

Airproofing: piloting a strategy for improving air health in East Boston



Olin College
of Engineering



QUANTAQ



Aerodyne Research

AIRInc

MOTHERS OUT FRONT
MOBILIZING FOR A LIVABLE CLIMATE



OUTLINE



What's the problem? **How are we testing it?**
What's the solution? **What do we need?**

OUTLINE



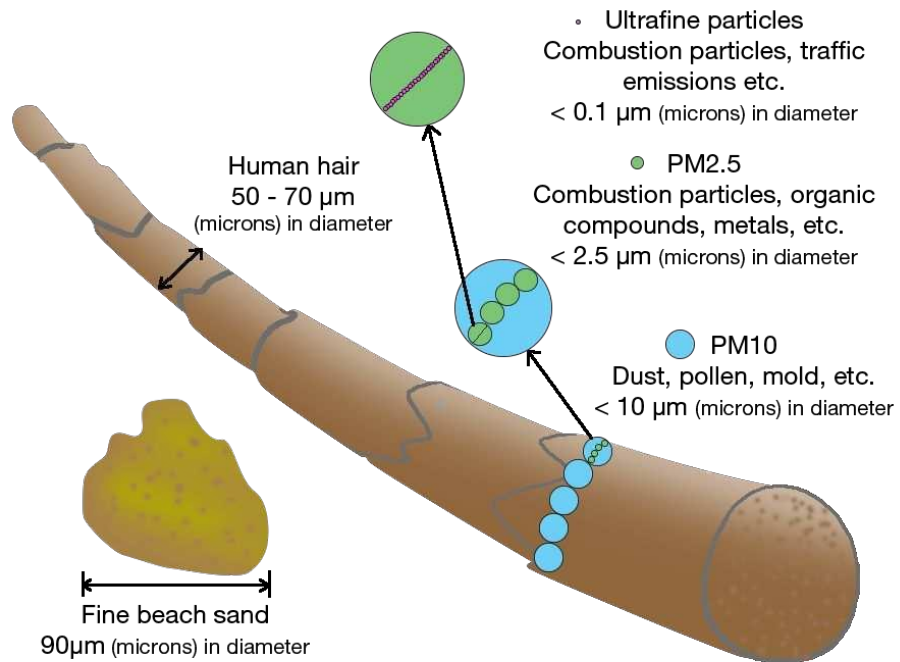
What's the problem?

What's the solution?

How are we testing it?

What do we need?

ULTRAFINE PARTICLES (UFPs)

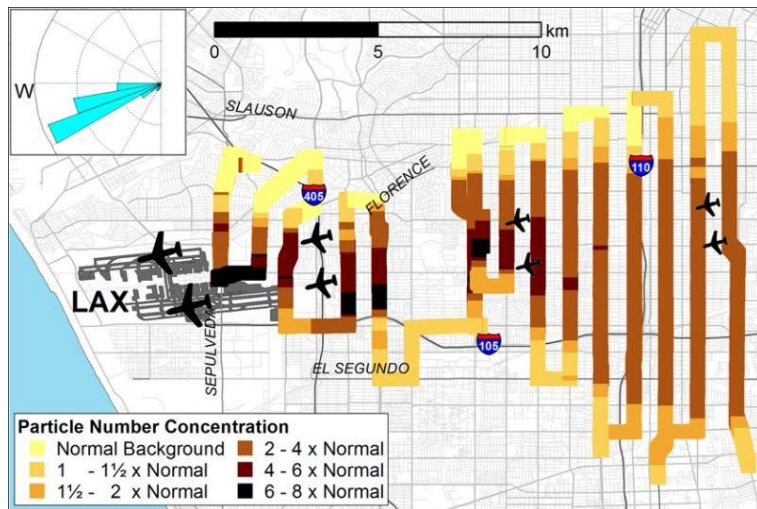


Associations

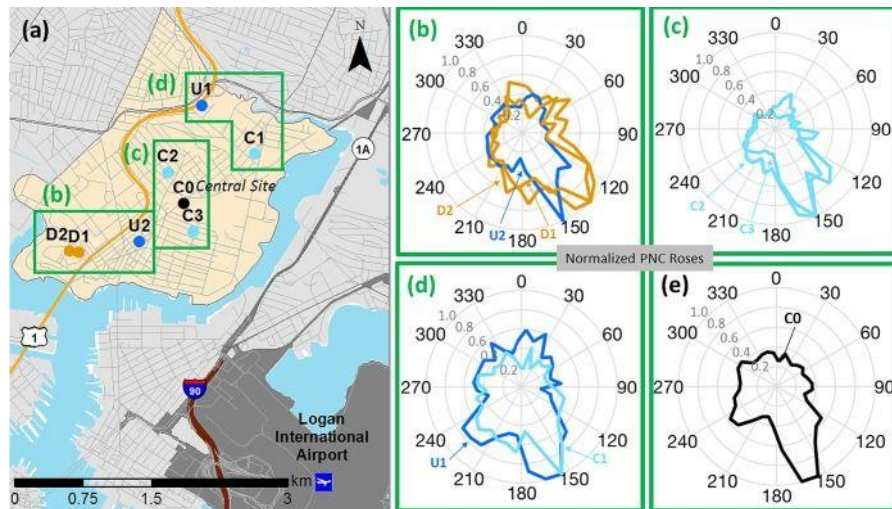
- Cardiovascular disease
- Asthma
- COPD
- Neurological disorders
- Lowered IQ and school performance
- Autism
- Early onset Alzheimer's

AIRPORTS MAKE UFPs (LOTS OF THEM)

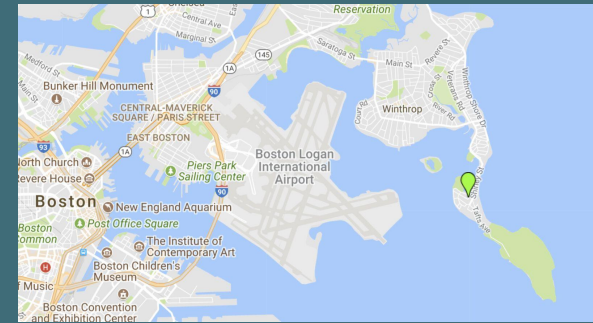
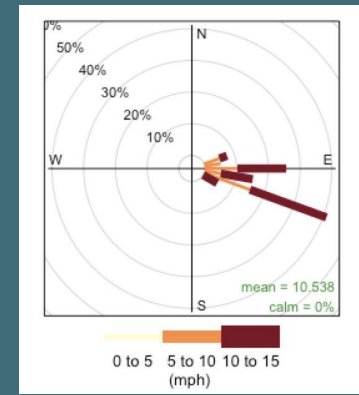
2014 (Hudda et al; LAX)



2018 (Hudda et al; BOS)



1. UFP concentrations are 2-4x background at 15 mi downwind
2. > 70% of Logan UFPs enter area homes



Friday, 01-Sep-2017 3:03 pm

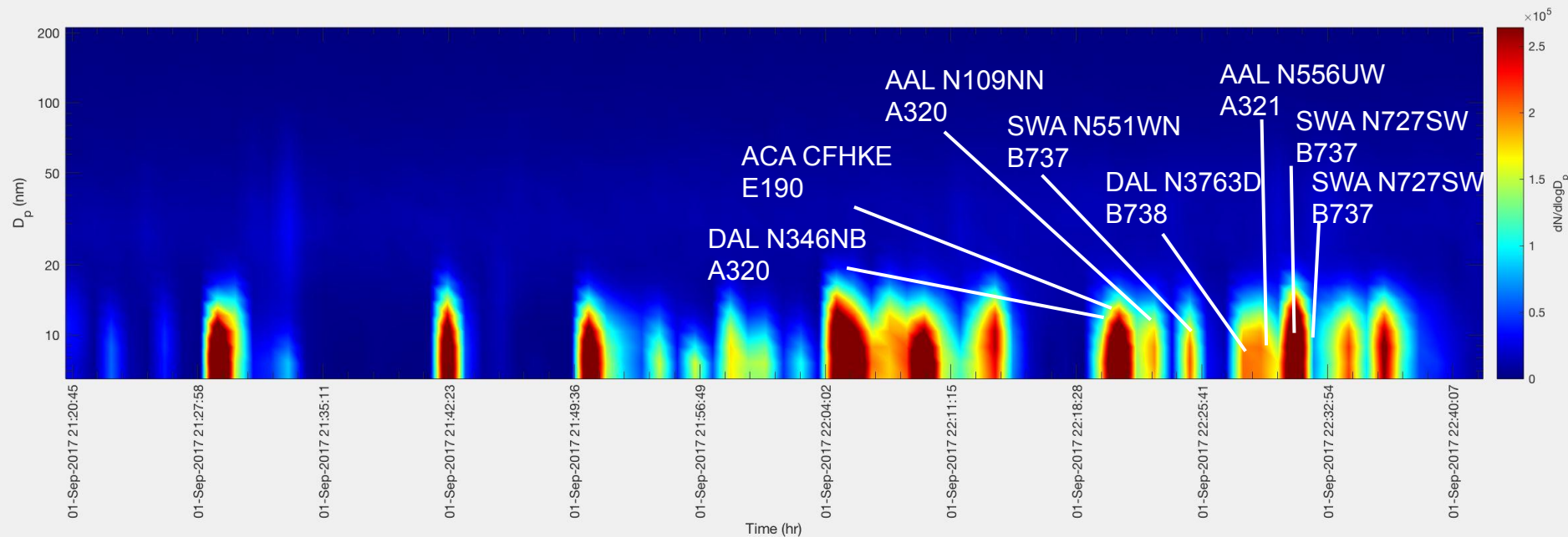
JetBlue N712JB (A320)

KTPA-KBOS

183 ft altitude

142 kt

1-hour living in East Boston



AIRPROOFING



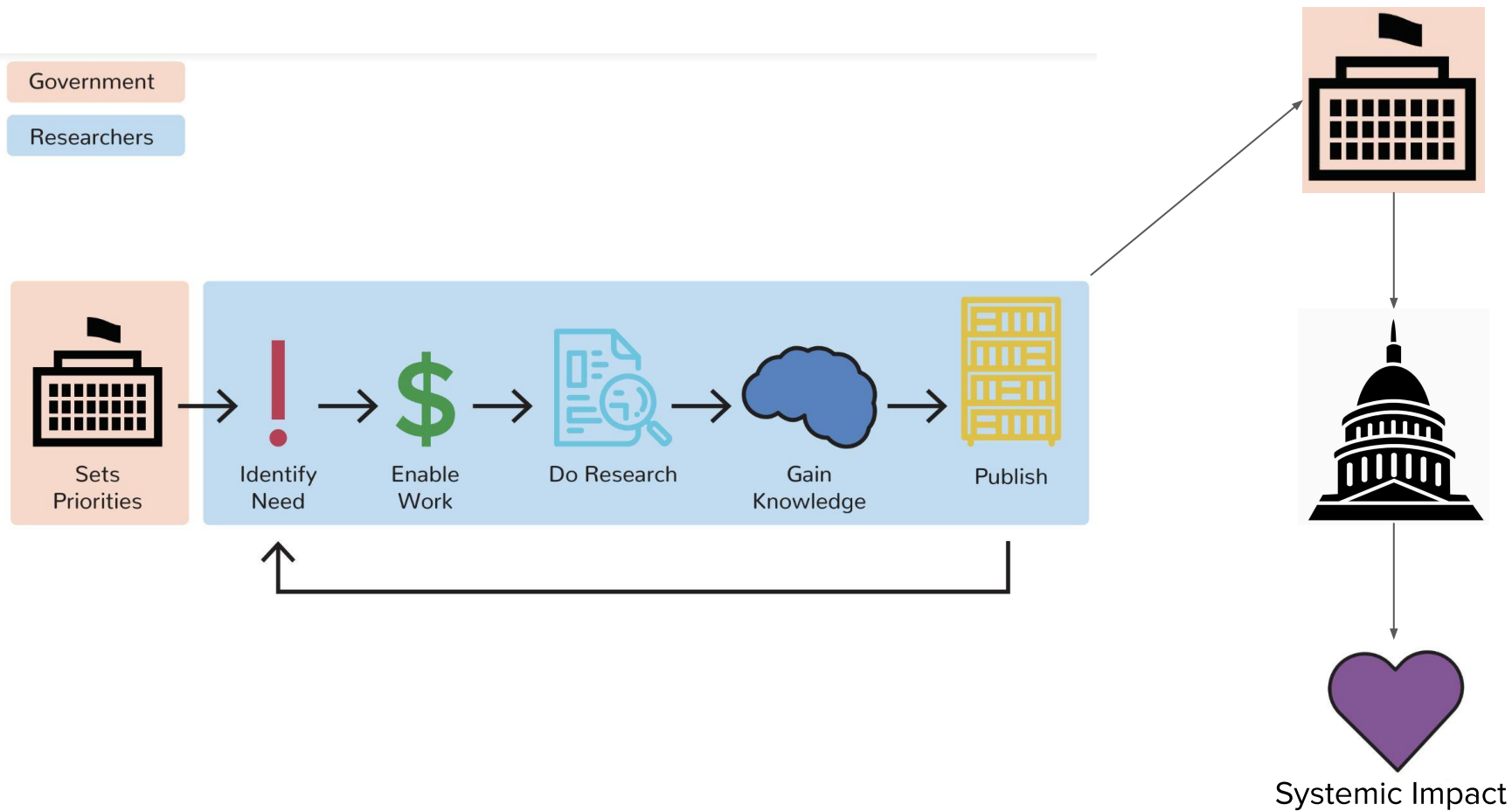
What's the problem?

What's the solution?

How are we testing it?

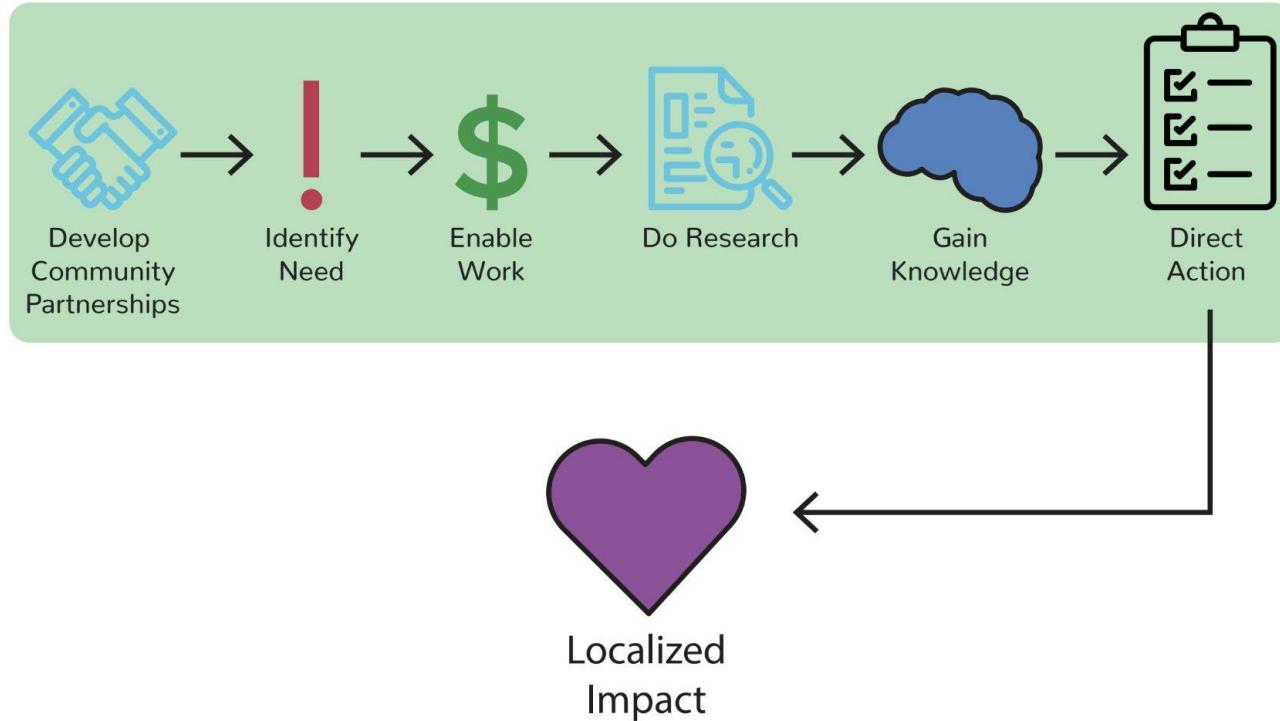
What do we need?

