Performance-Based IAQ and Optimized Ventilation

2017 Building Technologies Office Peer Review

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

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Project Summary

Timeline:

Start date: October 1, 2016

Planned end date: September 30, 2018

Key Milestones

1. Sensors tested in lab chamber; 06/31/2017
2. Monitoring packages deployed in homes; 08/31/2017
3. Humidity control ERV installed in new construction homes; 08/31/2017

Budget:

Total Project $ to Date:

- DOE: $42,794
- Cost Share: $14,325

Total Project $:

- DOE: $661,417
- Cost Share: $214,134

Key Partners:

UL Environment	Beazer Homes
University of Illinois	Kerley Family Homes
LBNL	Greater Atl HBA
Venmar	WrightSoft
Senseware	LG Squared

Project Outcome: *Enable adoption of high performance home technologies by proving maintained/improved IAQ*

- Establish performance metrics for low-cost IAQ sensors.
- Enable smart, connected technologies which optimize IAQ, energy and comfort.
- Improve valuation of IAQ technologies by measuring impacts pollutant levels and energy consumption.

Purpose and Objectives

Problem Statement: High performance homes are at increased risk of IAQ, humidity and comfort challenges. In order to improve indoor air quality (IAQ) in homes, while also ensuring comfort and reducing energy consumption, ventilation manufacturers should develop technologies which respond to pollutant levels and optimize fresh air exchange. Establishing performance requirements for IAQ pollutant sensors is essential to acceptance of such approaches.

Target Market and Audience: Sensor/monitor manufactures, standards development organizations and home builders. Fifty percent (50%) adoption of the humidity control ERV in new construction in the South will save 340,000 MMBtu/yr over central fan integrated systems.

Purpose and Objectives

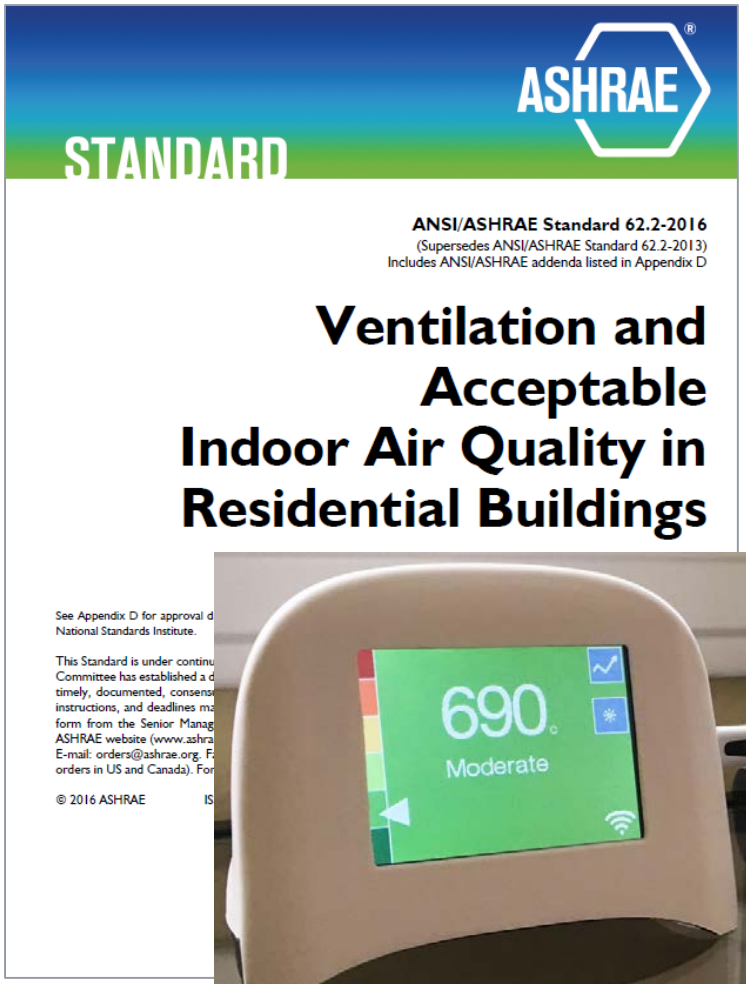
Impact of Project: *Success will result in improved IAQ at lower total cost of ownership*. Outputs will enable sensor, monitor and equipment manufacturers to coordinate with standards development and program administrators to transition from prescriptive to performance metrics. Project will also demonstrate impact of humidity-control ERV in hot-humid climate zone.

