05 Create Artifacts	06 Leverage Artifacts	07 Conclude Project
GOALS	Find alignment and create trust Identify questions that need answering	Translate stakeholder priorities into a project plan that can answer key questions	Collect the right data to answer key questions	Analyze data to draw conclusions	Display and package insights to tell stories that support stakeholder priorities	Sharing artifacts to create change	Develop a plan to either sustain or end project
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Lessons Learned

Many challenges result from misaligned goals and expectations between community and academic partners

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Begin with the end in mind

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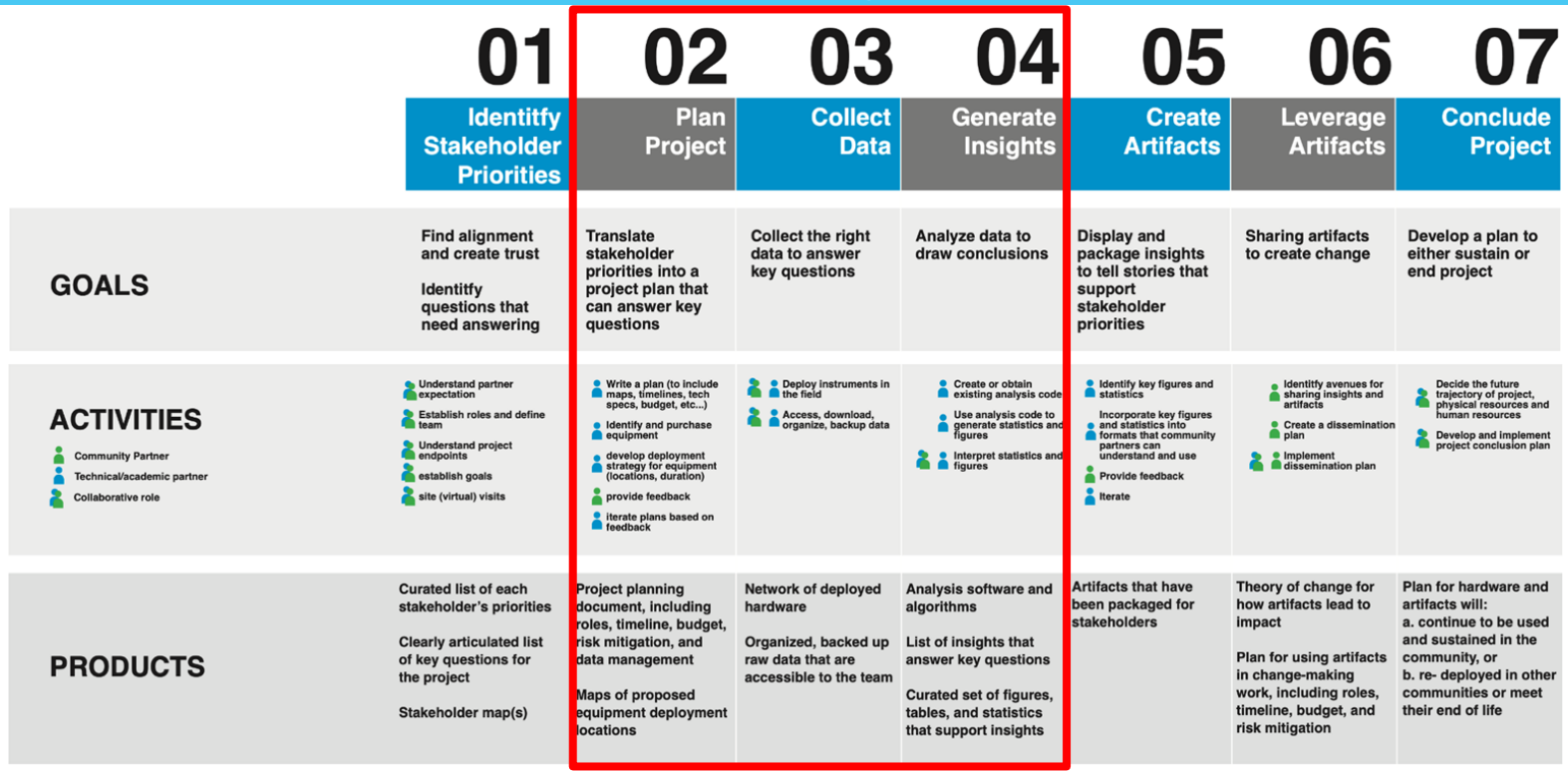
Problems often show up here

