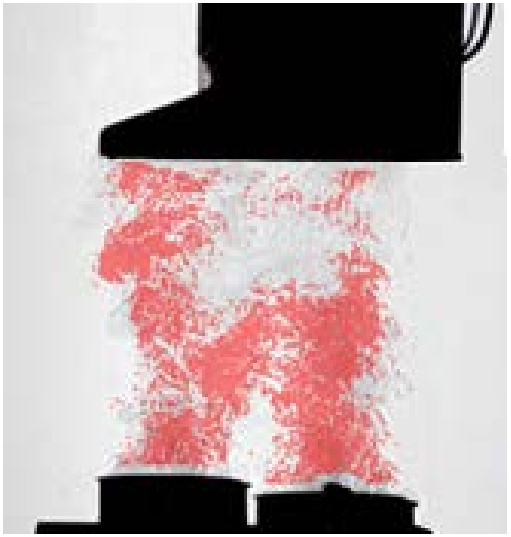
Development of the Industry's First Smart Range Hood

2017 Building Technologies Office Peer Review



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Mike Moore, mmoore@newportventures.net
Newport Partners

Project Summary

Timeline:

Start date: October 1, 2016

Planned end date: September 30, 2019

Key Milestones

1. M1.1: Sensor & pollutant spec table; 1/16/17
2. M1.2: Identify and acquire sensors; 3/31/17
3. GNG: Develop control logic model; 6/30/17

Budget:

Total Project $ to Date:

- DOE: $5,892
- Cost Share: $3,123

Total Project $:

- DOE: $462,803
- Cost Share: $213,819

Key Partners:

Newport Partners L.L.C.

BROAN NuTone

Project Outcome:

Develop, test, and demonstrate the industry's first Smart Range Hood.

Project Goal:

Integrate smart features in future, commercially available range hoods.

Purpose and Objectives

Problem Statement

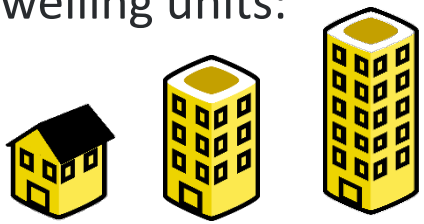
1. Infiltration accounts for more energy use than any other building envelope component.
2. Tight, energy efficient dwelling units require mechanical ventilation to provide acceptable IAQ.
3. One of the largest sources of indoor air pollution is cooking.
4. Ineffective kitchen ventilation ("too noisy" or "not needed") is a barrier to the construction of healthy, energy efficient dwelling units.

Objectives

1. Develop a Smart Range Hood that senses pollutants, with automatic operation
2. Improve residential IAQ, extend lives, and save billions of dollars in health-related costs annually

Purpose and Objectives, cont'd

Target Market and Audience: Single-family and multifamily dwelling units: infiltration energy use of 2.26 quads/yr (MYPP Table 6)



Impact of Project:

