

Development of Laboratory Test Methods for Low- Cost Indoor Air Quality Sensors

Newport Partners LLC

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Project Summary

Timeline:

Start date: 10/1/2017

Planned end date: 9/30/2020

Key Milestones

1. Consensus Draft of Test Methods; 10/1/2018
2. Testing Successfully Completed and Consensus Draft approved for 2 Test Methods; 10/1/2020

Budget:

Total Project \$ to Date:

- DOE: \$108,246.59
- Cost Share: \$51,435.96

Total Project \$:

- DOE: \$359,948
- Cost Share: \$89,997

Key Partners:

South Coast Air Quality Management District	Home Ventilating Institute
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Project Outcome:

Test methods established for low cost indoor air quality sensors, making dynamically controlled ventilation a reality. The energy savings potential assuming 50% market penetration could be 1.4 Quads annually through more efficiently controlled ventilation. Potential impact on health of up to 25% reduction in disability adjusted life years due to indoor air pollutants.

Team



Newport Partners L.L.C.



Home Ventilating Institute

Represents Industry End Product

Ventilation and Indoor Air Quality

Outreach and Stakeholder Engagement

Newport Partners

Building Science and Ventilation Expertise

Codes and Standards Expertise

Project Management and Consensus Process

South Coast Air Quality Management District

Developed Existing Test Protocols (AQ-SPEC)

Lab Expertise in Testing Air Quality Sensors

Content Expertise and Laboratory Testing

Advisory Work Group

Other Technical Experts and Industry Stakeholders

Government, Labs, Manufacturers, Content Experts

Consensus Development and Advisory Role

Challenge

Current Ventilation Approach

- Static Ventilation Design
- Non-responsive to Actual Conditions

Over-ventilation

- Wasted Energy
- Climate-Specific Concerns

Under-ventilation

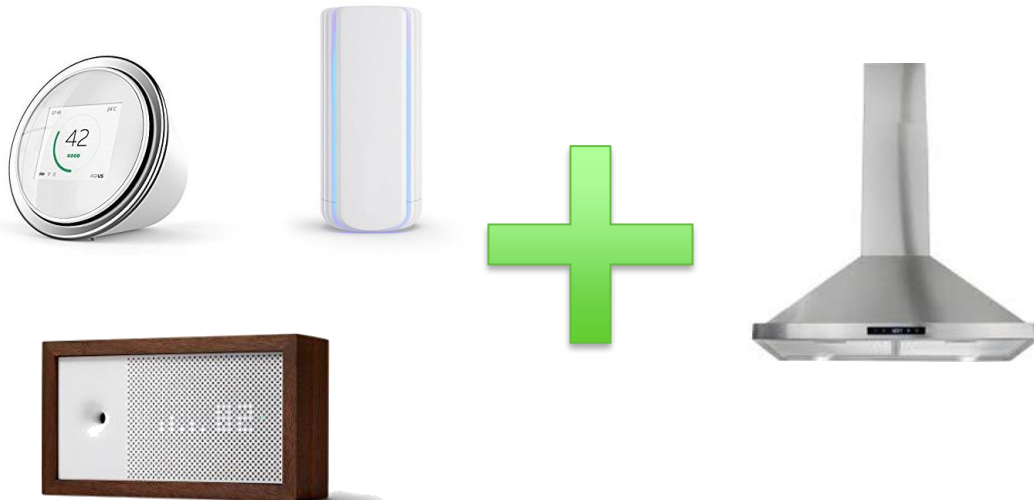
- Health Concerns
- Lost Opportunity to Deal with Specific Pollutant Concerns