Many challenges result from misaligned goals and expectations between community and academic partners



Because community partners weren't meaningfully involved here

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Or because this never (sufficiently) happened

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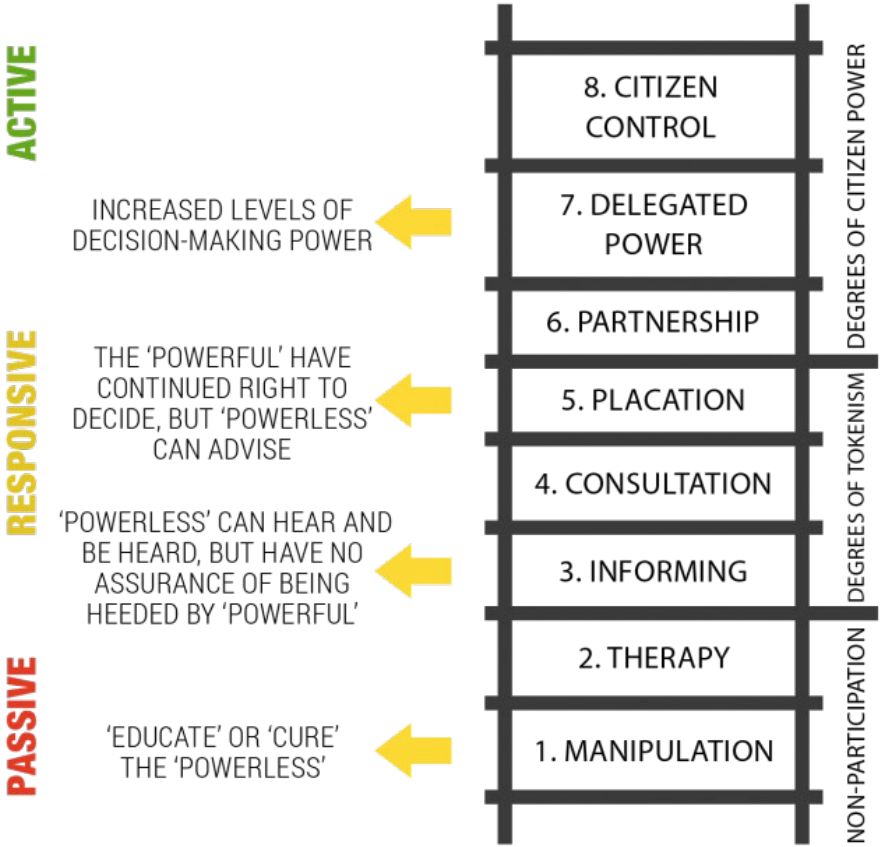
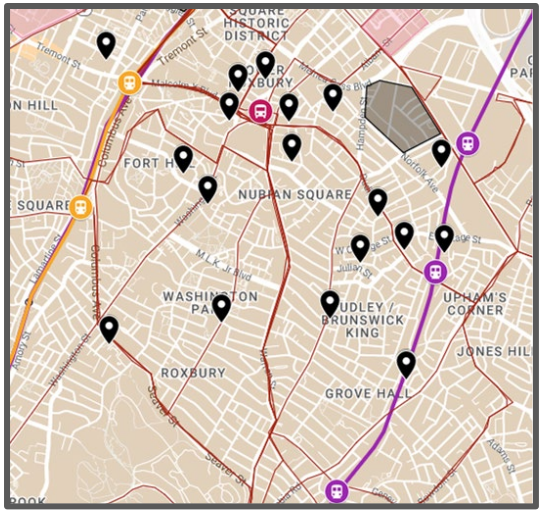
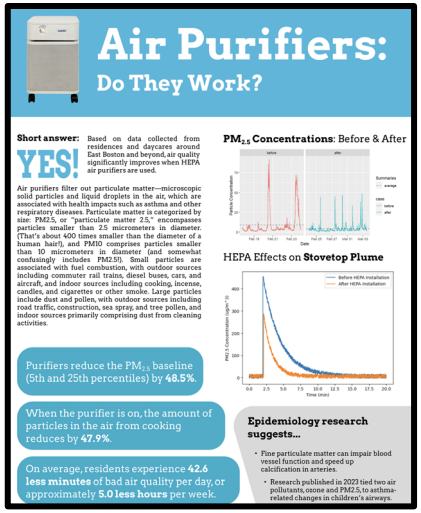