Program Goals:

a. Approach for establishing sensor performance requirements.
b. IAQ pollutants benchmarked in new and existing homes using low-cost sensors.
c. Proven and documented innovative ERV overcoming builders' barriers to ventilation and increased air tightness in the South.
d. Pathway to allowing a performance-based (smart) ventilation standard.

- Reduce EUI by decreasing energy consumption for HVAC
- Integrated, systems approach to enclosure air tightness, IAQ, and comfort systems

What Is “Good” Air Quality?



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Approach

Approach:

- Establish performance requirements for IAQ sensors with industry/standards engagement
- Benchmark pollutants in new and existing homes using low-cost sensors/monitors
- Demonstrate, test and validate energy saving ventilation technology in test homes

Key Issues:

- Prescriptive vs. Performance
  - May be over ventilating – wasting energy

Distinctive Characteristics:

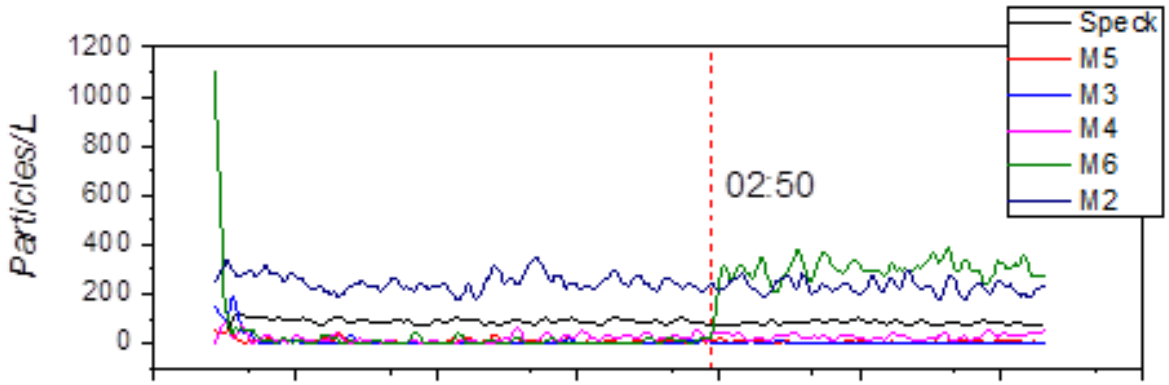
- Define Key Performance Indicators
- Innovative ERV
- Address market uncertainty around sensors and ventilation

Progress and Accomplishments

Accomplishments: Engaged with market-leading partners, including Beazer Homes, Venmar, WrightSoft and Senseware. Also leveraging intradepartmental relationships with LBNL and EPA.

Market Impact: Demonstrated $PM_{2.5}$ sensor/monitor performances in UL Environment chamber.

Lessons Learned: Software challenges for modeling ERV extend beyond humidity control to include HVAC design (Manual J), and are an issue for all E/HRV's.



Southface-built $PM_{2.5}$ and Speck monitors in clean test chamber

Project Integration and Collaboration

Project Integration: Collaborate with LBNL on IAQ Score development/pilot; sub-contractor University of Illinois is member of GTI Building America team; NREL on innovative modeling approach.

Partners, Subcontractors, and Collaborators: UL Environment, University of Illinois, Venmar (Broan/NuTone), Beazer Homes, Kerley Family Homes, LBNL, WrightSoft, Senseware, Greater Atlanta Home Builders Association, LG Squared.

Communications: RESNET and Home Performance Coalition National Conferences.