FEM/FRM Research Grade Sensors = \$10,000+

Challenge

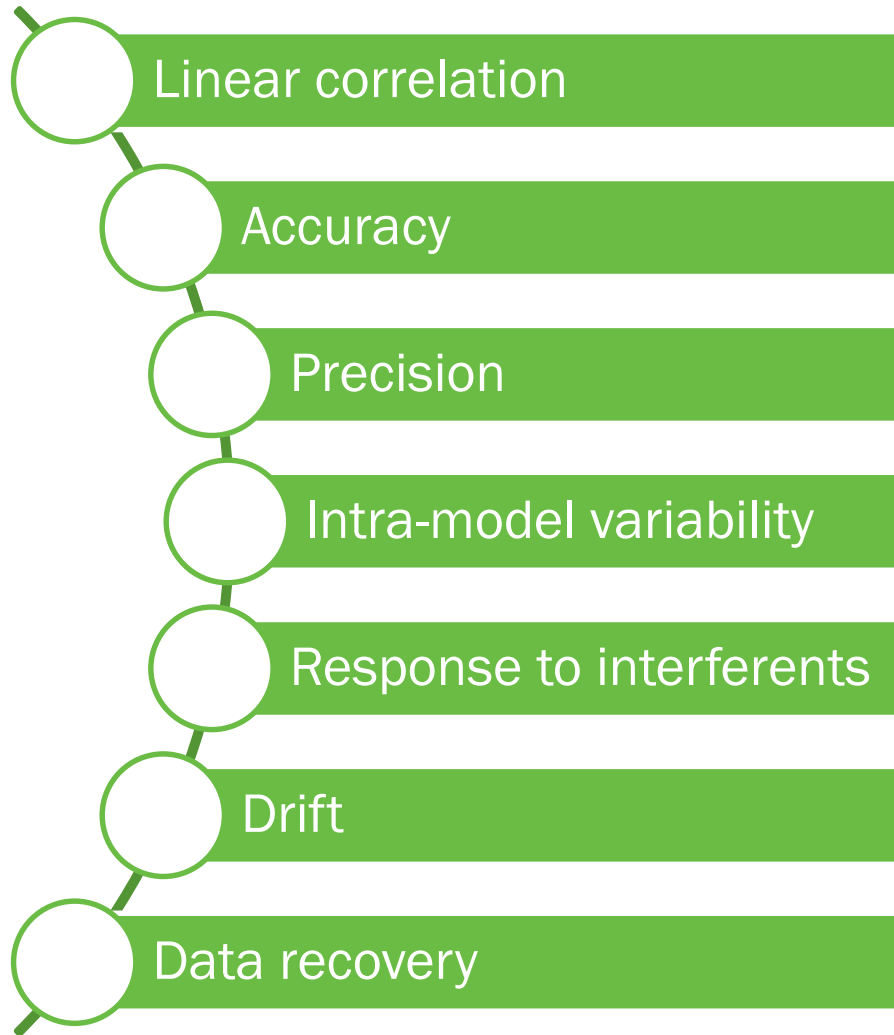
Market-ready
Low-Cost
IAQ Sensors

Sensor-Controlled
Ventilation



No Standardized
and Accepted
Method for Testing
and Comparing
Performance of
Low-Cost IAQ
Sensors

Approach: Test Parameters



Other Considerations

- Hysteresis
- Response Time
- Accelerated Aging
- Local Atmospheric Pressure
- Self-Calibrating Baselines

Approach: PM_{2.5} Testing Phases

Phase 1: Concentration Ramping

6 PM_{2.5} Concentrations

20 Measurements/Concentration

Phase 2: T&RH

15-30 T&RH Combinations

20 Measurements/T&RH Combo

Phase 3: Interferent Testing

3 Interferents X 4 Concentrations

20 Measurements/Interferent Concentration

Phase 4: Temperature Cycling

163 Cycles

10°C-50°C

No Measurements

Phase 5: Repeat Concentration Ramping (DRIFT)