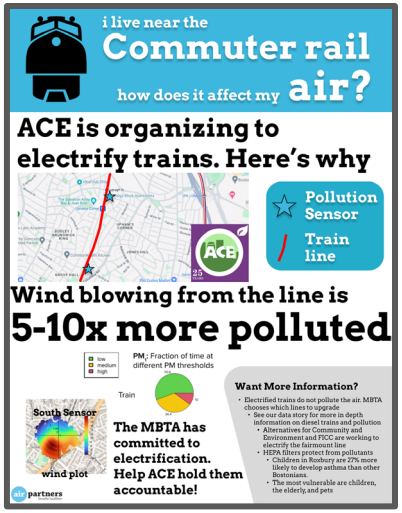
Increased responsibility
Increased accountability
Decreased control of outcomes
Decreased control of process

Simple stories hold the greatest potential for impact

Simple stories hold the greatest potential for impact







An Agile approach minimizes risk

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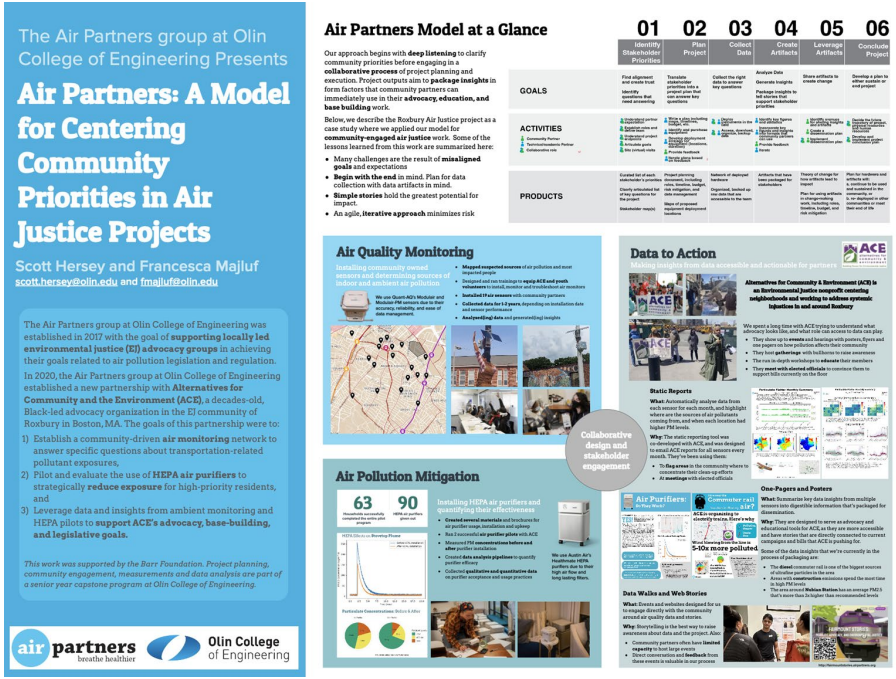
Do you have the right sensors?
Are they functioning?
Are they in the right places?
Are data being collected and managed as anticipated?
Are you getting the data you need?
Do the data help you answer key questions?
Do residents view sensors as a threat?
…