1. Project output: demonstration of smart, energy efficient range hood

2. Energy savings potential of air sealing and mechanical ventilation: ~2 quads/yr (Sherman et al., 2013*)

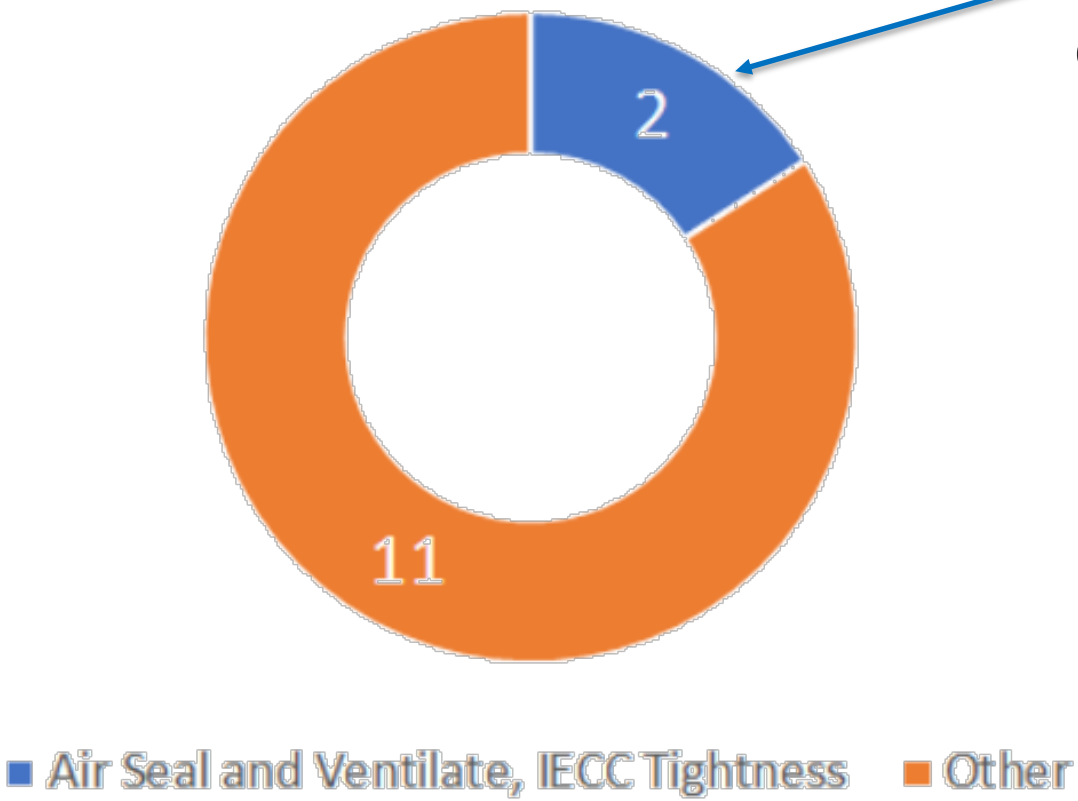
3. Outcomes:
   A. Near: concept demonstration
   B. Intermediate: market introduction of products
   C. Long: 25% market penetration

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

*Sherman et al. 2013. Residential Energy Savings from Air Tightness and Ventilation Excellence. CEC-500-2014-014

Relevance

BTO Goal: 40% reduction in residential EUI by 2030 (~13 quads)



Air seal & ventilate: could account for up to 2 quads (16%) of BTO's goal for the residential building sector

Approach

Address critical market barriers

Problem	*Solution*
Too Noisy:	≤ 1 sone at 150 cfm
Poor Capture:	~100% CE
Not Operated:	auto response
Inefficient:	up to 5x more efficient than ENERGY STAR
High Cost:	pricing for intermediate market

Distinctive Characteristics: quiet, superior capture efficiency, energy efficient, responsive to pollutants