6 PM_{2.5} Concentrations

20 Measurements/Concentration

Approach: CO₂ Testing Phases

Phase 1: Concentration Ramping

5 CO₂ Concentrations

20 Measurements/Concentration



Phase 2: T&RH

15-30 T&RH Combinations

20 Measurements/T&RH Combo



Phase 3: Interferent Testing

5 RH (as Interferent) Levels

20 Measurements/RH level



Phase 4: Temperature Cycling

163 Cycles

10°C-50°C

No Measurements

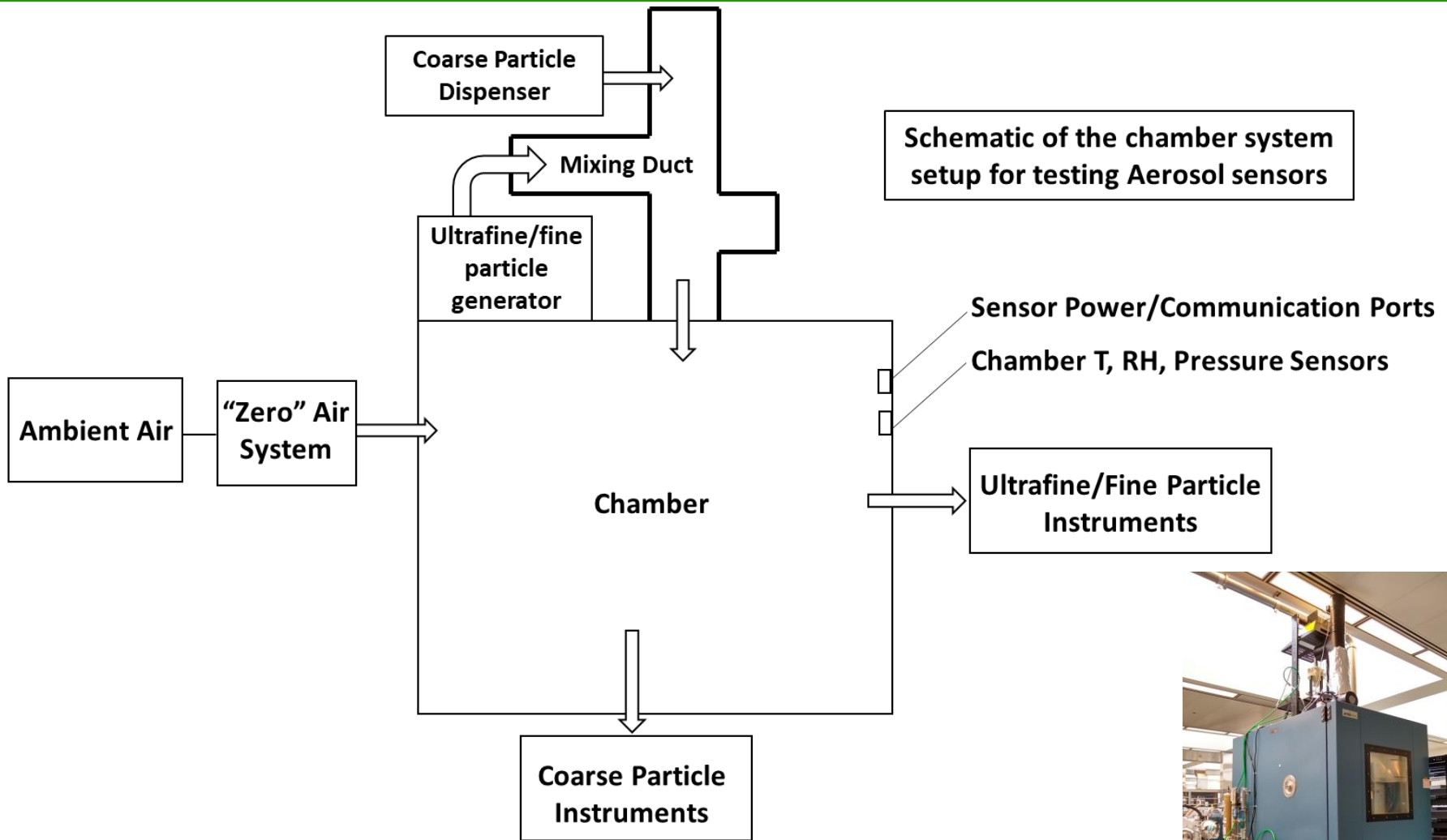


Phase 5: Repeat Concentration Ramping (DRIFT)