Poster Session this afternoon



The Air Partners group at Olin College of Engineering Presents

Air Partners: A Model for Centering Community Priorities in Air Justice Projects

Scott Hersey and Francesca Majluf
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The Air Partners group at Olin College of Engineering was established in 2017 with the goal of **supporting locally led environmental justice (EJ) advocacy groups** in achieving their goals related to air pollution legislation and regulation.

In 2020, the Air Partners group at Olin College of Engineering established a new partnership with **Alternatives for Community and the Environment (ACE)**, a decades-old, Black-led advocacy organization in the EJ community of Roxbury in Boston, MA. The goals of this partnership were to:

1) Establish a community-driven **air monitoring** network to answer specific questions about transportation-related pollutant exposures,
2) Pilot and evaluate the use of **HEPA air purifiers** to strategically **reduce exposure** for high-priority residents, and
3) Leverage data and insights from ambient monitoring and HEPA pilots to **support ACE's advocacy, base-building, and legislative goals.**

This work was supported by the Barr Foundation. Project planning, community engagement, measurements and data analysis are part of a senior year capstone program at Olin College of Engineering.

air partners breathe healthier — Olin College of Engineering

Air Partners Model at a Glance

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ACTIVITIES	Share project partner goals Establish goals Articulate goals Mix (virtual) visits	Share 4 data tracking methods Identify and purchase tools Develop deployment plan Provide feedback Co-develop a project timeline	Deploy Collect data Analyze data Share insights	Identify Key Teams Generate insights Communicate data Share insights Provide feedback Iterate	Develop artifacts to share insights Share artifacts Implement plan	Decide the if/how/when to end project Develop and implement transition plan
PRODUCTS	Curated list of each stakeholder's priorities Clearly articulated list of goals/questions for the project Stakeholder map(s)	Project planning documents (timeline, roles, timeline, budget, risk mitigation, and data management) Maps of proposed deployment locations	Network of deployed hardware Organized, backed up data that is accessible to the team	Artifacts that have been developed for stakeholders	Visions of change for how artifacts lead to impact Plan for using artifacts in change-making work, including roles, timeline, budget, and risk mitigation	Plan for hardware and artifacts will a. continue to be used and maintained in the future, b. be displayed in other communities or meet their end of life

Below, we describe the Roxbury Air Justice project as a case study where we applied our model for community-engaged air justice work. Some of the lessons learned from this work are summarized here:

- Many challenges are the result of **misaligned goals** and expectations
- **Begin with the end** in mind. Plan for data collection with data artifacts in mind.
- **Simple stories** hold the greatest potential for impact.
- An agile, **iterative approach** minimizes risk

Air Quality Monitoring

Installing community owned sensors and determining sources of indoor and ambient air pollution

- **Mapped suspected sources** of air pollution and most impacted people
- Designed and ran trainings to **equip ACE and youth volunteers** to install, monitor and troubleshoot air monitors
- **Installed 19 air sensors** with community partners
- **Collected data for 1-2 years**, depending on installation date and sensor performance
- **Analyzed[map] data** and generated[ing] insights

We use Quant-AQ's Modulair and Modulair-PM sensors due to their accuracy, reliability, and ease of data management.

Data to Action

Making insights from data accessible and actionable for partners

Alternatives for Community & Environment (ACE) is an Environmental Justice nonprofit centering neighborhoods and working to address systemic injustices in and around Roxbury

We spent a long time with ACE trying to understand what advocacy looks like, and what role can access to data can play.