SOLUTIONS: SYSTEMIC



SOLUTIONS: LOCALIZED

Researchers &
Communities



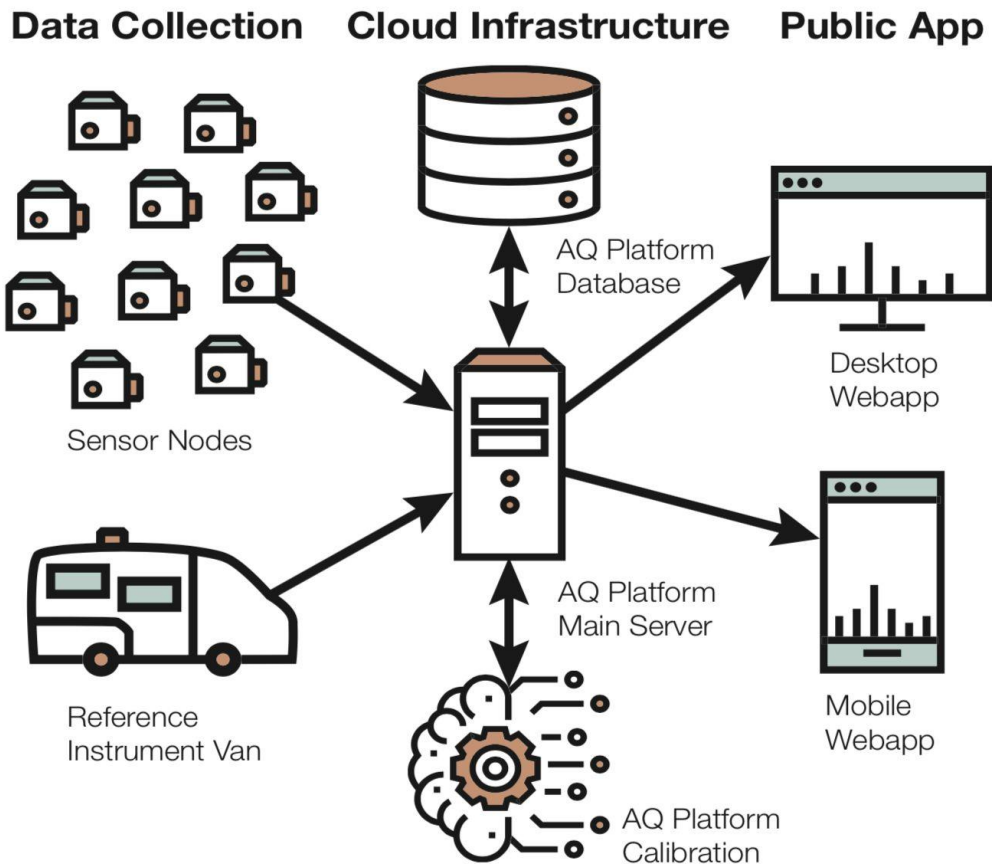
**“Help us get access to
the tools we need to
reduce our exposure.”**

[democratized data + HEPA air purifiers]

AIR QUALITY MONITORING NETWORK



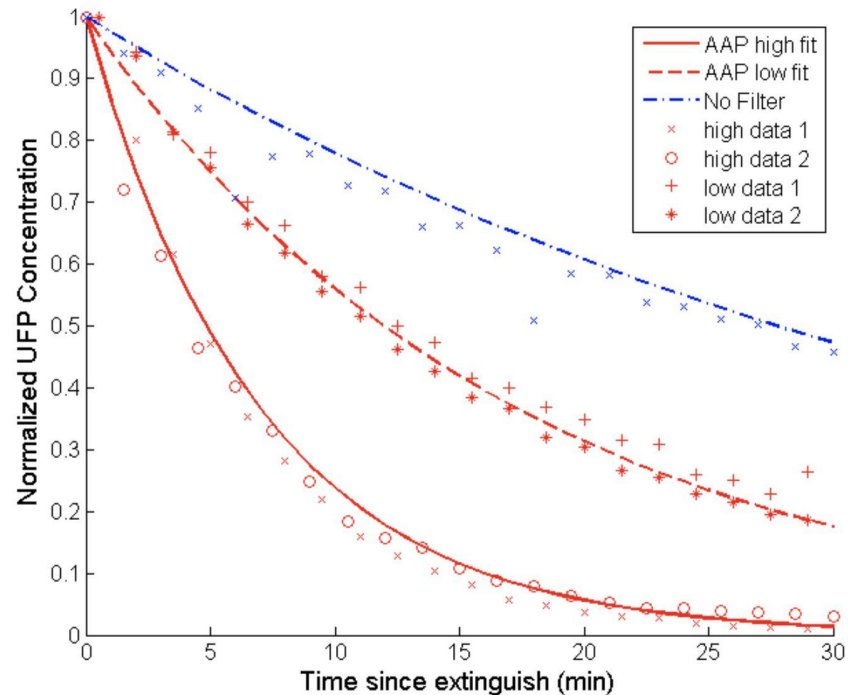
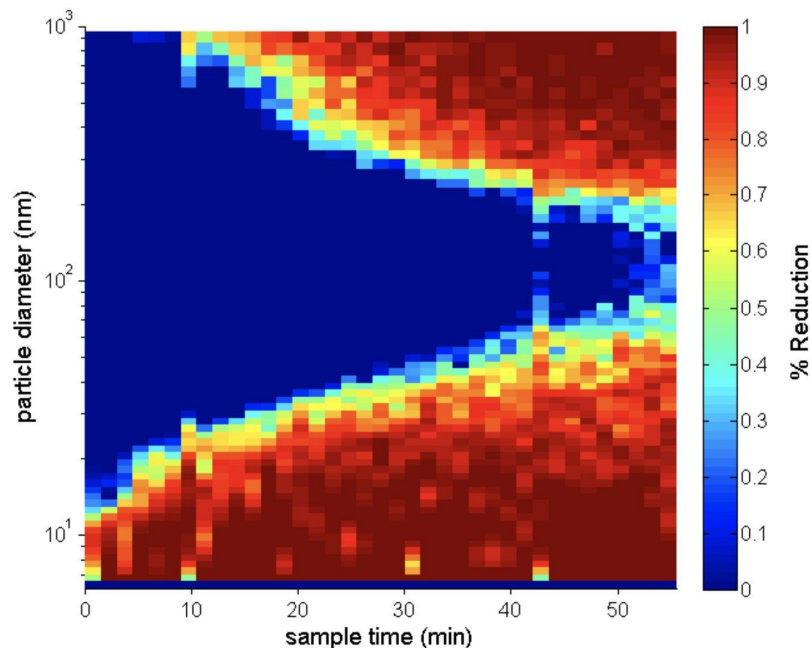
OUR NETWORK ARCHITECTURE