Next Steps and Future Plans

Next Steps and Future Plans:

Establish IAQ Sensor requirements

Assemble and test sensor package

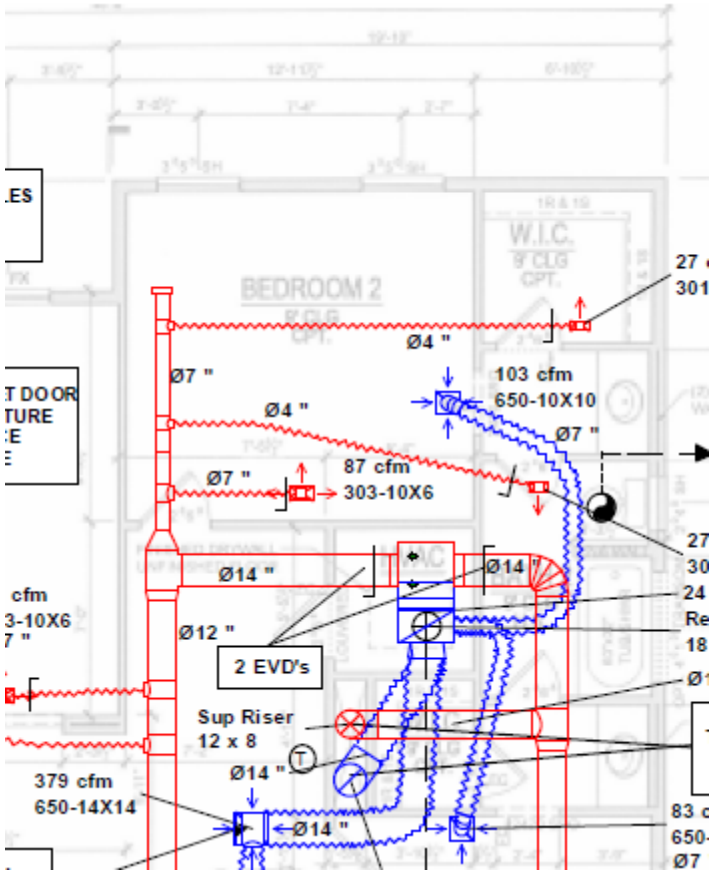
New Construction Test Homes: measure impact of ERV vs. CFIS and pilot IAQ Score

- 2 Homes in Charleston
- 2 Homes in Atlanta

Existing Home Test Homes: measure impact of energy upgrade

- Collaboration with GTI Team

Potential for Future Exploration of Measurement-Based Scoring/Certification



REFERENCE SLIDES

Project Budget

Project Budget: DOE: $661,417; Cost Share: $214,134
Variances: Finalizing contracts with UL Environment and University of Illinois.
Cost to Date: $42,794 has been invoiced to date. Southface invoices DOE quarterly.
Additional Funding: Southface is grateful for the contributions of LBNL, NREL and other Federal partners.

Budget History					
10/01/2016 – FY 2016 (past)		FY 2017 (current)		FY 2018 – 09/31/2018 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$42,794	$14,325	$363,438	$119,509	$255,185	$80,300

Project Plan and Schedule

Timeline 10/01/2016 – 09/31/2018

TASKS TO BE PERFORMED - PHASE 1		Budget Period 1												Budget Period 2												Milestones
TASK		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1.0	develop IAQ Assessment Protocol/Sensor Package	Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8			
	1.1 Conduct literature review	–	–	–	–	→	■																			
	1.2 Initial sensor performance requirements developed	–	–	–	–	→	■																			
	1.3 Monitoring packages assembled and calibrated	–	–	–	–	→	■																			
	1.4 Monitoring packages tested at Southface Eco Office	–	–	–	–	→	■																			
							■																			1.1 Monitoring packages assembled and programmed
							■																			1.2 Working units calibrated in controlled environment
							■																			1.3 Working units tested on Southface campus
2.0	IAQ Benchmarking																									
	2.1 Submit test plan							■																		
	2.2 Select test homes monitoring packages							■																		
	2.3 Recruit test homes							■																		
	2.4 Meassure test home building performance parameters							–	–	–	–	→	■													
	2.5 Deploy and maintain sensors							–	–	–	–	→	■													
	2.6 Monitor, retrieve, and redeploy sensors as needed							–	–	–	–	→	■													
	2.7 Process and analyze IAQ and performance data							–	–	–	–	→	■													
										■																2.1 Monitoring packages deployed in first cohort
										■																2.2 Monitoring packages deployed in second cohort
3.0	Assess "Smart" Ventilation on IAQ and Energy																									
	3.1 Recruit at least 2 test homes	–	–	–	–	–	–	–	–	–	–	→	■													
	3.2 Partner with builders on HVAC system design	–	–	–	–	–	–	–	–	–	–	→	■													
■	Go/No-Go 1.1 MOU signed with 2 homebuilders									■																