5 CO₂ Concentrations

20 Measurements/Concentration

Approach: Chamber Test



Impact: Energy and Indoor Air Quality

Efficient
Ventilation

Potential
for 1.4
Quads
Annually

Up to 10%
BTO Goal

Facilitates
High
Performance

Air Sealing

Ventilation
/ Pollutant
Control

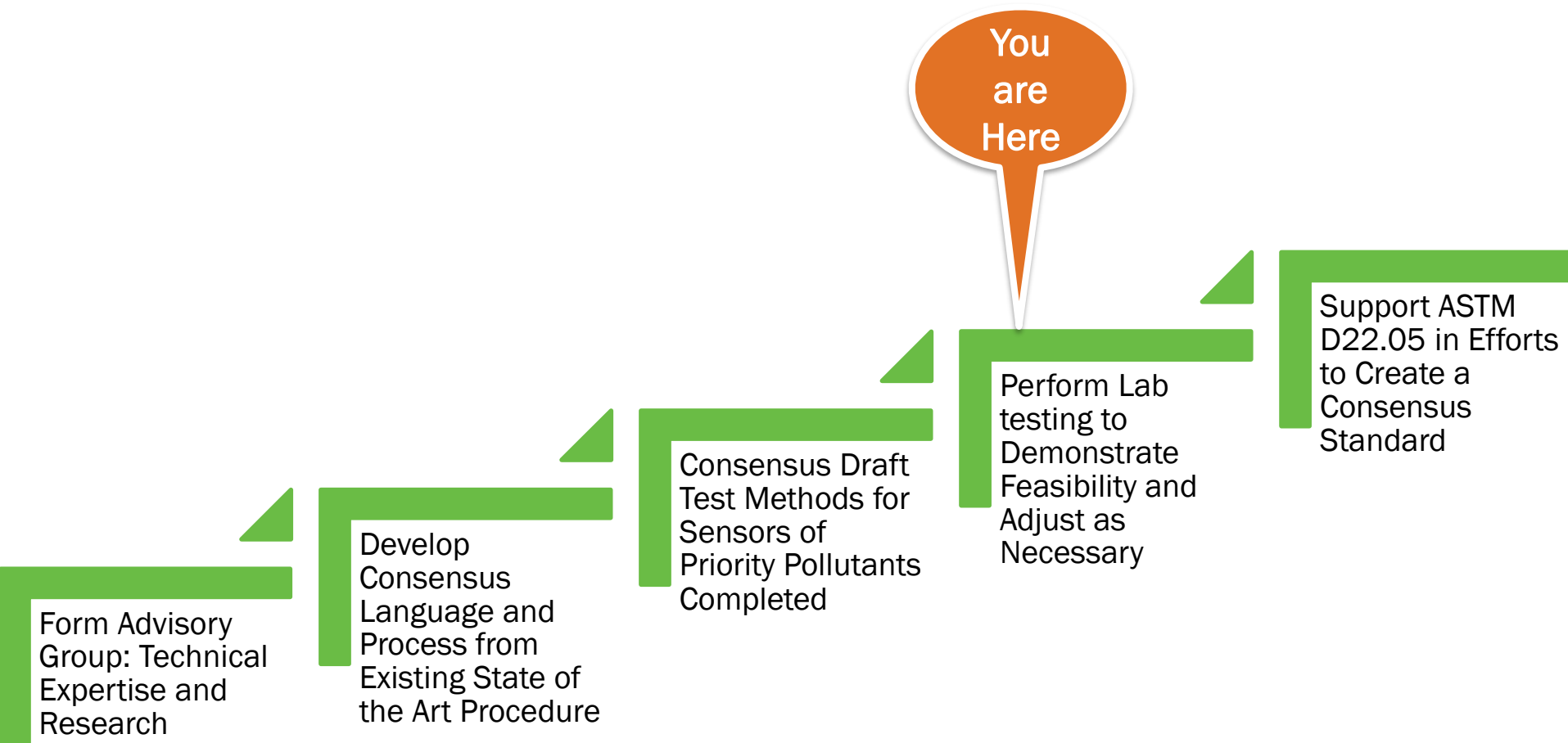