HEPA AIR PURIFIERS

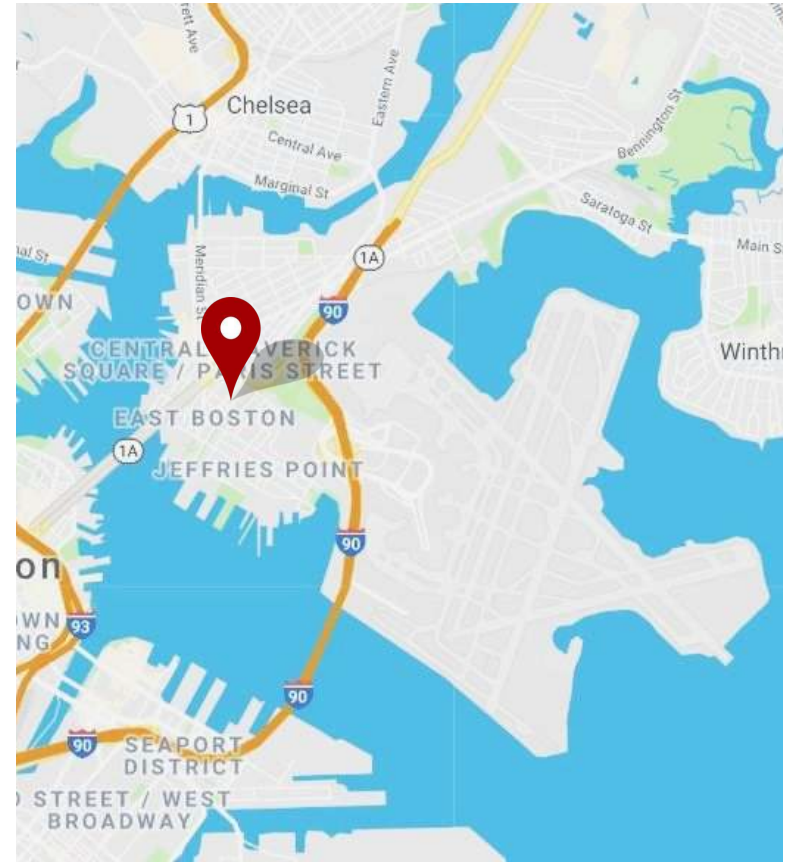


HEPA AIR PURIFIERS

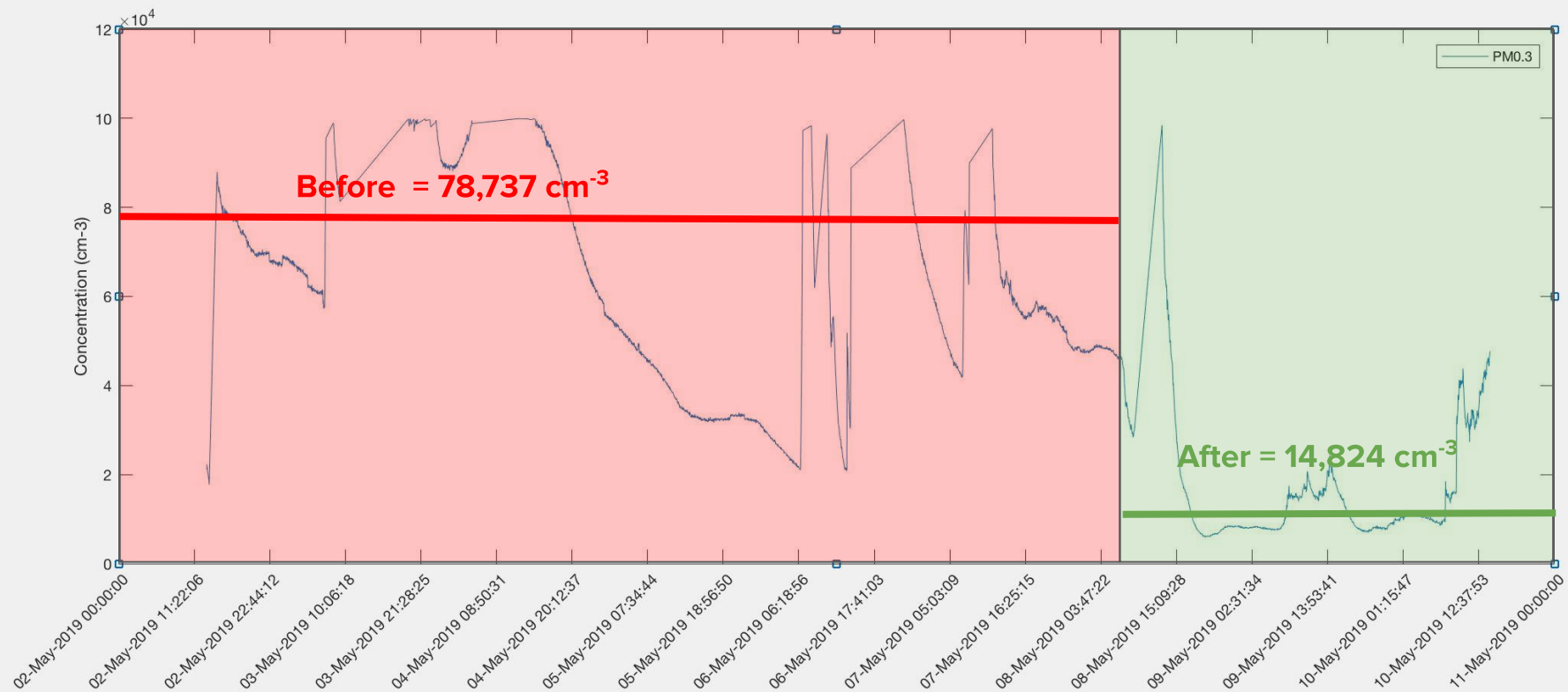


HEPA Filters remove UFPs (and larger particles) effectively and rapidly

DANTE ALIGHIERI MONTESSORI SCHOOL

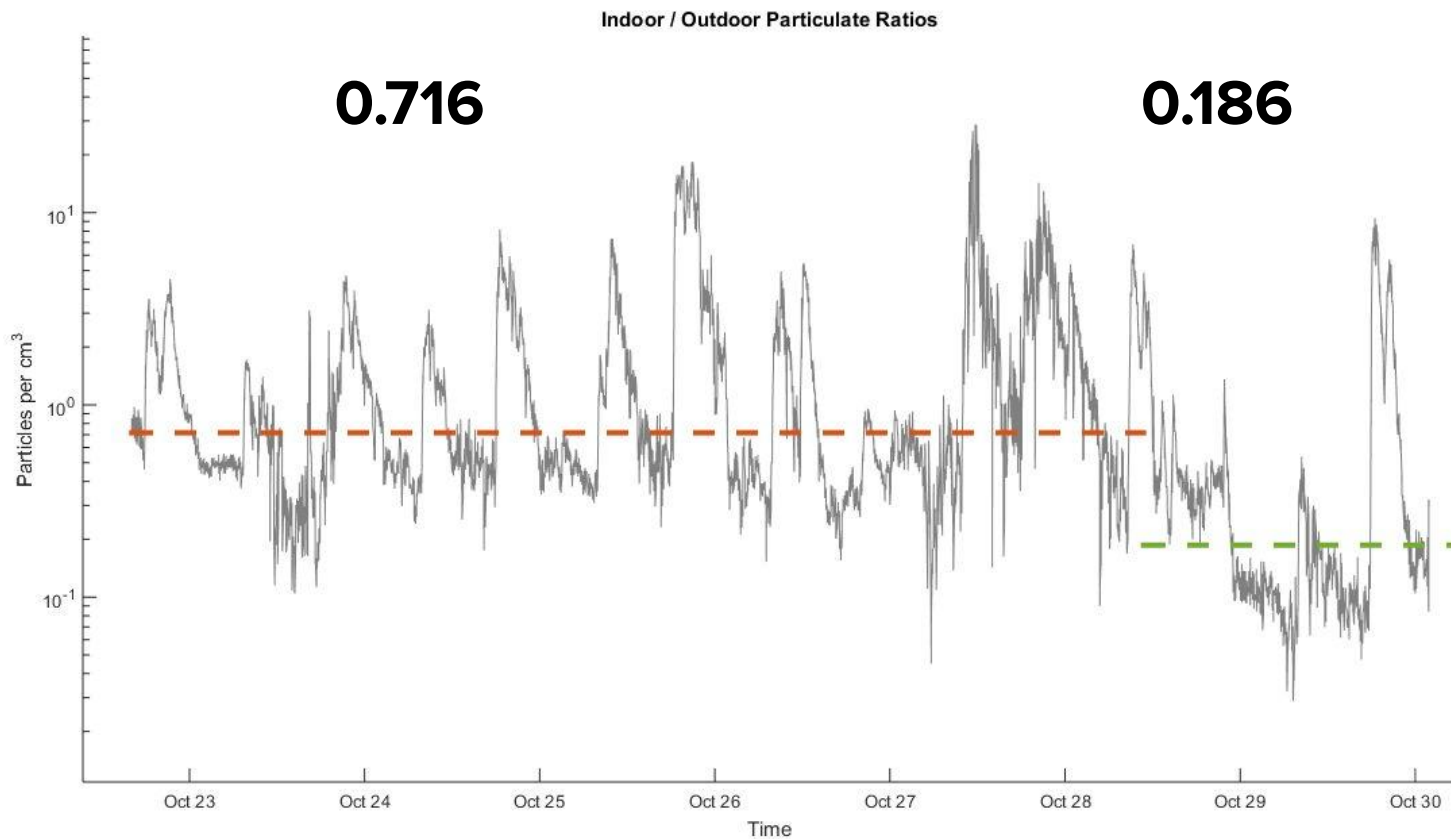


DANTE ALIGHIERI MONTESSORI SCHOOL



INTERVENTION TEST RESULTS

INDOOR/OUTDOOR PARTICULATE RATIOS



75-82%

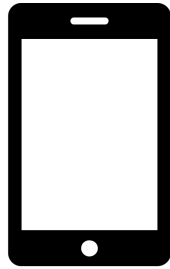
Reduction in <300 nm particle concentration



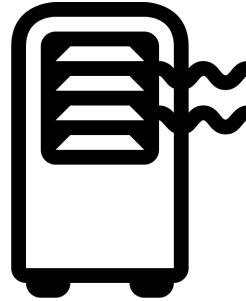
IN-HOME TESTS



AIRPROOFING



**Actionable
Air Quality Data**



**HEPA Air
Purifiers**

That's generally the end; what follows is a specific list of “asks” that is tailored for the particular elected official we're meeting with.

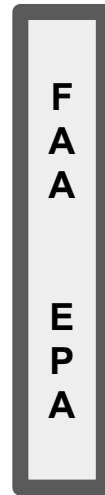
Engage with Massport: **mitigation = airproofing (now!)**

Engage with Massport: mitigation = airproofing

Erode the FAA/EPA wall

- EPA needs to establish UFP standards
- FAA should publish UFP guidelines

Massport
Airlines



UFP mitigation
for impacted
communities

Engage with Massport: mitigation = airproofing

Erode the FAA/EPA wall

- EPA needs to establish UFP standards
- FAA should publish UFP guidelines

Enable (force?) near-airport health and intervention studies

Engage with Massport: mitigation = airproofing

Erode the FAA/EPA wall

- EPA needs to establish UFP standards
- FAA should publish UFP guidelines

Near-airport health and intervention studies

Fund airproofing pilots and adoption

Thank you



Olin College
of Engineering



QUANTAQ



Aerodyne Research

AIRInc

MOTHERS OUT FRONT
MOBILIZING FOR A LIVABLE CLIMATE



References:

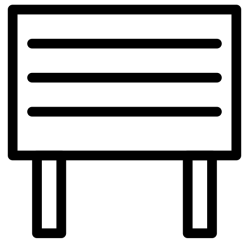
Invite icon by Adrien Coquet from the Noun Project

EAST BOSTON



SOLUTION: AIRPROOFING

AWARENESS CAMPAIGN



**Poster
Campaign**

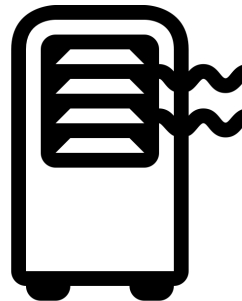


**Public
Art**



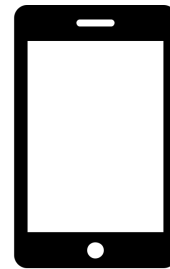
**Website
airpartners.org**

SUBSIDY PROGRAM



**HEPA Air
Purifiers**

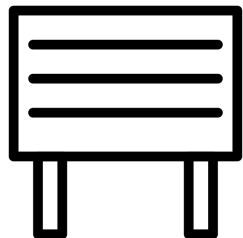
APP DEVELOPMENT



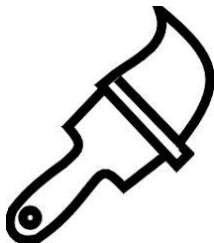
**Air quality
monitoring app**

SOLUTION: AIRPROOFING

AWARENESS CAMPAIGN



Poster
Campaign



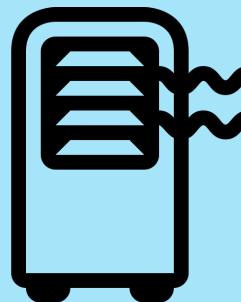
Public
Art



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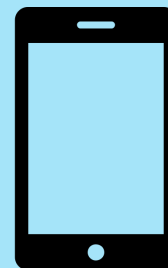
AIRPROOFING