- They show up to **events** and hearings with posters, flyers and use papers on how pollution affects their community
- They host **gatherings** with ballrooms to raise awareness
- The run in-depth workshops to **educate** their members
- They **meet with elected officials** to convince them to support bills currently on the floor

Static Reports

What: Automatically analyze data from each sensor for each month, and highlight where are the sources of air pollutants coming from, and where each location had higher PM levels.

Why: The static reporting tool was co-developed with ACE, and was designed to email ACE reports for all sensors every month. They've been using them:

- To **flag areas** in the community where to concentrate their clean-up efforts
- **At meetings** with elected officials

One-Pagers and Posters

What: Summarize key data insights from multiple sensors into digestible information that's packaged for dissemination.

Why: They are designed to serve as advocacy and educational tools for ACE, as they are more accessible and have stories that are directly connected to current campaigns and bills that ACE is pushing for.

Some of the data insights that we're currently in the process of packaging are:

- The **diesel** commuter rail is one of the biggest sources of PM2.5 pollution in Roxbury
- Areas with **construction** emissions spread the most time in high PM levels
- The area around **Ruggles Station** has an average PM2.5 that's more than 2x higher than recommended levels

Data Walks and Web Stories

What: Events and websites designed for us to engage directly with the community around air quality data and stories.

Why: Storytelling is the best way to raise awareness about data and the project. Also:

- Community partners often have **limited capacity** to host large events
- Direct conversations and **feedback** from these events is valuable to our process

Air Pollution Mitigation

63 Households successfully completed the entire pilot

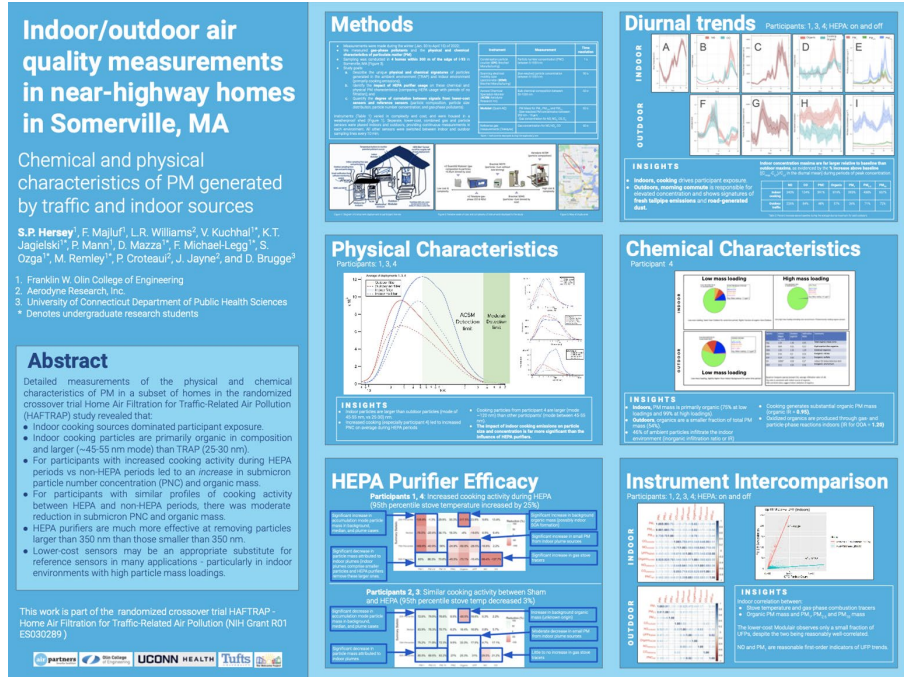
90 HEPA air purifiers given out

Installing HEPA air purifiers and quantifying their effectiveness

- **Created several materials** and brochures for air purifier usage, installation and upkeep
- Has 2 successful **air purifier pilots** with ACE
- Measured PM **concentrations before and after** purifier installation
- Created **data analysis pipeline** to quantify purifier efficacy
- Collected **qualitative and quantitative data** on purifier acceptance and usage practices

We use Austin Air's Healthmate HEPA purifiers due to their quiet, long-lasting filters.