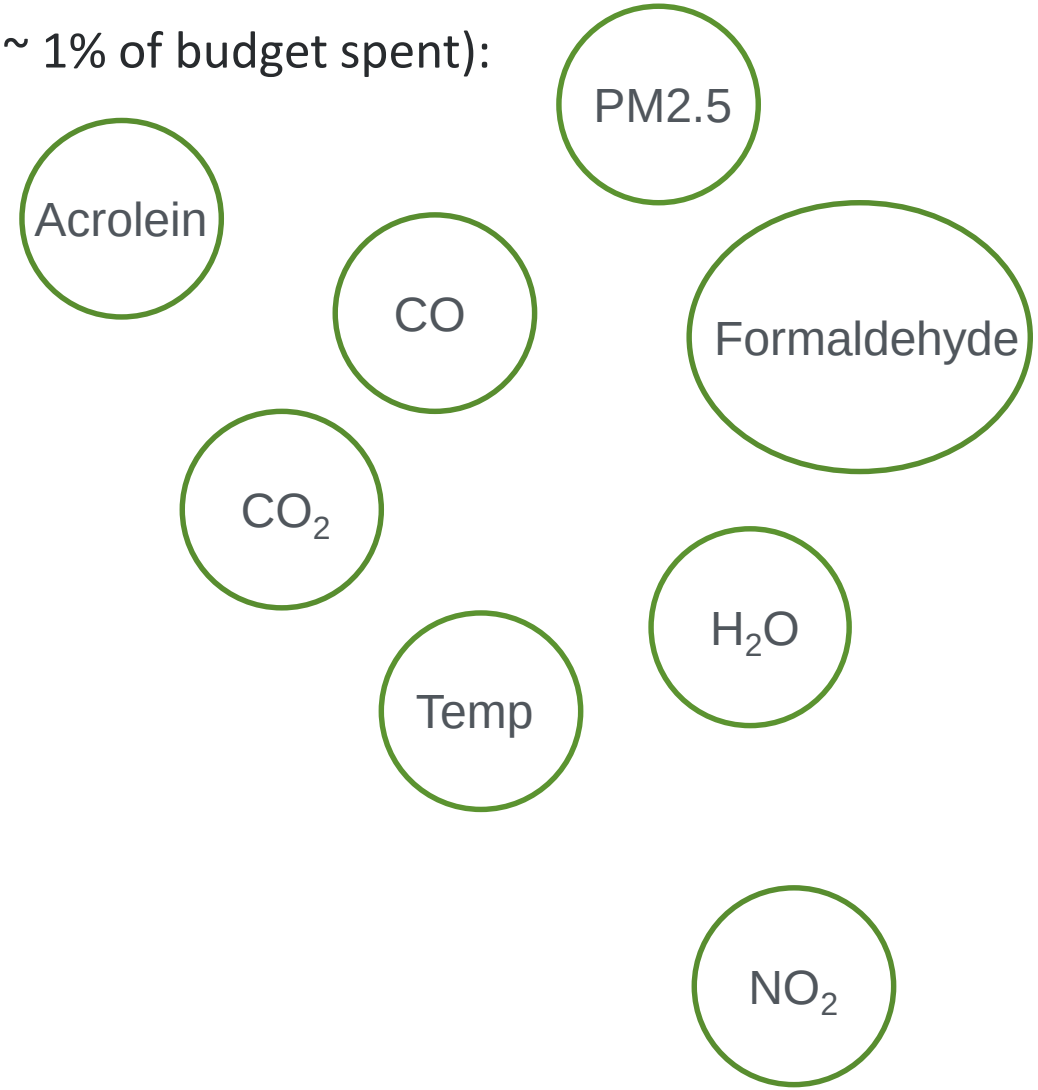
Key Issues: Sensor accuracy, control algorithms, user acceptance

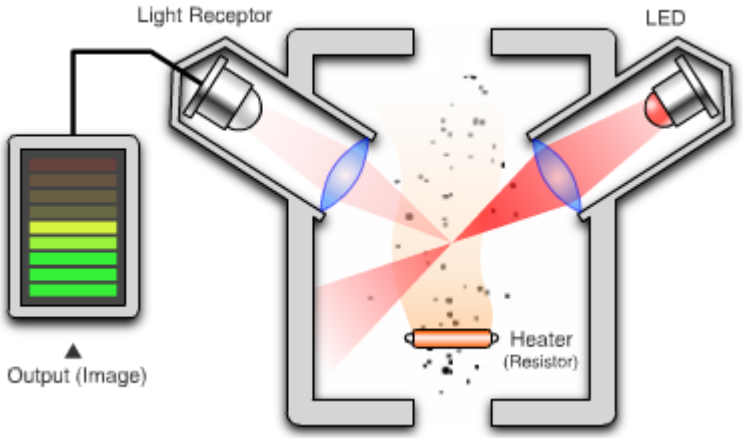
Progress and Accomplishments

Accomplishments (New project with ~ 1% of budget spent):

1. Developed Pollutant and Sensor Matrix: concentration thresholds and ranges, sensor accuracy and costs

2. Identified Low-Cost, Accurate Sensors





Images c/o Shinyei Technology

Progress and Accomplishments, cont'd

3. Addressed Regulatory Barrier:
   A. Currently, ASHRAE 62.2 does not permit auto-ON controls without occupant OFF control (no such barrier in I-codes)
   B. Proposed change to permit such controls
   C. approved by 62.2 committee in January by a vote of 21-0-2.