SUBSIDY PROGRAM



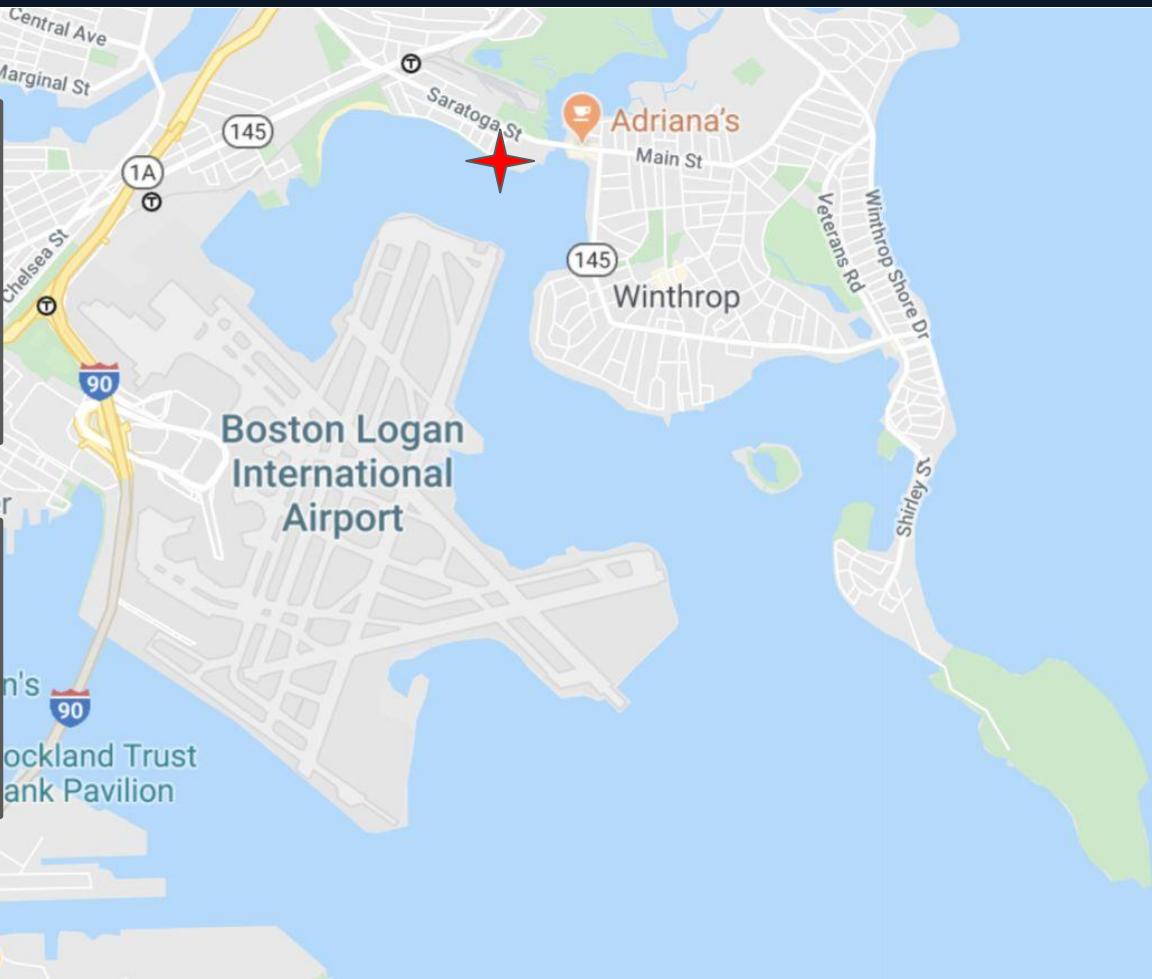
HEPA Air
Purifiers

APP DEVELOPMENT

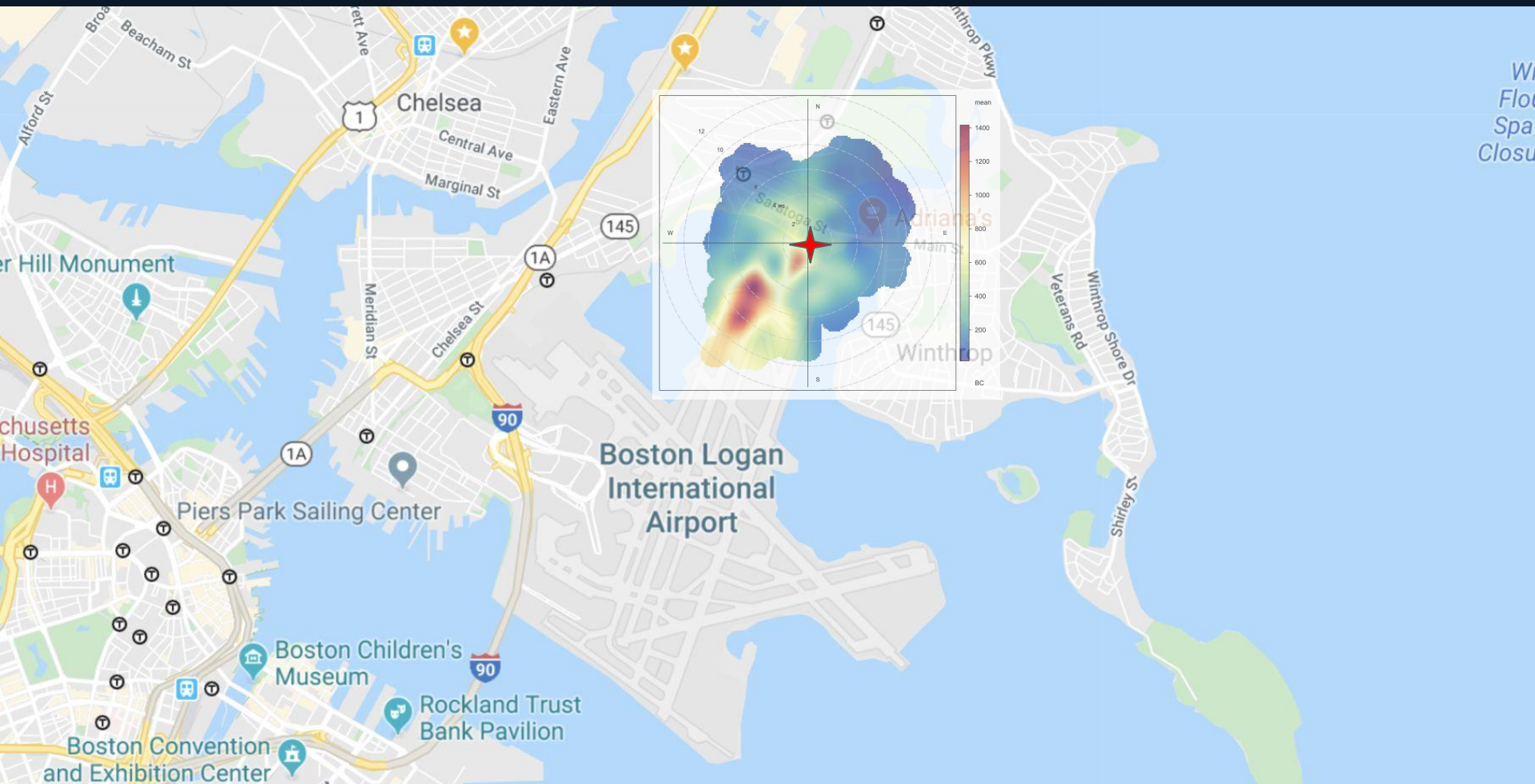


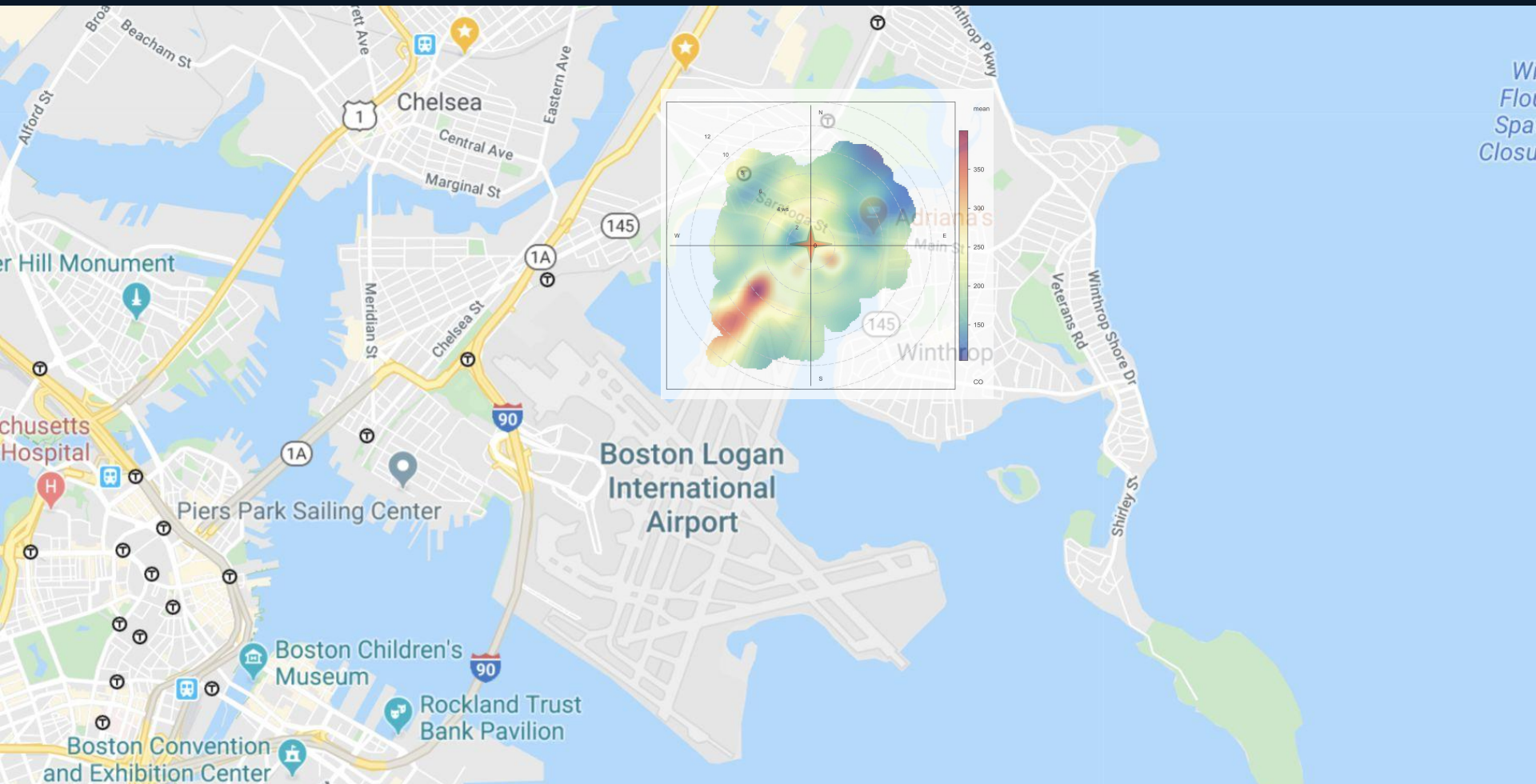
Air quality
monitoring network
and app

AIR QUALITY MONITORING NETWORK

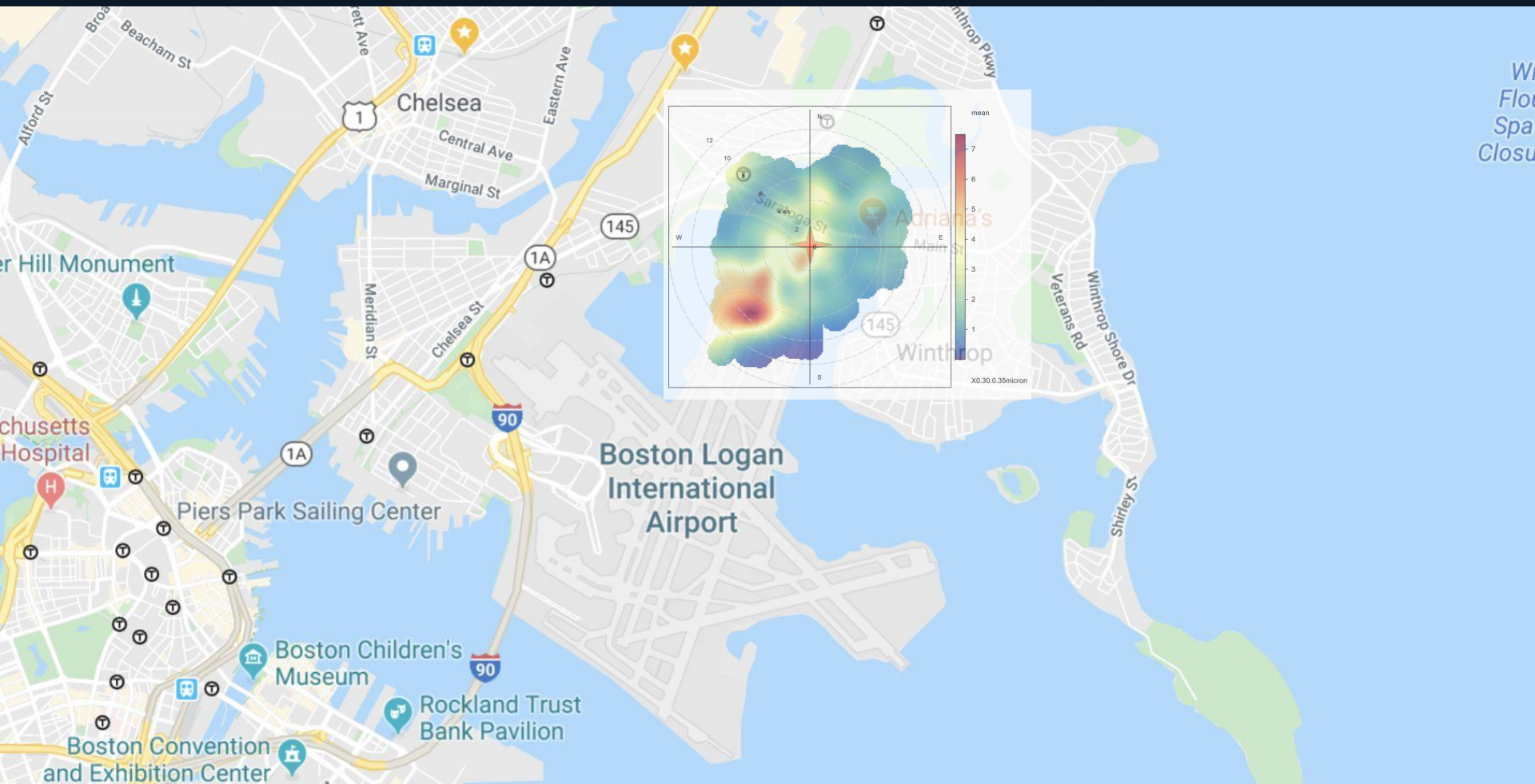


BLACK CARBON





300-350 nm PARTICLES





WHAT ARE UFPs?

- 1 UFPs (Ultra Fine Particles) are incredibly small particles: 3,000 UFPs can fit in the period at the end of this sentence.
- 2 Because of their size, UFPs can get into the bloodstream and travel to other parts of your body, damaging organs like your heart and brain.
- 3 UFPs come from combustion, for example, planes, cars, and busses burning fuel. Even burning candles or cooking on high heat in your home can produce UFPs.

WHAT ARE THE HEALTH EFFECTS?

Children in East Boston are 3-4x more likely to experience symptoms of asthma due to air pollution.

Studies indicate a strong correlation between UFP exposure and respiratory and cardiovascular disease.

Children who are exposed to UFPs, including black carbon, are linked to lower academic performance.

WHAT CAN I DO TO PROTECT MYSELF?



Get a HEPA filter. HEPA-rated filters are the only filters that can effectively filter out UFPs.



Circulate the air in your car when on the highway.



Close the windows and doors of your house at times of high traffic.

POSTERS + BUS STOPS

**STUDENTS CAN'T BE STUDENTS
IF THEY'RE BREATHING UFPs**

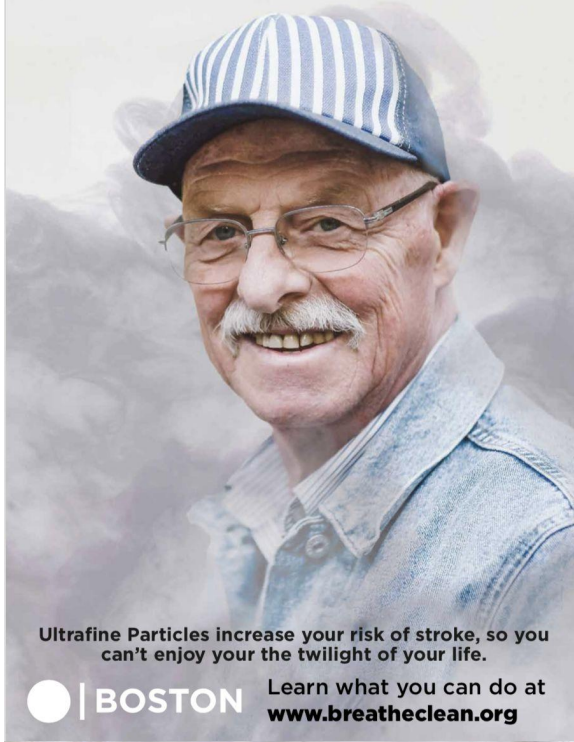


Ultrafine Particles decrease academic performance and IQ, so you can't focus on your studies.



Learn what you can do at
www.breatheclean.org

**POPOPS CAN'T BE POPOPS
IF THEY'RE BREATHING UFPs**

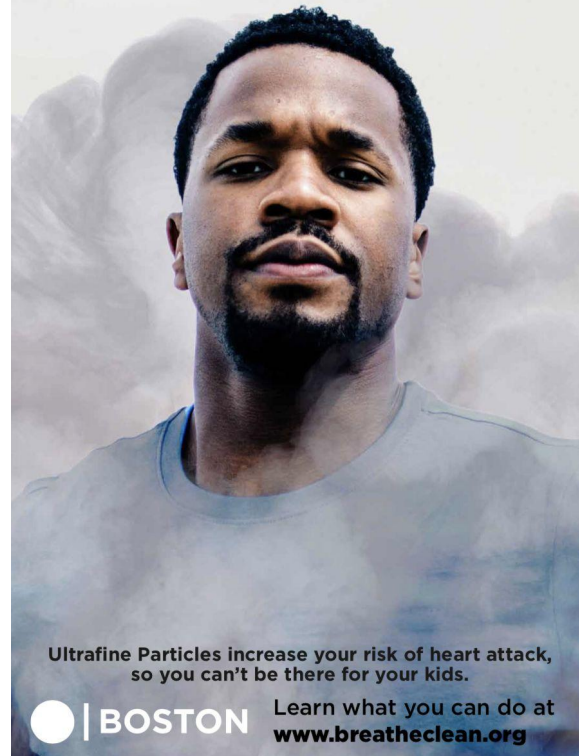


Ultrafine Particles increase your risk of stroke, so you can't enjoy your the twilight of your life.



Learn what you can do at
www.breatheclean.org

**DADS CAN'T BE DADS
IF THEY'RE BREATHING UFPs**

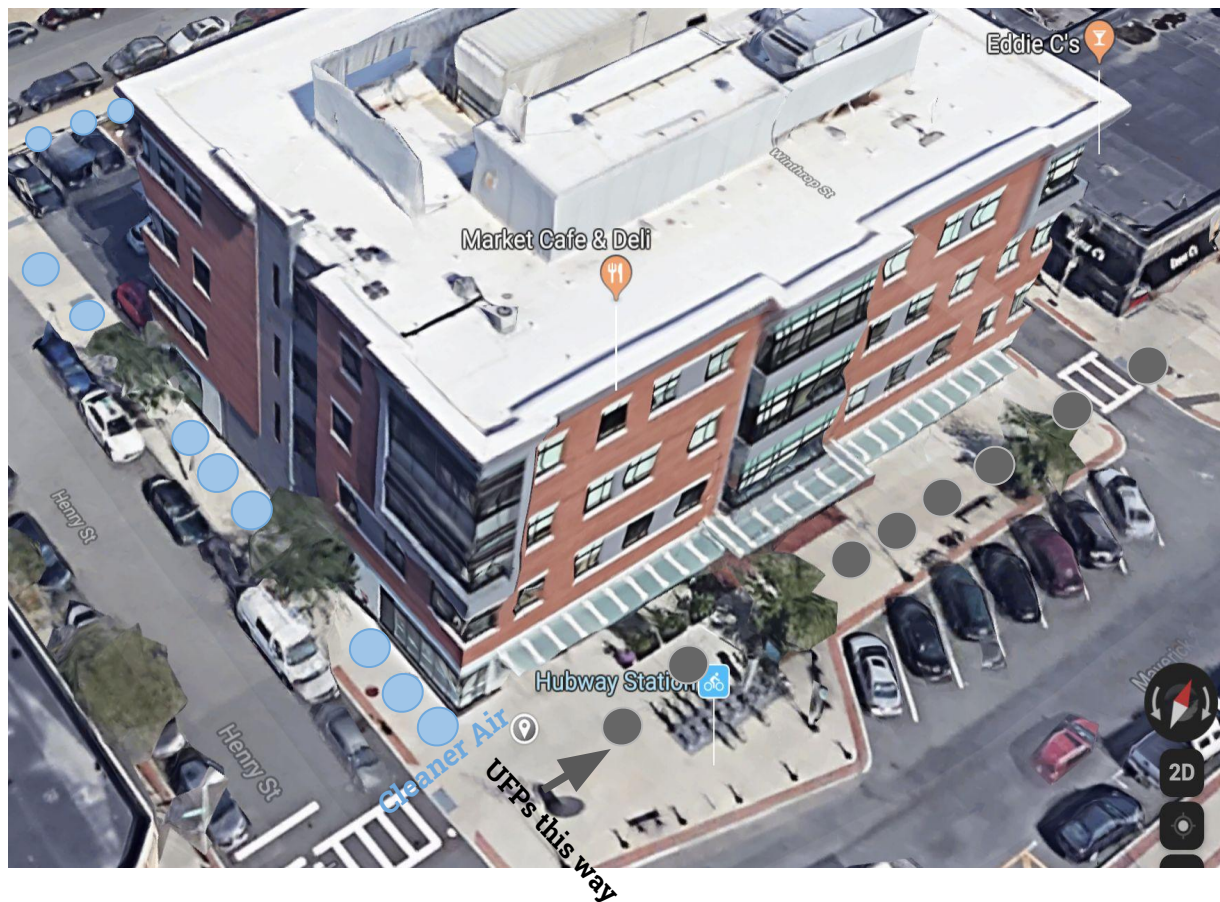


Ultrafine Particles increase your risk of heart attack, so you can't be there for your kids.



Learn what you can do at
www.breatheclean.org

PUBLIC ART: CLEAN AIR PATH



There are 54% fewer particles here than on Maverick St.