Collaborative design and stakeholder engagement



Indoor/outdoor air quality measurements in near-highway homes in Somerville, MA

Chemical and physical characteristics of PM generated by traffic and indoor sources

S.P. Hersey[1], F. Majluf[1], L.R. Williams[2], V. Kuchhal[1*], K.T. Jagielski[1*], P. Mann[1], D. Mazza[1*], F. Michael-Legg[1*], S. Ozga[1*], M. Remley[1*], P. Croteau[2], J. Jayne[2], and D. Brugge[3]

1. Franklin W. Olin College of Engineering
2. Aerodyne Research, Inc.
3. University of Connecticut Department of Public Health Sciences
* Denotes undergraduate research students

Abstract

Detailed measurements of the physical and chemical characteristics of PM in a subset of homes in the randomized crossover trial Home Air Filtration for Traffic-Related Air Pollution (HAFTRAP) study revealed that:

- Indoor cooking sources dominated participant exposure.
- Indoor cooking particles are primarily organic in composition and larger (~45-55 nm mode) than TRAP (25-30 nm).
- For participants with increased cooking activity during HEPA periods vs non-HEPA periods led to an *increase* in submicron particle number concentration (PNC) and organic mass.
- For participants with similar profiles of cooking activity between HEPA and non-HEPA periods, there was moderate reduction in submicron PNC and organic mass.
- HEPA purifiers are much more effective at removing particles larger than 350 nm than those smaller than 350 nm.
- Lower-cost sensors may be an appropriate substitute for reference sensors in many applications - particularly in indoor environments with high particle mass loadings.

This work is part of the randomized crossover trial HAFTRAP - Home Air Filtration for Traffic-Related Air Pollution (NIH Grant R01 ES030289)

Methods

Diurnal trends

Participants: 1, 3, 4; HEPA: on and off

INDOOR / OUTDOOR

INSIGHTS

- **Indoors, cooking** drives participant exposure.
- **Outdoors, morning commute** is responsible for elevated concentration and shows signatures of **fresh tailpipe emissions** and **road-generated dust**.

Physical Characteristics

Participants: 1, 3, 4

INSIGHTS

- **Indoors,** PM mass is primarily organic (75% at low loadings and 90% at high loadings).
- **Outdoors,** organics are a smaller fraction of total PM mass.
- 46% of ambient particles infiltrate the indoor environment (in-organic infiltration ratio of 0)
- Cooking particles from participant 4 are larger (mode ~125 nm) than other participants' (mode between 45-55 nm).
- The impact of indoor cooking particles on particle size and concentration is far more significant than the influence of HEPA purifiers.
- Cooking generates substantial organic PM mass (organic fr. > 0.95).
- Oxidized organics are produced through gas- and particle-phase reactions indoors (R for OOA = 1.00)

Chemical Characteristics

Participant: 4

Low mass loading / High mass loading

INDOOR / OUTDOOR

INSIGHTS

HEPA Purifier Efficacy

Participants 1, 4: Increased cooking activity during HEPA (95th percentile stove temperature increased by 25%)

Participants 2, 3: Similar cooking activity between Sham and HEPA (95th percentile stove temp decreased 3%)

Instrument Intercomparison

Participants: 1, 2, 3, 4; HEPA: on and off

INDOOR / OUTDOOR

INSIGHTS

Indoor correlation between:

- Stove temperature and gas phase combustion tracers
- Organic PM mass and PM_{1}, $PM_{2.5}$ and PM_{10} mass

The lower-cost MicroAeth observes only a small fraction of UFPs, despite the two being reasonably well-correlated.

NO and PM_{1} are reasonable first-order indicators of UFP trends.

Poster 34

Poster 36