Other BA
Research

Prototype
Smart
Range
Hood

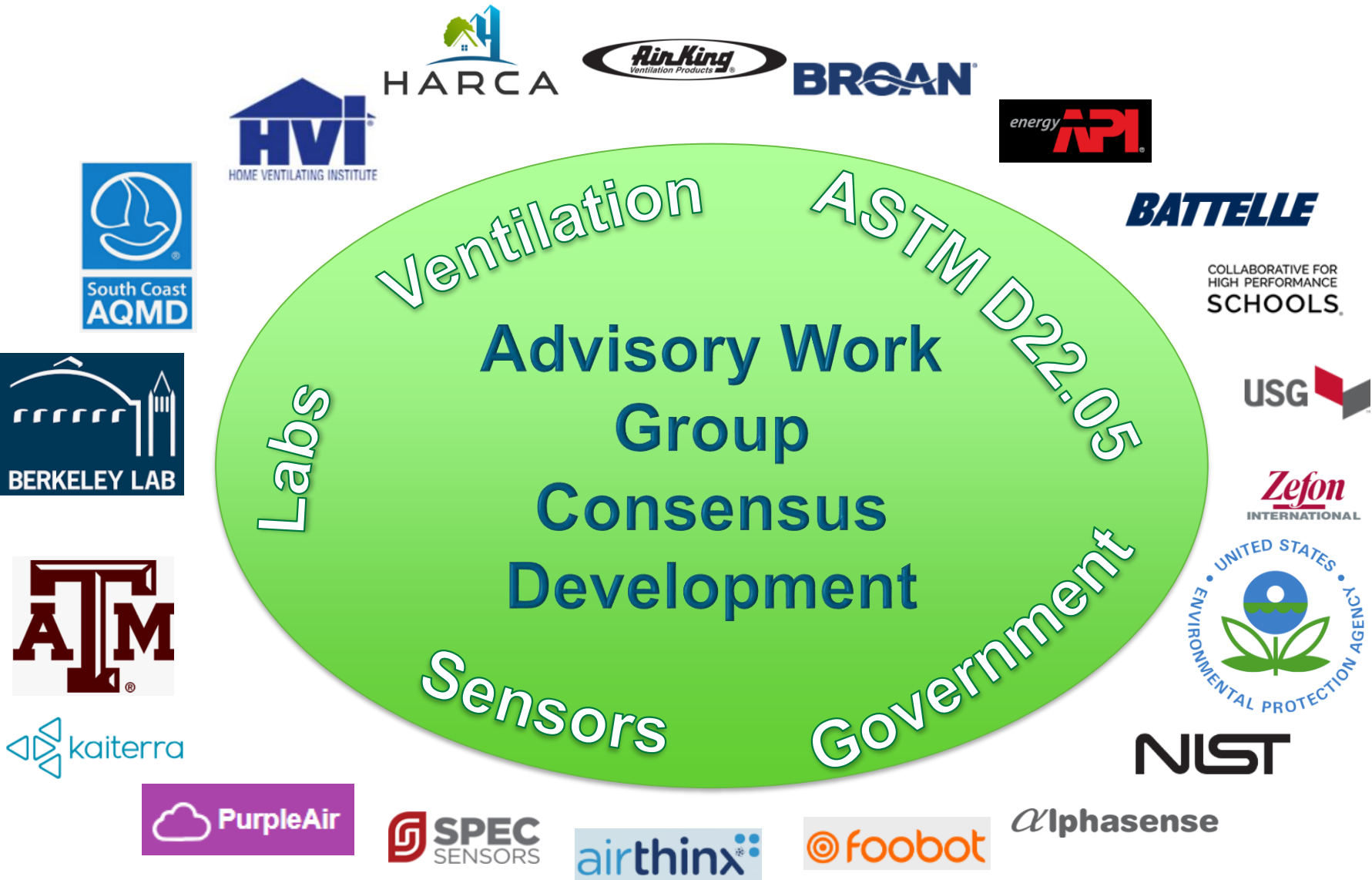
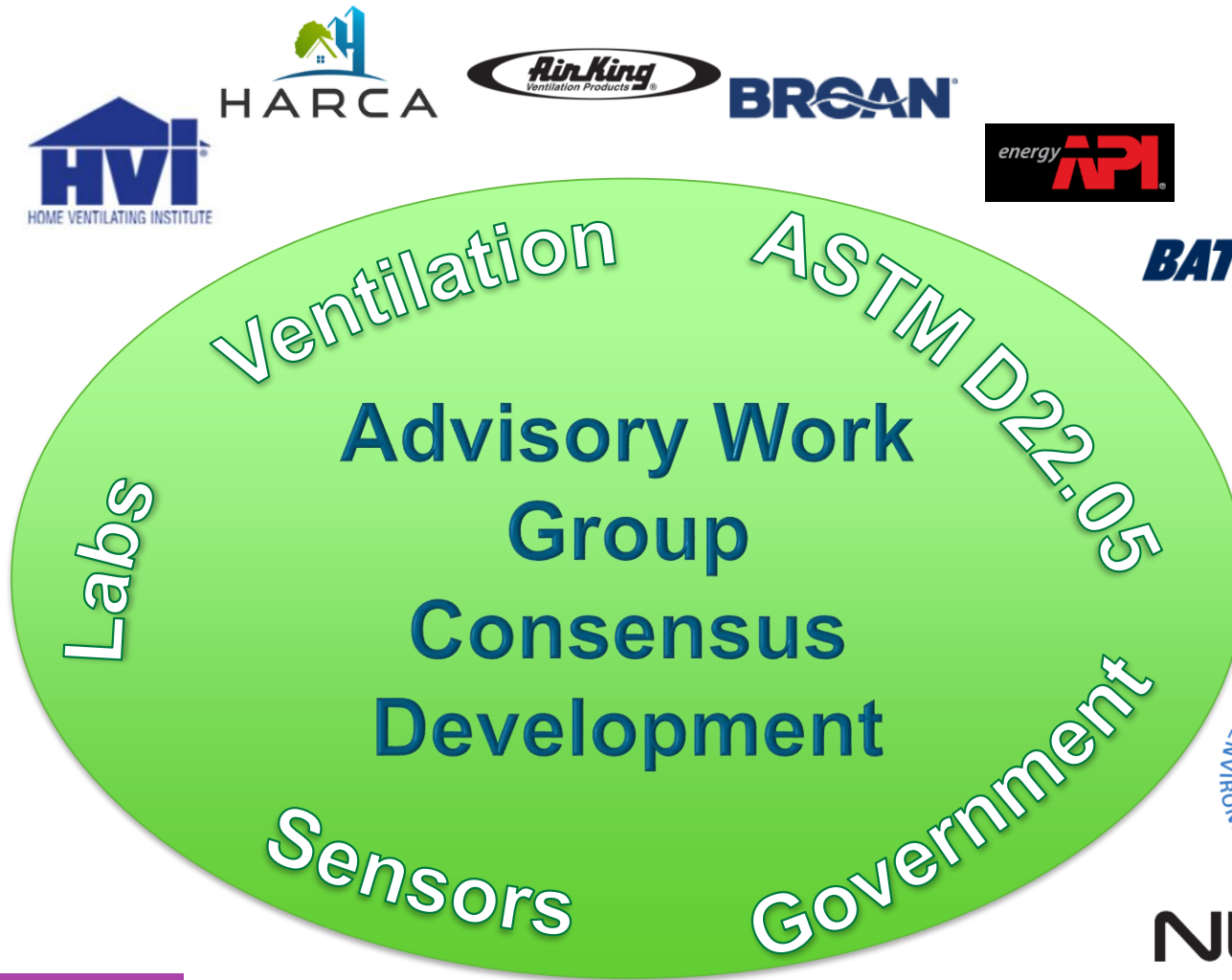