Project Plan and Schedule, continued

TASKS TO BE PERFORMED - PHASE 1		Budget Period 1												Budget Period 2												
TASK		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Milestones
4.0	**Technical and Project Management**																									
	4.1 Ongoing project management and reporting	–	–	–	–	–	–	–	–	–	–	→														
	4.2 Test plan development																									
																										4.1 PMP accepted by DOE
5.0	**Project Management and Reporting**																									
	5.1 Attend Building America meeting	–	–	–	–	–	–	–	–	–	–	→														
	5.2 Participate in BA peer review	–	–	–	–	–	–	–	–	–	–	→														
	5.3 Present results of BA projects (webinars/conferences)	–	–	–	–	–	–	–	–	–	–	→														
	5.4 Participate in BTO Peer Review	–	–	–	–	–	–	–	–	–	–	→														
	Go/No-Go Decision Points																									
	Go/No-Go 1.2 Twenty sensor packages deployed																									
6.0	**IAQ Benchmarking**																									
	6.1 Recruit additional homes if necessary													–	–	–	–	–	–	–	–	–	–	→		
	6.2 Measure test home building parameters													–	–	–	–	–	–	–	–	–	–	→		
	6.3 Deploy and maintain monitoring packages													–	–	–	–	–	–	–	–	–	–	→		
	6.4 Monitor, retrieve, and redeploy packages as needed													–	–	–	–	–	–	–	–	–	–	→		
	6.5 Process and analyze IAQ and performance data													–	–	–	–	–	–	–	–	–	–	→		
																										6.1 Data from monitored existing homes analyzed
																										6.2 Data from monitored new construction homes analyzed

Project Plan and Schedule, continued

TASKS TO BE PERFORMED - PHASE 1		Budget Period 1												Budget Period 2												Milestones
TASK		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
7.0	Assess "Smart" Ventilation on IAQ and Energy																									
	7.1 Recruit additional homes if necessary													–	–	–	–	–	–	–	–	–	–	→		
	7.2 Measure test home building parameters													–	–	→										
	7.3 Deteremine package needed for IAQ measurements																									
	7.4 Develop test plan for ERV performance measurement													–	→											
	7.5 Deploy monitoring in test homes													–	–	→										
	7.6 Request 12-month utility data for test homes													–	–	–	–	–	–	–	–	–	–	→		
	7.7 Monitor, retrieve, and redeploy monitoring packages													–	–	–	–	–	–	–	–	–	–	→		
	7.8 Analyze IAQ and energy metrics, and compare data													–	–	–	–	–	–	–	–	–	–	→		
																										7.1 Determine IAQ impact of "smart" ventilation strategies
8.0	Technical and Project Management																									
	8.1 Ongoing project management and reporting													–	–	–	–	–	–	–	–	–	–	→		
9.0	Building America Program Support																									
	9.1 Attend Building America meeting													–	–	–	–	–	–	–	–	–	–	→		
	9.2 Participate in Building America peer review													–	–	–	–	–	–	–	–	–	–	→		
	9.3 Present results in technical webinars and conferences													–	–	–	–	–	–	–	–	–	–	→		
	9.4 Participate in BTO Peer Review													–	–	–	–	–	–	–	–	–	–	→		