A HEPA filter in your home can reduce UFP concentration by 82%

Right now you're avoiding cars and busses, which means you're breathing fewer UFPs

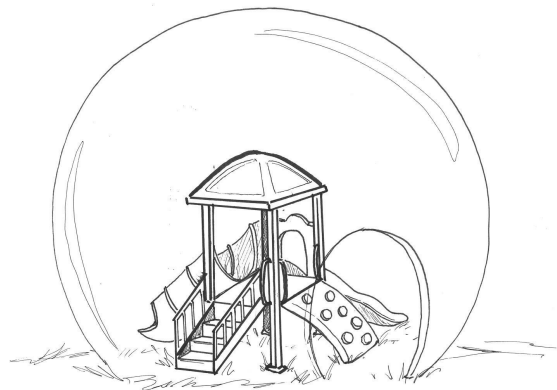
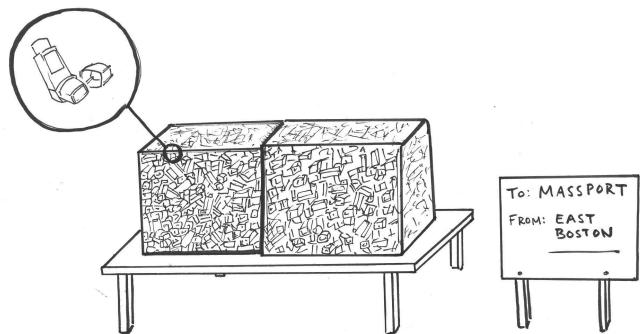
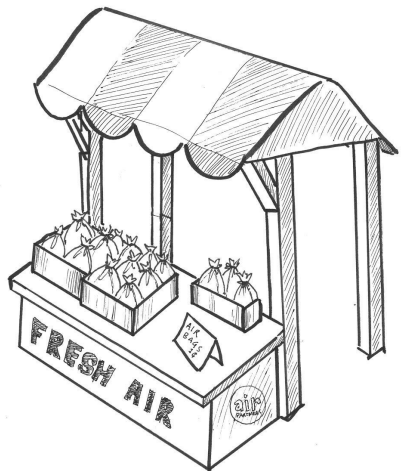
Ultrafine particles (UFPs) are emitted by fuel combustion in cars and airplanes

UFPs are associated with cardiovascular disease, asthma, and lower IQ and test scores

Ultrafine particles (UFPs) are emitted by fuel combustion in cars and airplanes

You breathed over 1 billion UFPs since the last bubble

PUBLIC ART



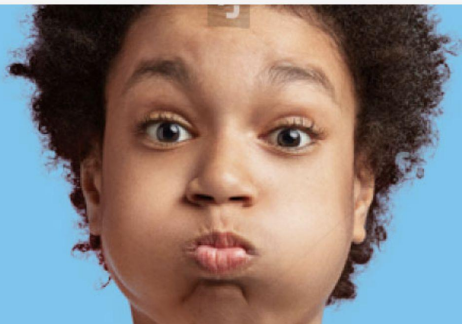
WEBSITE AND AQ APP

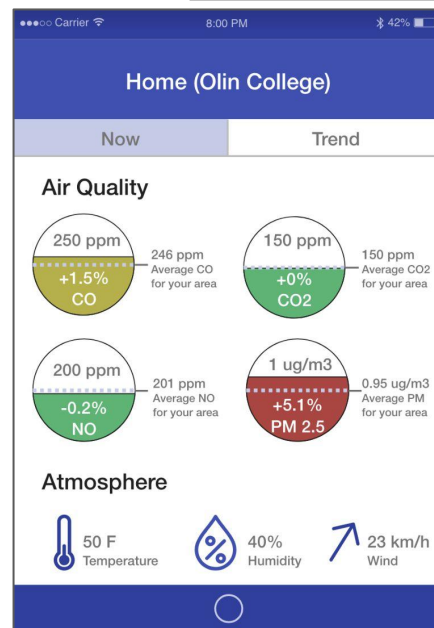
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HEADS UP!

You're breathing in a lot of UFPs right now.

UFPs are a type air pollution so small that more than 3000 can fit on the head of a pin. They are especially dangerous because of their size, but we're here to help you breathe healthier.





NEXT STEPS

Scale the pilot to:

25 homes (50 filters)

Mario Umana School (25 filters)

East Boston Social Center (10 filters)

Enhance our Monitoring and Evaluation Capabilities

Sensors

Surveys

Travel budget



SUSTAINABILITY

Short-term: \$50k supplementary funds from East Boston Foundation and AIRInc

Long-term: political alignment + community advocacy → official adoption

bostonlogan

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[To & From Logan](#)

[At the Airport](#)

[Dining & Shopping](#)

[About Logan](#)

[Opportunities](#)

[← ABOUT LOGAN / NOISE ABATEMENT](#)

Sound Insulation Program

Noise Abatement

\$170M

5500 homes

36 schools



[Business](#)

[Finance](#)

[Community](#)

[Media](#)

[About Massport](#)

[← MEDIA / NEWSROOM](#)

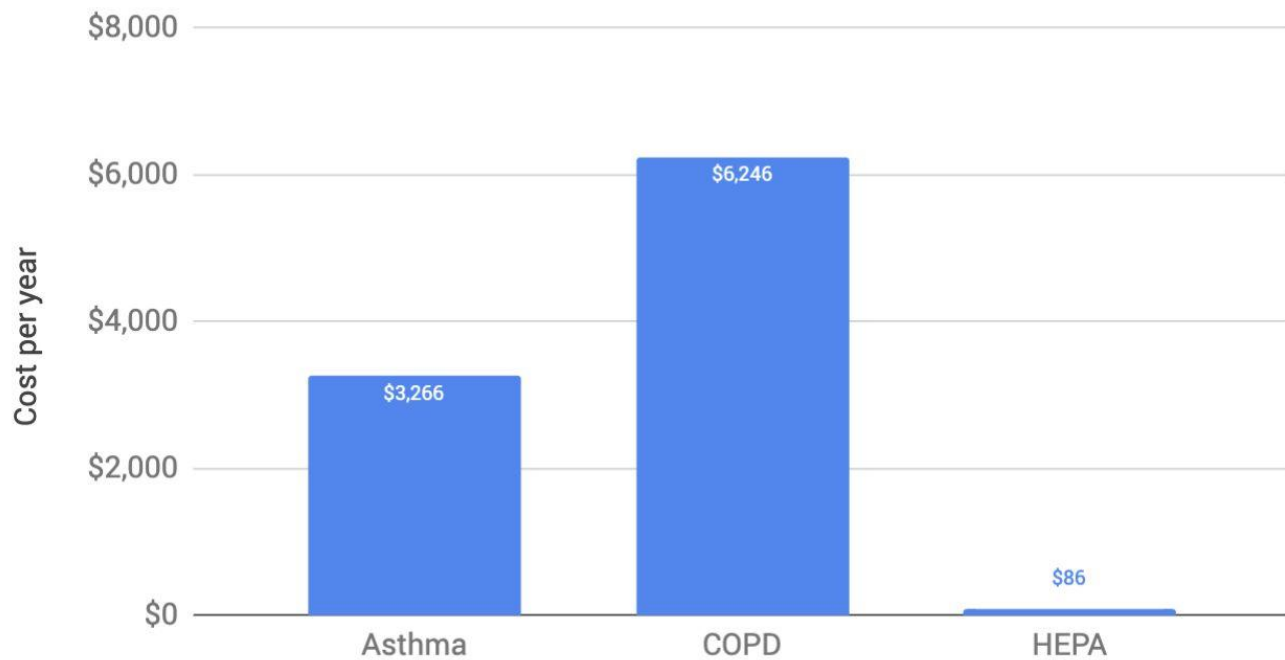
Massport to Fight Neighborhood Asthma with Community Health Groups



Soundproofing: \$4.9M/year; 5500 homes; 36 schools

Airproofing: 3 filters in every dwelling (16,145)
1 filter in every classroom (~720)
100 Air Quality Monitors
\$3.7M/year (**\$0.09/passenger**)

VISION: AIRPROOFING





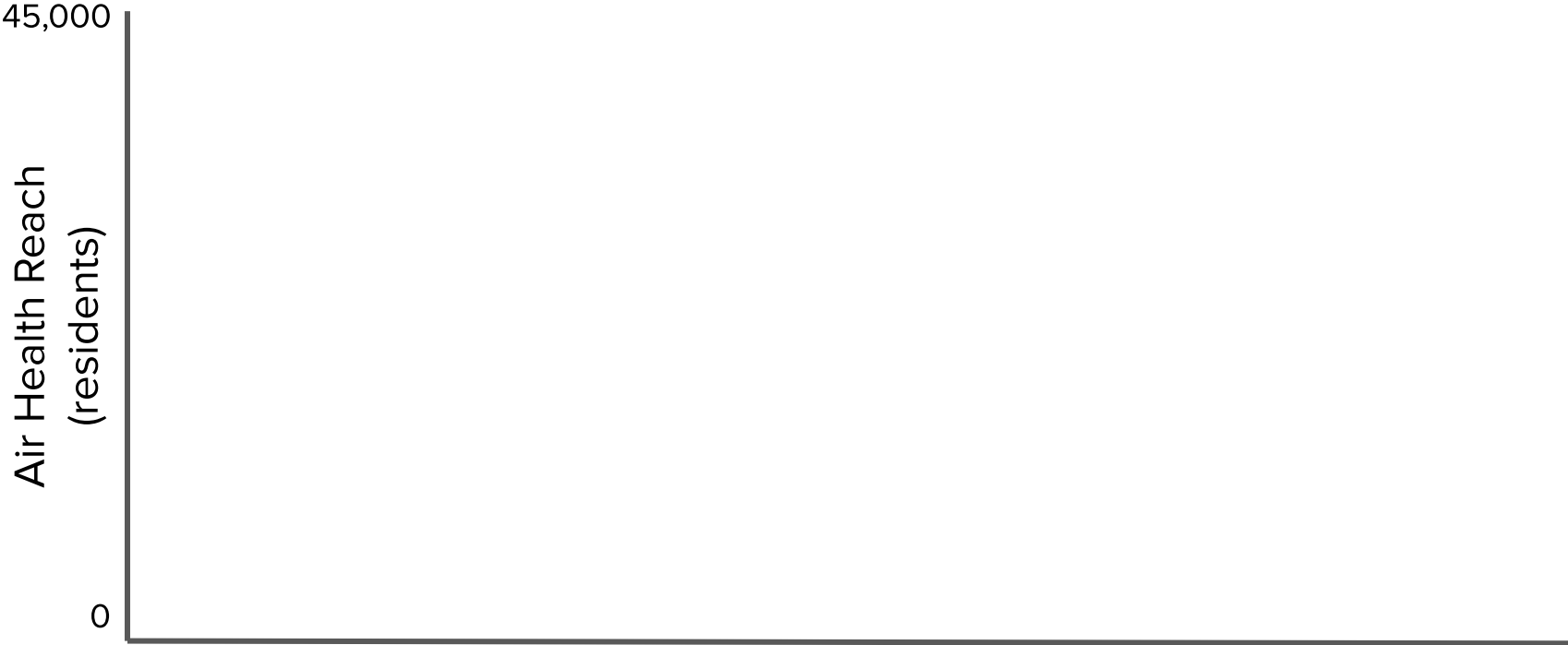
POLITICAL SUPPORT

City of Boston - Alison Brizius, Lydia Edwards [*Michelle Wu, Mayor Walsh's Office*]

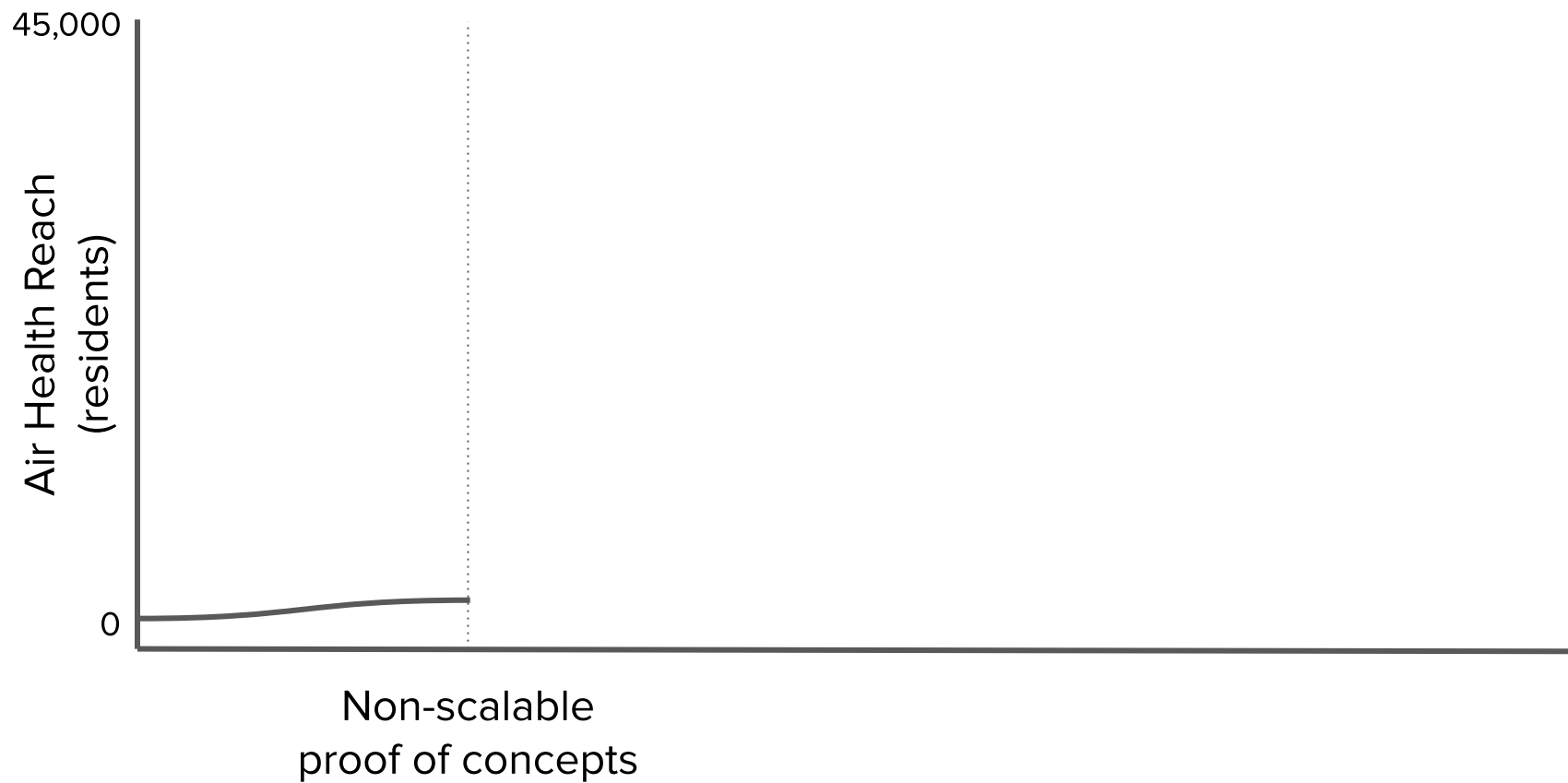
State of Massachusetts - Adrian Madaro [*Joe Boncore*]

Healthcare System - *East Boston Neighborhood Health Center, Board of Public Health*