Potential
80% - 90%
reduction in
cooking
pollutant
exposure

Progress



Stakeholder Engagement: Advisory Work Group



Stakeholder Engagement: Outreach

ASTM

- Work Item at D22.05 Open
- Regular Updates

HVI

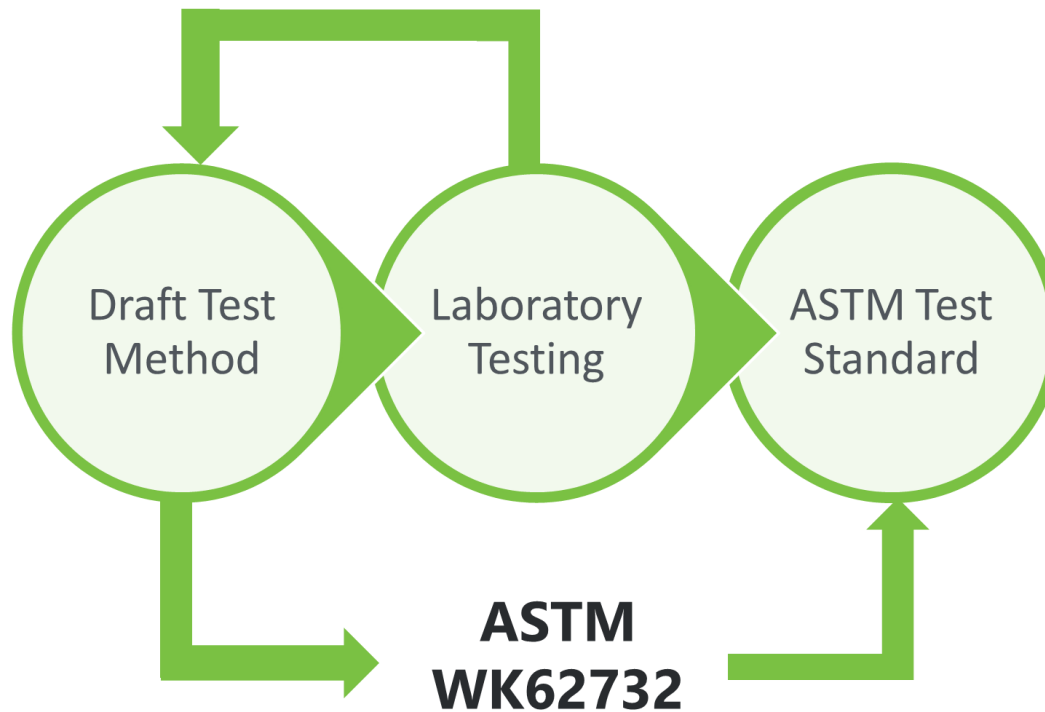
- Listing and Labeling Program
- Outreach to Ventilation Manufacturers

Other

- Social Media Posts
- Upcoming Webinars

Remaining Project Work

Laboratory Testing



Thank You



Newport Partners L.L.C.

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REFERENCE SLIDES

Project Budget

Project Budget: \$359,948 (\$51,435.96 Cost Share)

Variances: No Budget Variance, but project was adjusted from a 2 year to a 3 year timeline with no-cost extension

Cost to Date: \$108,246.59 (89,997 Cost Share)

Budget History

10/1/2017 – FY 2018 (past)		FY 2019 (current)		FY 2020 – 9/30/2020 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$87,634.03	\$49,812.56	\$162,066.97	\$25,184.44	\$110,247.00	\$15,000

Project Plan and Schedule

Task	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Past Work												
Task 1: Recruit Work Group	◆											
Task 2: Review Test Methods and Lit Review	◆											
Task 3: Develop Draft Test Methods					◆							
Task 4: Lab Test Plan	◆				◆							
Current/Future Work												
Task 4: Lab Testing									◆			
Task 5: Go / No-Go: Successfully Tested Methods Approved By Advisory Work Group via Consensus									◆			
Task 6: Technical Support for ASTM										◆	◆	◆