62.2 New Text (in process):

automatic control: a control that operates without the need for manual or remote occupant intervention and operates as a function of one or more input variables or conditions, including but not limited to time, humidity, temperature, occupancy, appliance operation, and contaminant concentration.

Demand-controlled mechanical exhaust systems shall be provided with at least one of the following controls:
1. A readily accessible occupant-controlled ON-OFF control.
2. An *automatic control* that does not impede occupant ON control.

Progress and Accomplishments, cont'd

Market Impact: On-track to address critical market barriers and achieve goals

Awards/Recognition: None to date

Lessons Learned: No unanticipated barriers

Project Integration and Collaboration

Project Integration:

- Manufacturer Partner: Broan-NuTone is the largest U.S. manufacturer of residential range hoods
- Ventilation Codes and Standards: Newport has proposed more successful changes to ICC and ASHRAE 62.2 than any other group in last 5 years

Partners, Subcontractors, and Collaborators:

- Manufacturer: Broan-NuTone
- Collaborators: Lawrence Berkeley Lab – project review/comments

Newport Partners L.L.C.

BROAN NuTone

BERKELEY LAB

Parallel Efforts

- LBL: ASTM Capture Efficiency Test Method
- Home Ventilating Institute: Likely to develop CE certified rating program

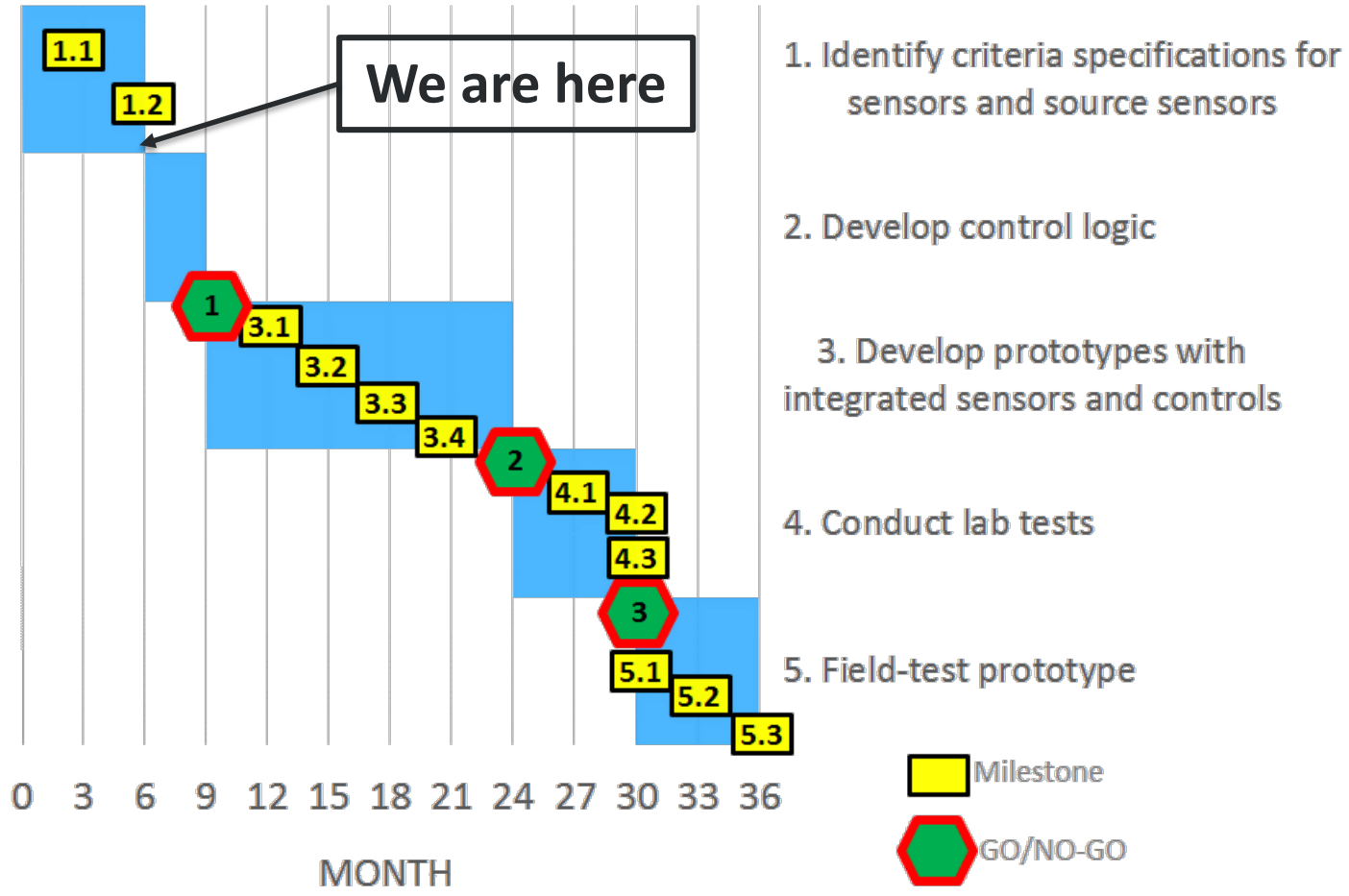
Communications: None to date. ASHRAE meetings expected to be regular outlet