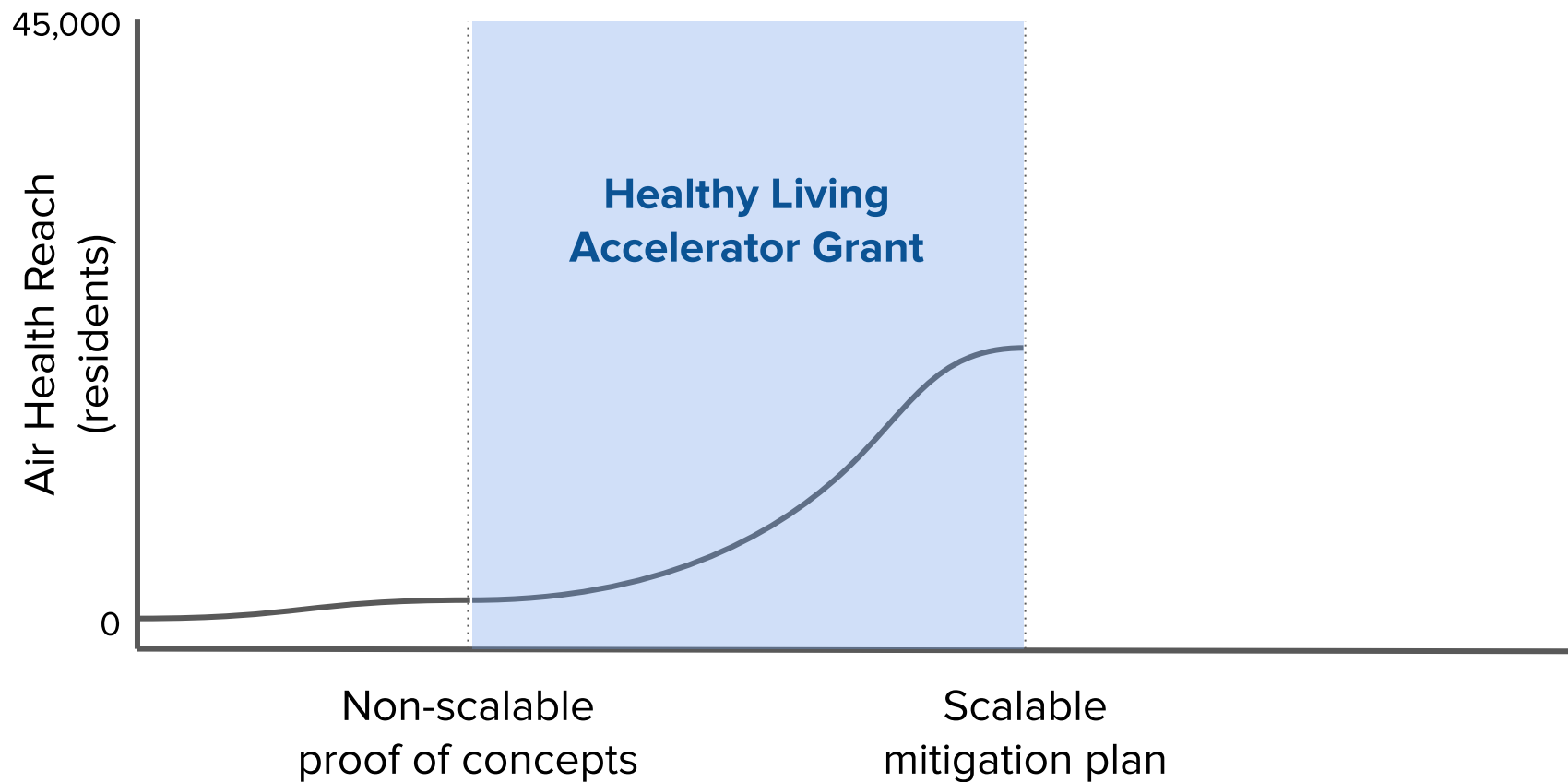
SUMMARY



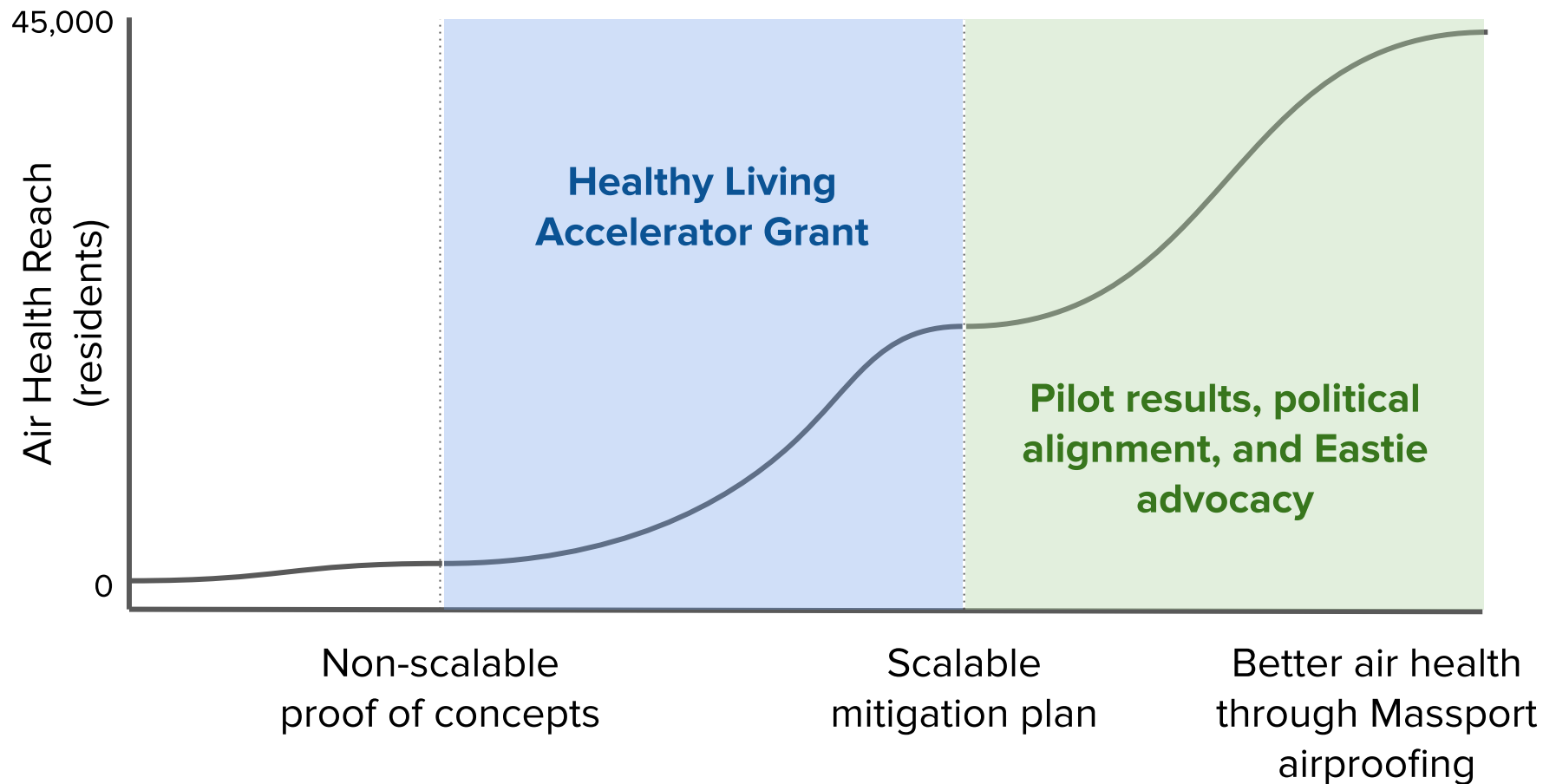
SUMMARY

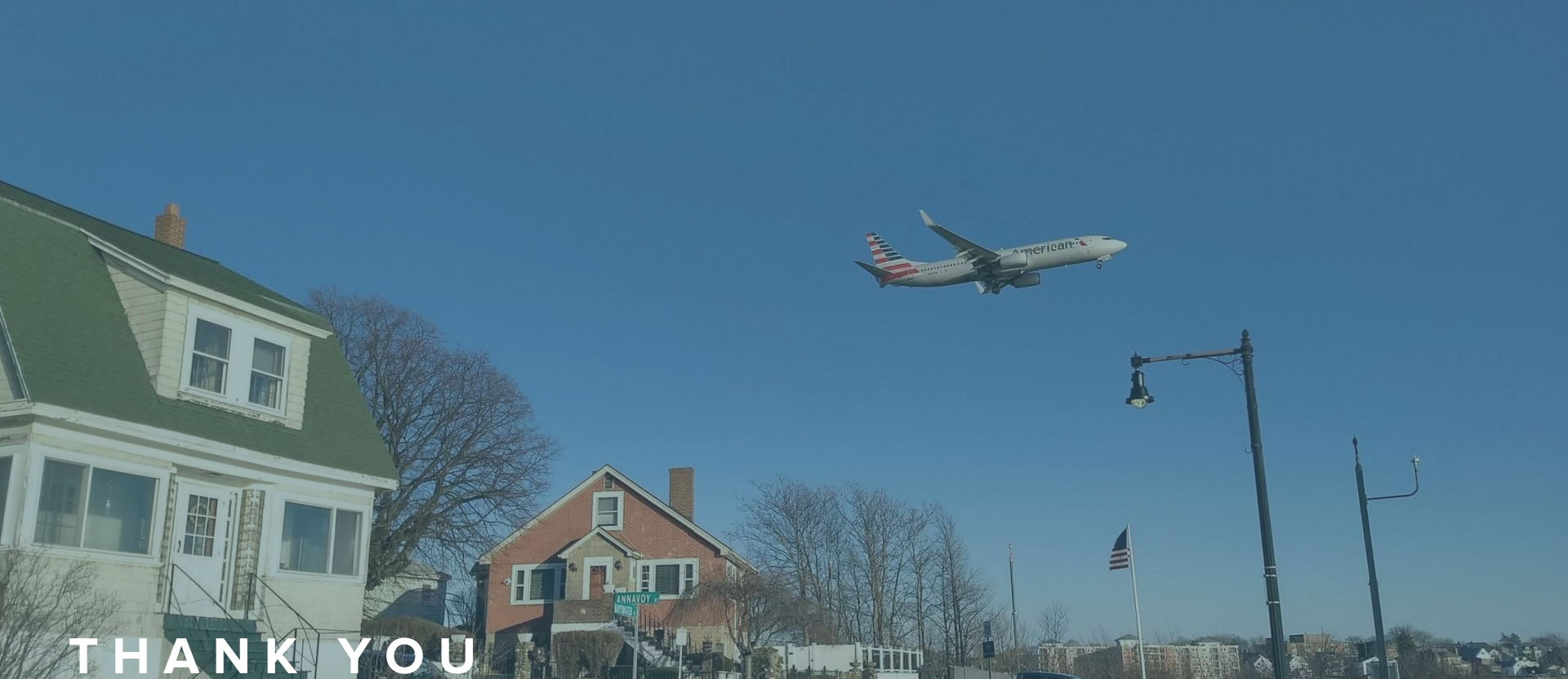


SUMMARY



SUMMARY





THANK YOU



AIRInc



Olin College
of Engineering

We got the money.

\$100k from BC/BS

We got the money.

\$100k from BC/BS

\$30k in-kind from Austin Air

\$??k from AIRInc

\$??k from Waypoint Development

\$??k from EB Foundation

What did we promise?

Filter Subsidy Pilot in 50 homes, 75 classrooms, and 25 rooms at EBSC

- Plan the pilot
- Design user engagement
- Purchase + deploy filters
- Make sensor packages
- Collect data (and move sensors around a LOT)
- Analyze data
- Summarize results

School engagement

- Lesson plan
- Marketing/subsidy pilot

Air Quality App Development and Launch

- Onboard to existing flask/react app structure
- API access
- Digest existing UX research and do more
- Test, launch, revise

Public art with Susan and Return Design

- Launch poster campaign
- Design new poster campaign
- Design and launch clean air paths
- Design + prototype inhaler boxes

Awareness campaign stuff

- Strategy
- Website finalizing (Scott)
- Social media campaign

1. Force multiplier for awareness work
2. Leverage with electeds and Massport
3. Co-design





SUPPLEMENTARY SLIDES



AIRInc



Olin College
of Engineering



partners





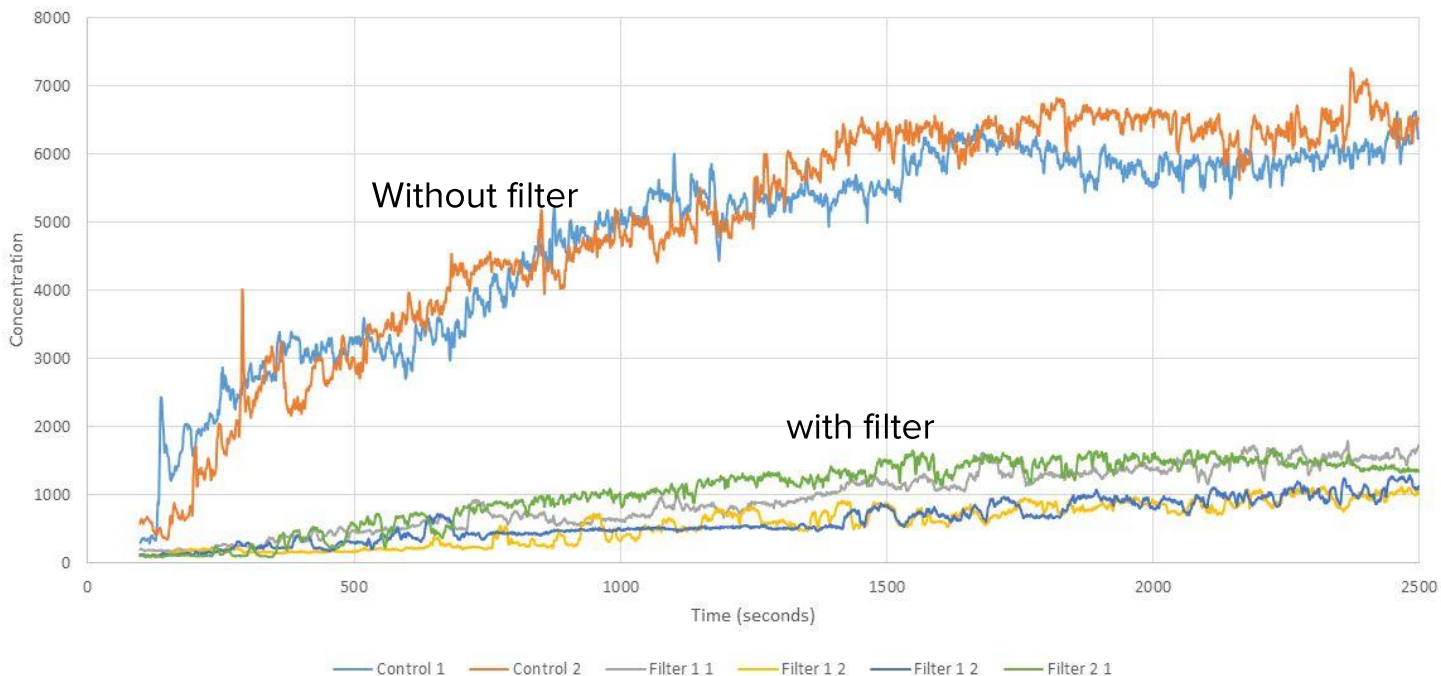
Moving forward

SUMMER SOLUTION TESTING



Passive in-window filters work really well

Indoor particle count over time



DANTE ALIGHIERI MONTESSORI SCHOOL



NEXT STEPS

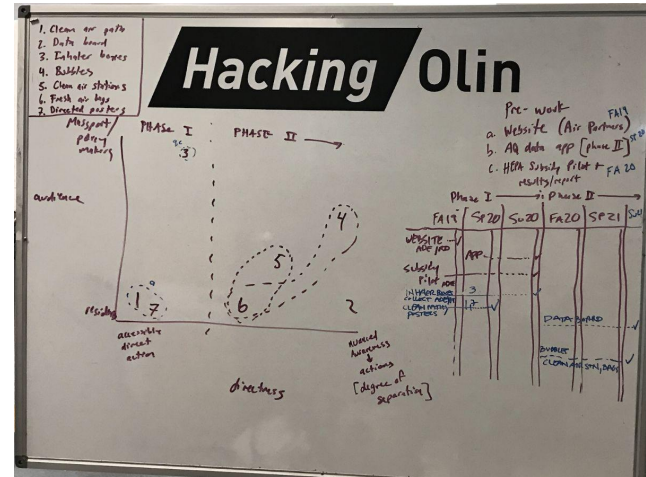
Develop + finalize design concepts

EB Photo Shoots

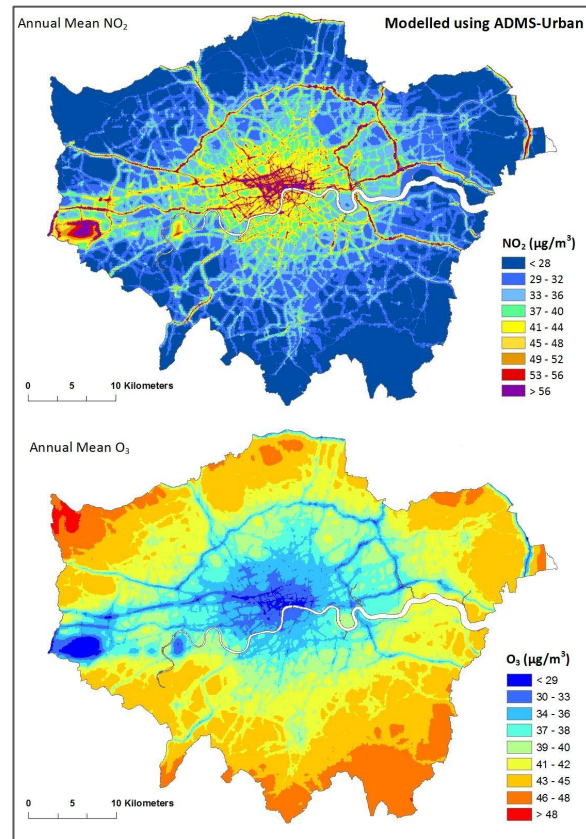
Create 2-3 art pieces

Produce materials

Launch (paste posters, buy advertisement space, deploy social media, ...)



DEMOCRATIZING DATA



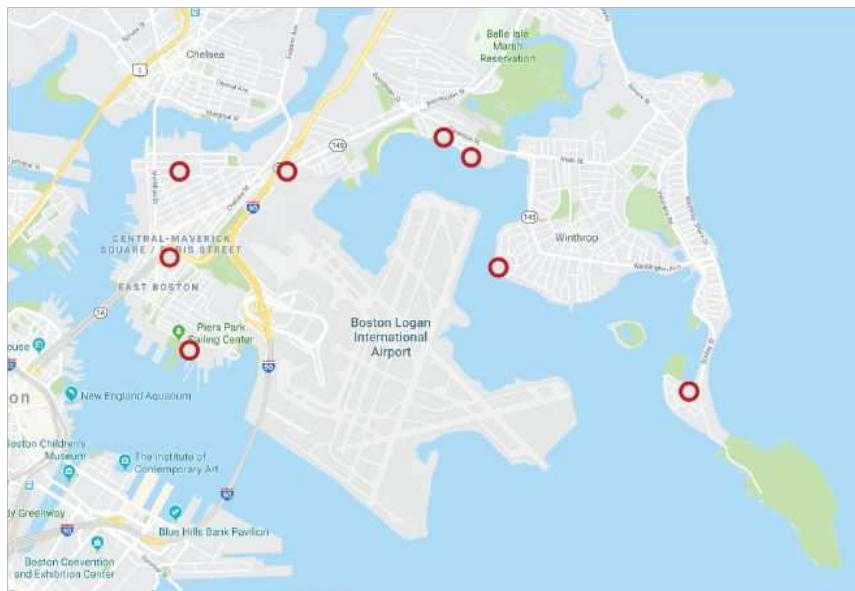
NEXT STEPS

Finalize app development (student researchers, dev. costs)

User testing

Launch app

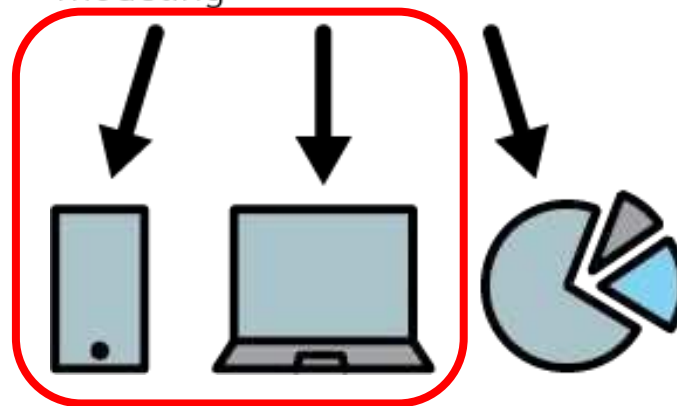
DEMOCRATIZING DATA



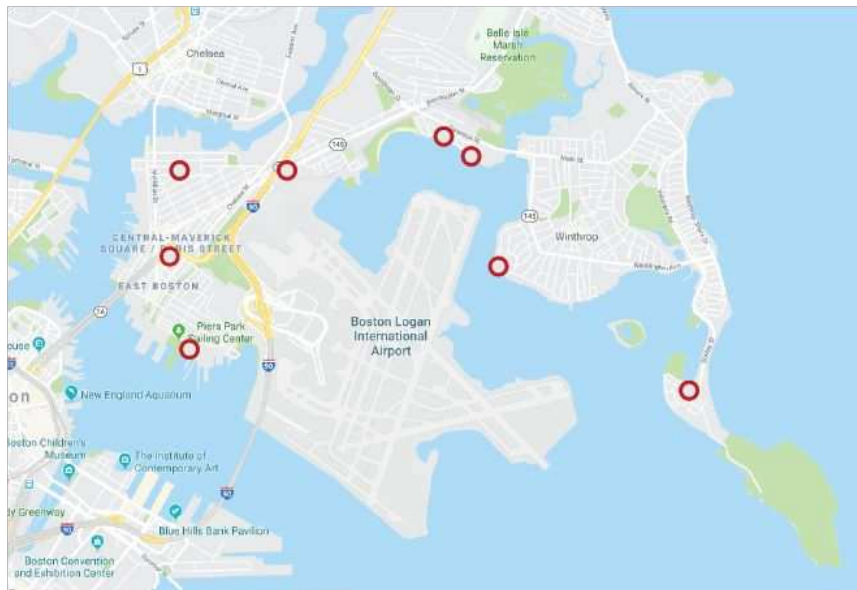
site data →



- calibration
- QA/QC
- data validation
- dispersion modeling
- security
- regime warnings
- user-defined functionality



DEMOCRATIZING DATA



site data



QUANTAQ

Dashboard

Devices

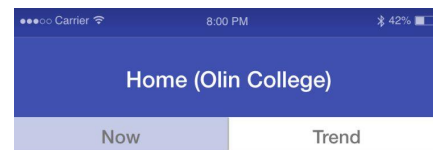
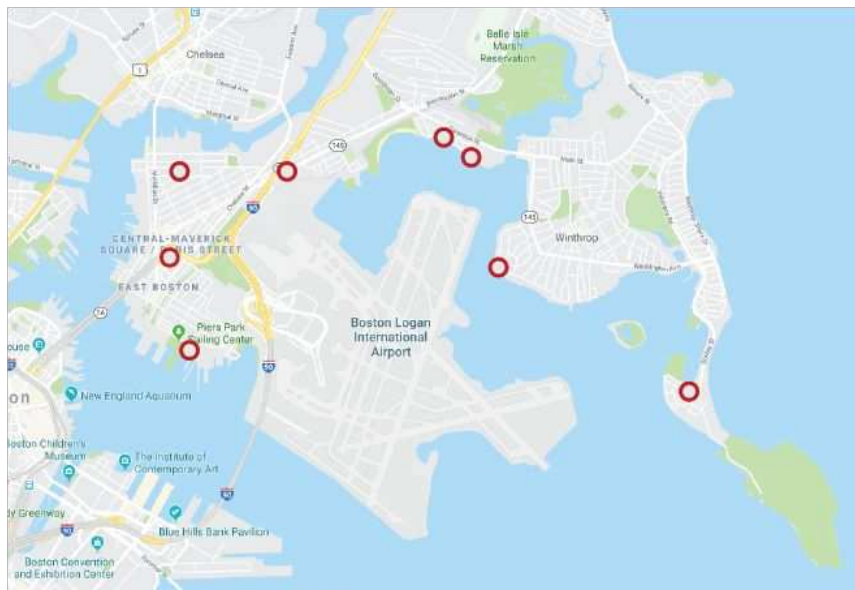
Active 33 Inactive 0

Search

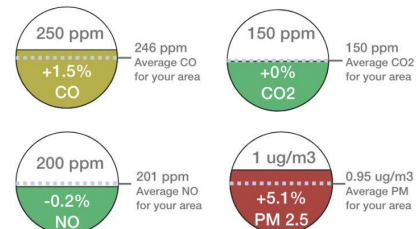
ID	TYPE	SERIAL	LAST SEEN	NUM. DATA
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39	ARI-Sense-v200	SN000-075	2 minutes ago	33.55k
7	ARI-Sense-v200	SN000-044	2 minutes ago	131.39k
55	ARI-Sense-v100	SN000-033	2 minutes ago	14.51k
27	ARI-Sense-v200	SN000-053	2 minutes ago	149.94k



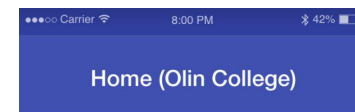
DEMOCRATIZING DATA



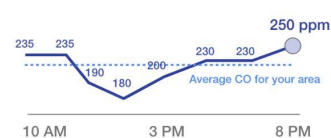
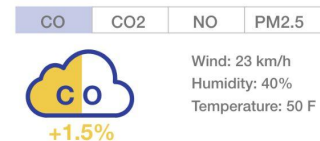
Air Quality



Atmosphere



Air Quality



Last Updated: 8:00 PM EST
Sensor Location: Roxbury, MA

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HEADS UP!

You're breathing in a lot of UFPs right now.

UFPs are a type air pollution so small that more than 3000 can fit on the head of a pin. They are especially dangerous because of their size, but we're here to help you breathe healthier.

Health Effects

Use this space to describe the impact your organization or company has made. Sed dictum ante a leo cursus mattis. Integer euismod, lorem sed molestie gravida, justo mauris dignissim orci, sed convallis elit ipsum at justo. Donec feugiat justo vitae mollis pretium. Suspendisse ultrices, tellus vitae varius convallis, ipsum justo commodo dui, a feugiat mauris turpis ut turpis. In laoreet magna eu consectetur facilisis. Etiam ut tempus metus. Phasellus maximus eros tempor est pretium.



INCREASED ASTHMA

Children in East Boston are 3-4x more likely to experience symptoms of asthma due to air pollution



RESPIRATORY DISEASE

Studies indicate a strong association between UFP exposure and respiratory and cardiovascular diseases



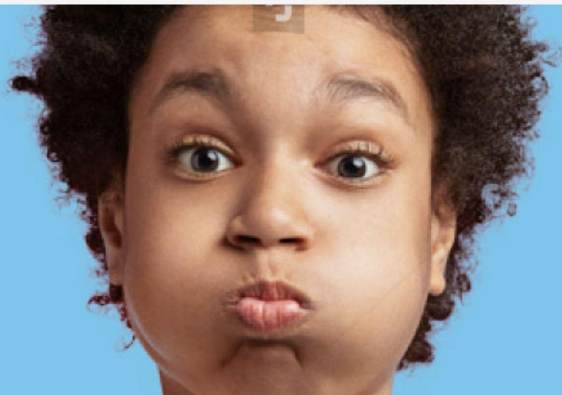
DNA DAMAGE

UFPs can penetrate deep into the airways of the respiratory tract, where they can damage DNA and act as a carcinogen.



REDUCED PERFORMANCE

Exposure to UFPs and black carbon is linked to lower academic performance in children.



WHAT CAN YOU DO ABOUT IT? HERE ARE 3 SIMPLE ACTIONS YOU CAN TAKE.

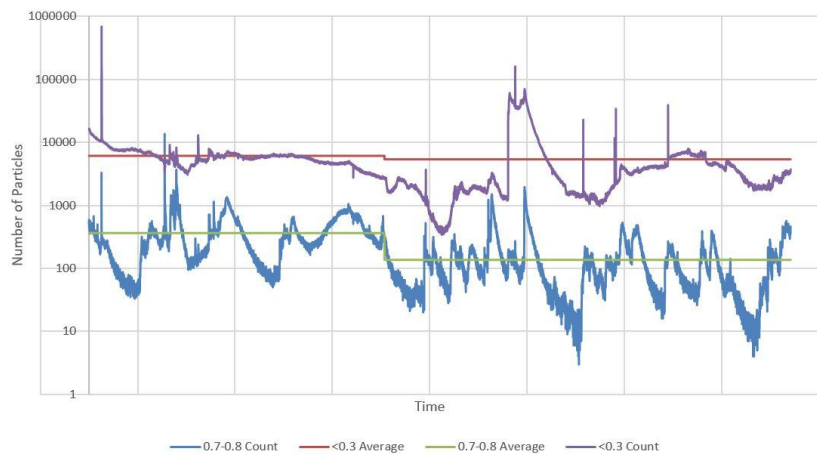
01 - Get a HEPA filter!

A HEPA filter is the most effective way to reduce the amount of UFPs you breathe in your home. Research shows that a HEPA filter can reduce the concentration of UFPs by over 70%, if used properly.