Next Steps and Future Plans

Phase 1: Pre-Prototype

Phase 2: Prototype Development

Phase 3: Lab and Field Testing



REFERENCE SLIDES

Project Budget

Project Budget: $462,803
Variances: None
Cost to Date: $5,892 (~1% of total)
Additional Funding: None

Budget History					
FY 2017 (planned)		FY 2018 (planned)		FY 2019 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$94,918	$47,617	$121,741	$88,296	$246,144	$77,907

Project Plan and Schedule

Period of performance: October 1, 2016 - September 30, 2019

Milestone	Description	Federal Year Due Date
M1.1	Develop sensor specification table with primary pollutants and key criteria	2017 Q2
M1.2	Source affordable sensors that also achieve high performance	2017 Q2
M1.3	Develop project management plan (PMP)	2017 Q2
GNG1	Develop logic models that addresses auto-operation and 62.2 compliance.	2017 Q3
M2.1	Develop lab test plan	2017 Q4
M3.1	Develop first prototype of sensor and control module	2018 Q1
M3.2	Develop second prototype of sensor and control module	2018 Q2
M3.3	Develop a first-generation prototype with integrated sensors and controls	2018 Q3
M3.4	Develop a second-generation prototype with integrated sensors and controls	2018 Q4
GNG2	Test and verify the response of the second gen prototype to a typical cooking scenario.	2019 Q1
M4.1	Conduct lab tests for capture efficiency using the latest ASTM draft capture efficiency test	2019 Q2
M4.2	Conduct lab test for sound per HVI 915	2019 Q3
M4.3	Conduct lab test for auto operation with respect to pollution sensing and response	2019 Q3
M4.4	Develop field test plan, including human subjects review (HSR)	2019 Q2
M5.1	Conduct first field test and report on performance	2019 Q3
M5.2	Conduct second field test and report on performance	2019 Q4
M5.3	Conduct third field test and report on performance	2019 Q4
M5.4	Final technical report and case study	2020 Q1
M6.1, M6.4, M6.7	Attend Building America stakeholder, expert or program planning meeting	2017, 2018, 2019
M6.2, M6.5, M6.8	Participate in Building America technical peer review process (up to 3 annually)	TBD
M6.3, M6.6, M6.9	Present results in webinars and conferences (up to 2 annually)	2017, 2018, 2019
M6.10	Participate in BTO Peer Review	TBD