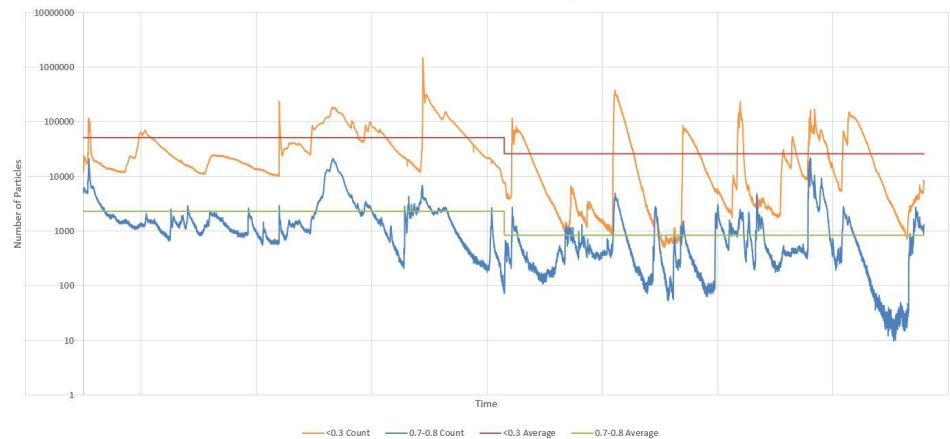


IN-HOME TESTS

65 St Andrew St East Boston, 4/24-4/29



11 Hale Avenue Winthrop, 4/19-4/24

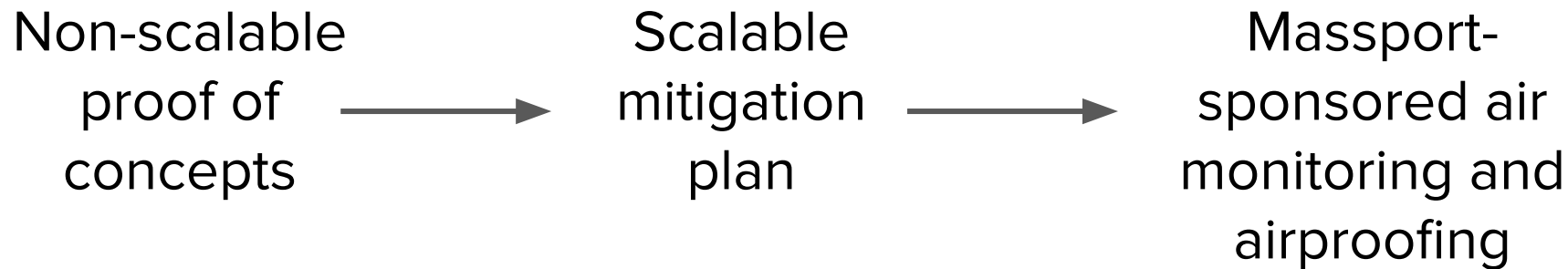


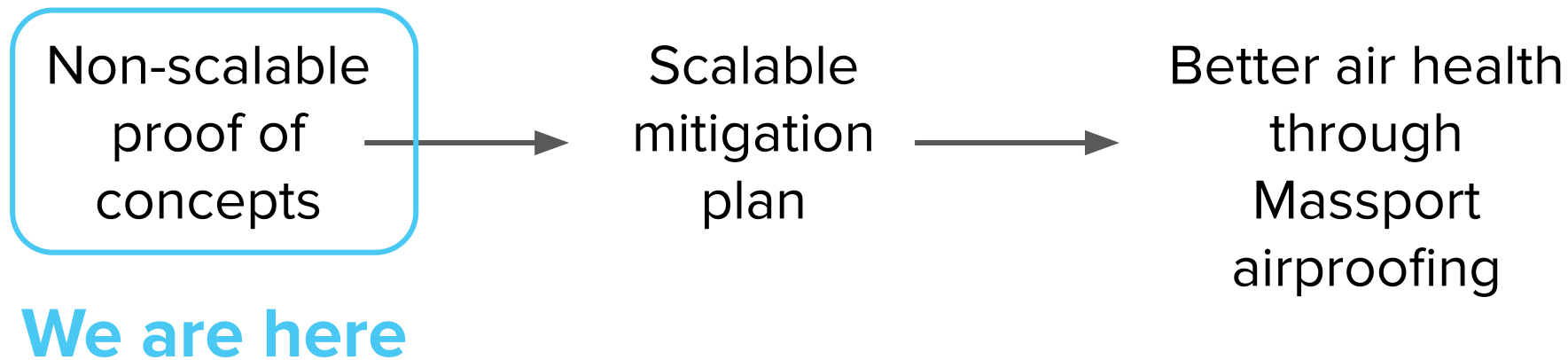
49-62%

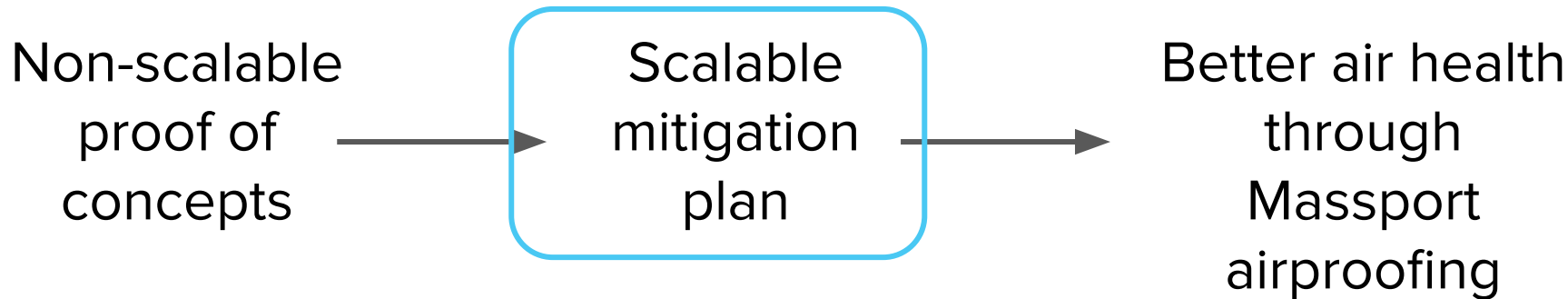
Reduction in <400 nm particle concentration



SUMMARY

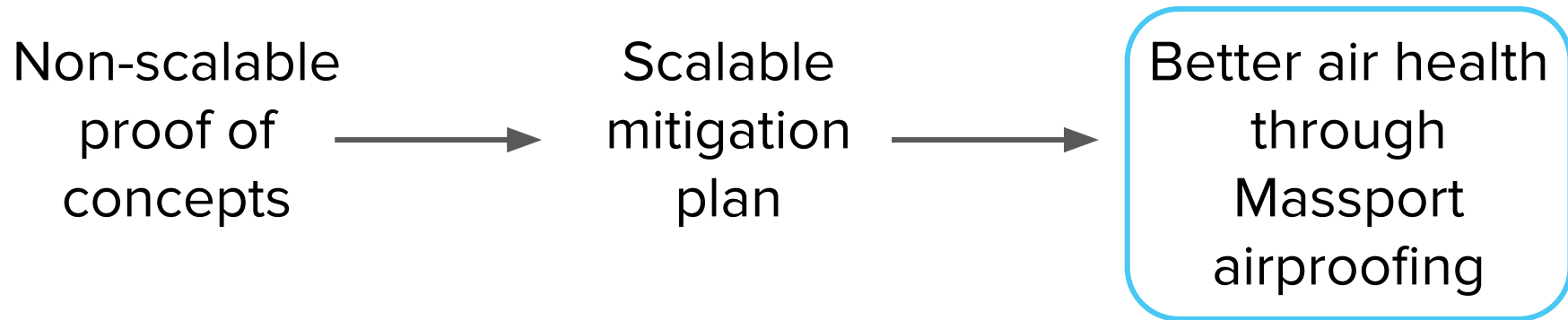






**Healthy living
accelerator grant
gets us here**

SUMMARY



**Our results,
political alignment,
and Eastie
advocacy get us
here**

SUMMARY

Budget goes to proven approaches

Substantial in-kind investment from Olin College (>\$200k instrumentation, salary support, summer student housing, curriculum access, Return Design, materials production costs)

Supplementary funds from East Boston Foundation and AIRInc

LOW COST != LOW COMPLEXITY

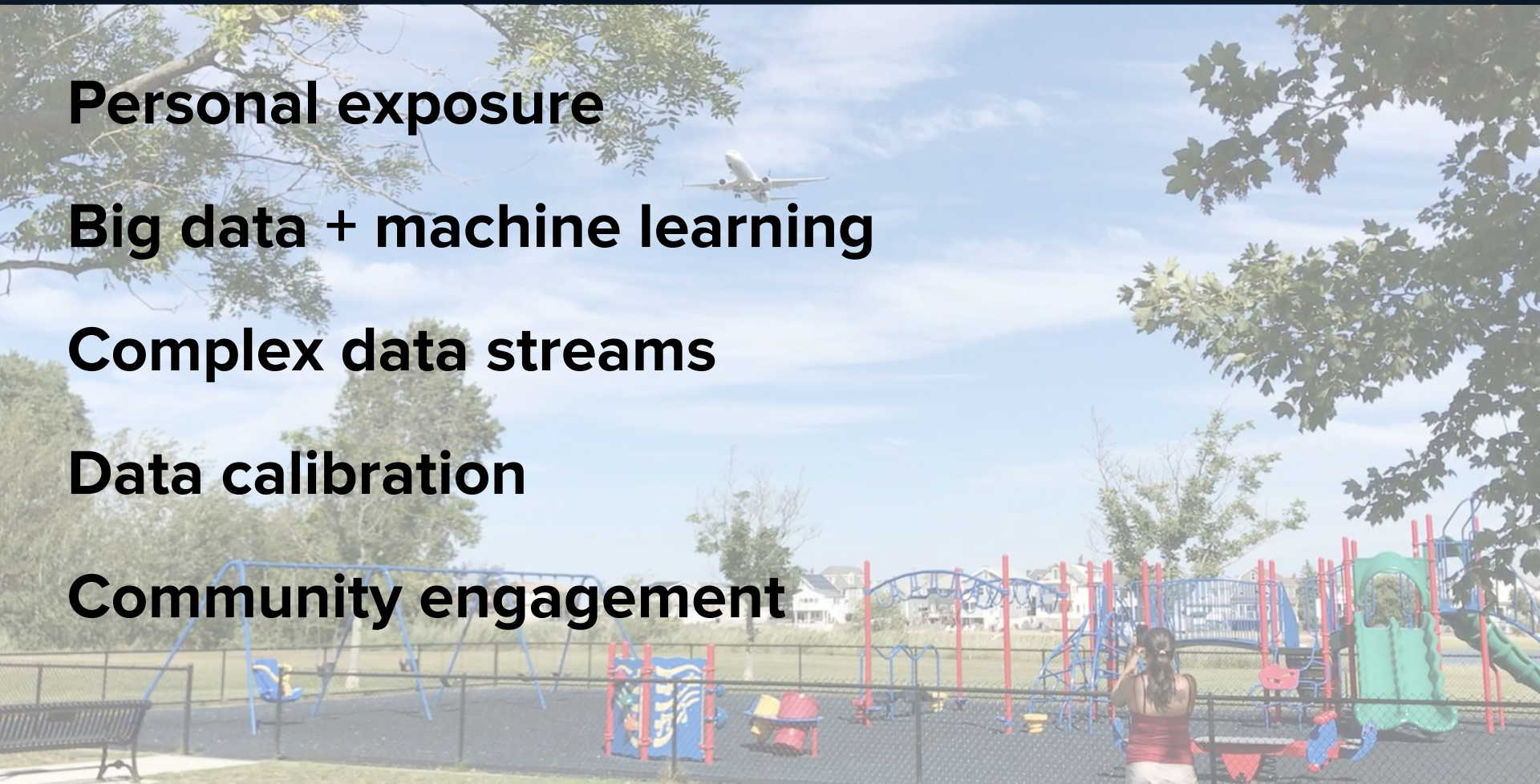
Personal exposure

Big data + machine learning

Complex data streams

Data calibration

Community engagement

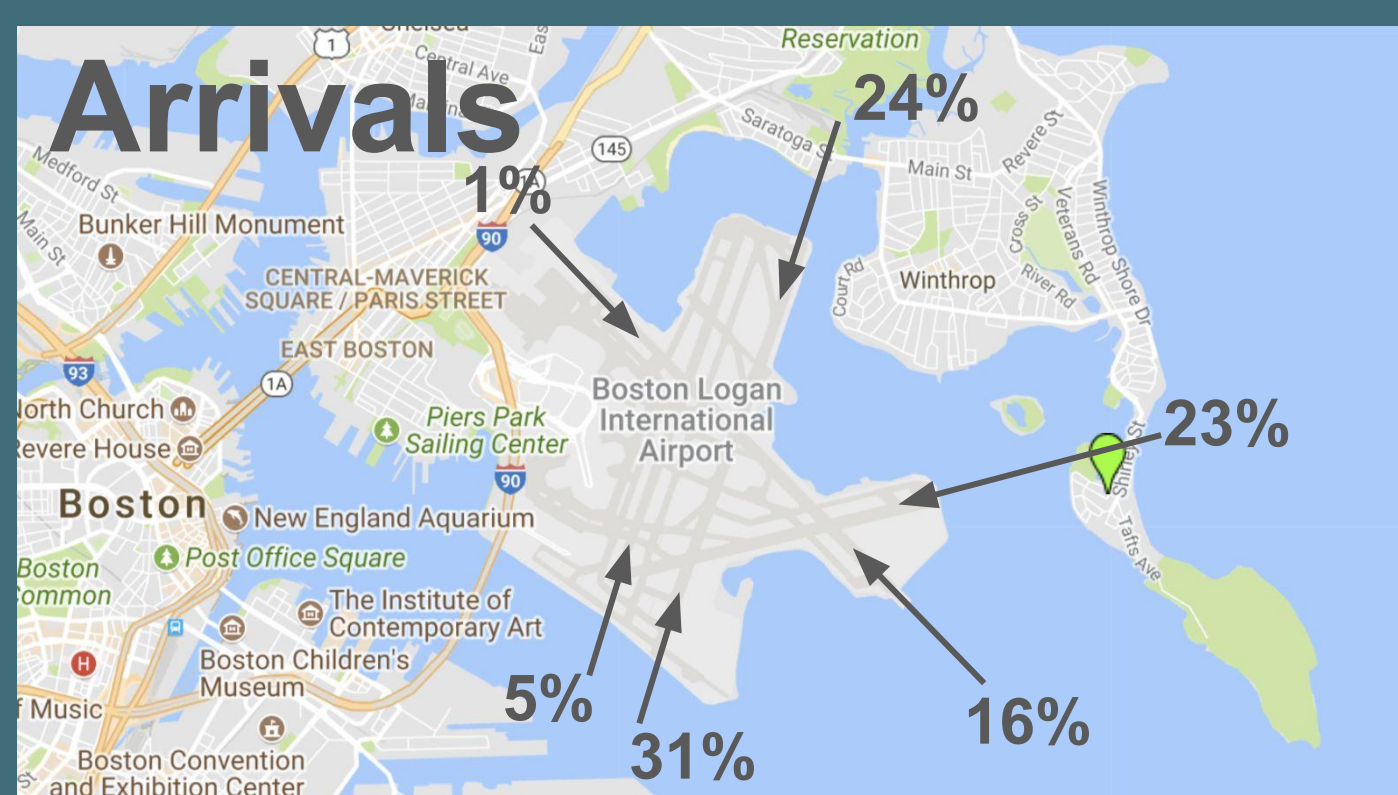


LOW COST != LOW COMPLEXITY

Low cost sensors = new paradigm for

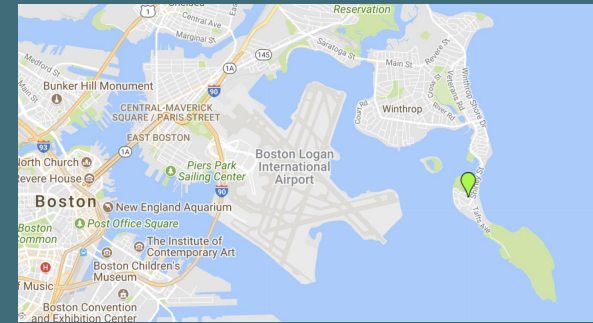
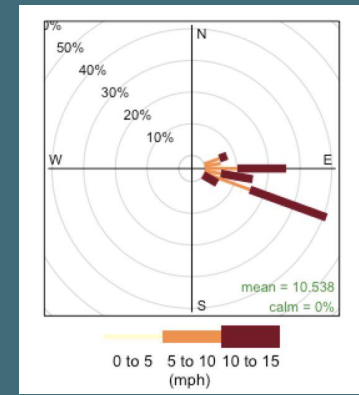
1. Researchers
2. Regulatory agencies
3. Communities





Sampling site

On the approach to Runway 27 (23% of arrivals)
200 m South of approach centerline
Aircraft descending at 50-100 m



Friday, 01-Sep-2017 3:03 pm

JetBlue N712JB (A320)

KTPA-KBOS

183 ft altitude

142 kt