Healthy Efficient Homes Research & Standards

2016 Building Technologies Office Peer Review

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

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Project Summary

Please note this data will be provided in later slides, take the time to make sure it matches.

Timeline:

Start date: FY14

Planned end date: FY19

Key Milestones

1. Technical Report on Occupancy Controlled Smart Ventilation, 9/15/2016
2. Completed ASTM Range Hood Capture Efficiency Standard, 9/15/2016
3. Report on Preliminary Development of an IAQ Valuation Score, 12/15/2016

Key Partners:

ASHRAE	CARB
ASTM	AIVC
RESNET	EPA
CEC	HUD
BPA	HVI

Budget:

Total Project $ to Date:

- DOE: $3.9 m
- Cost Share: $3.4m

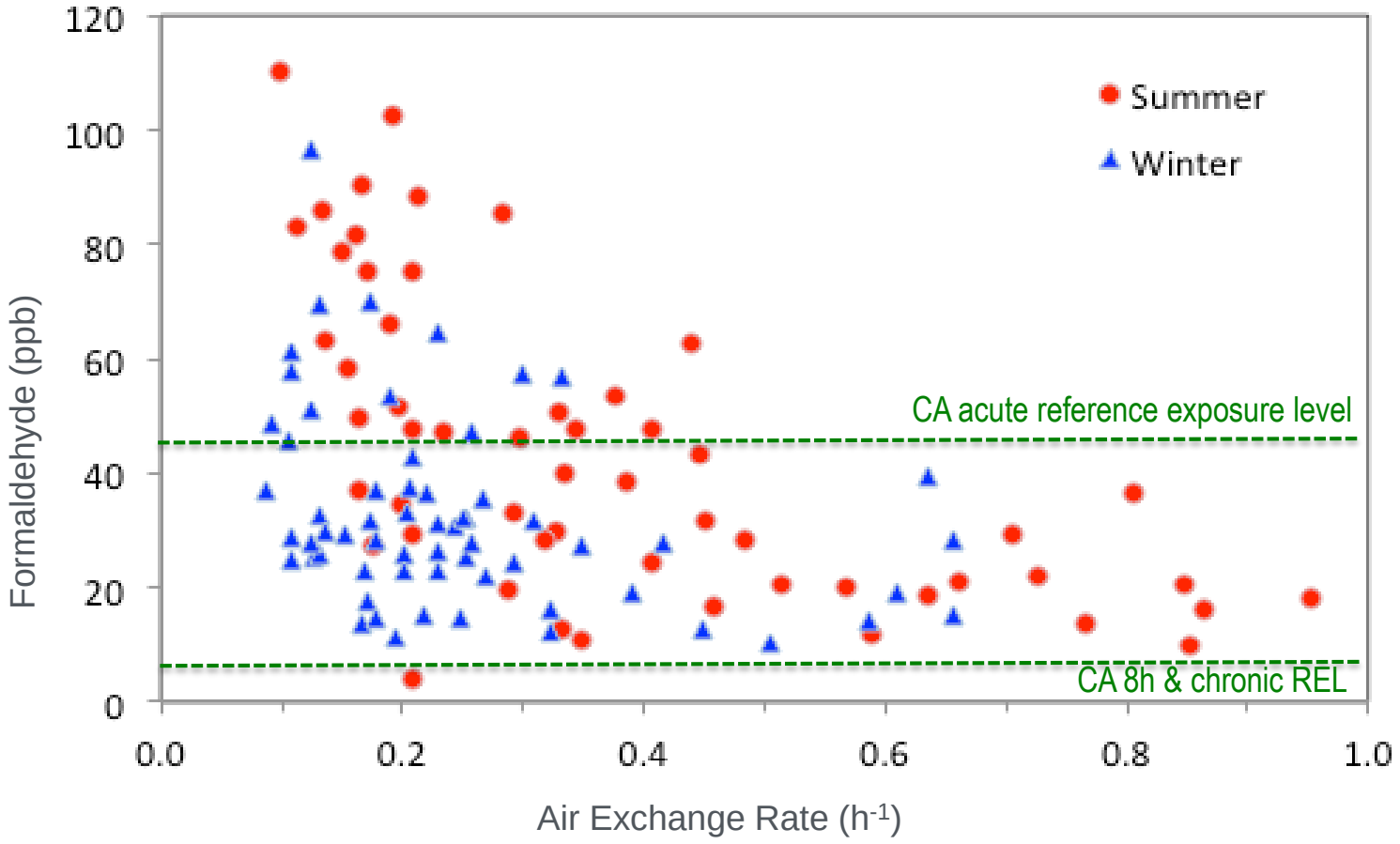
Total Project $:

- DOE: $7.8m
- Cost Share: $6m

Project Outcome:

This project will produce innovative technologies, industry guidance and codes and standards that ensure good indoor air quality (IAQ) in homes. This will remove barriers concerning IAQ while reducing the energy cost of IAQ, and allow the building industry to achieve the 40% energy savings in existing homes and 60% reductions in new homes targeted in the MYPP.

Problem: Pollutants elevated in tight homes w/o ventilation



Results from California New Home Study*

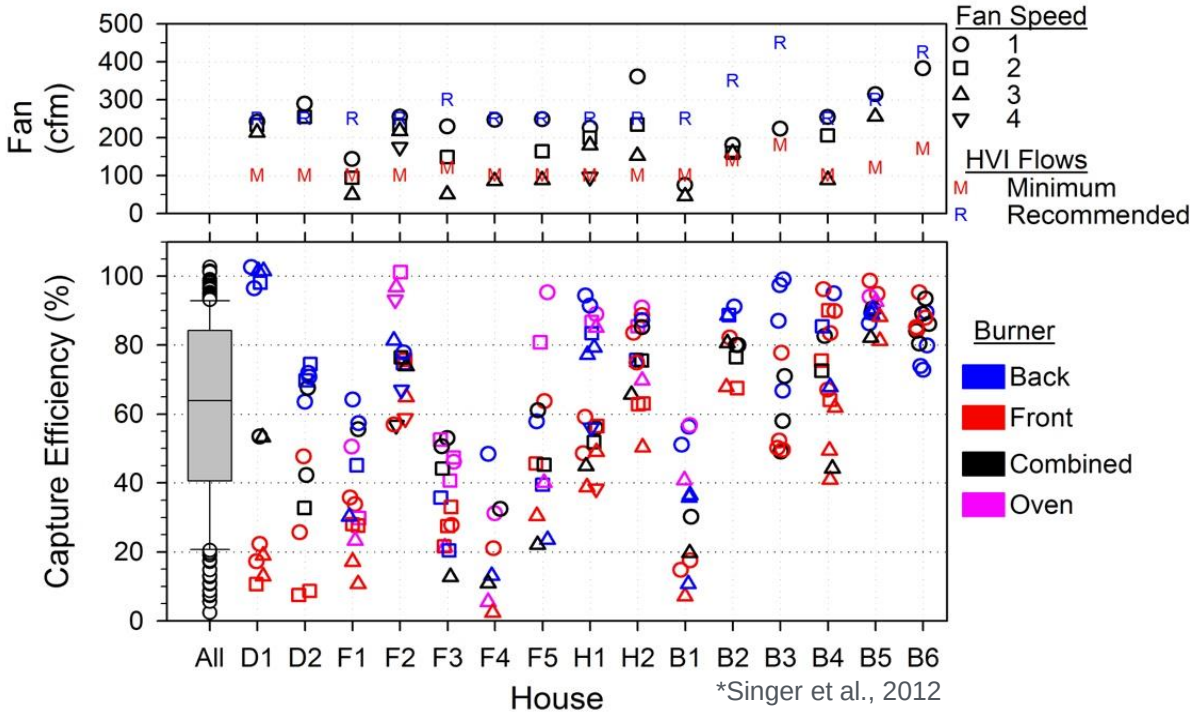
Built in 2002-5
Msd in 2006-7
N=108

*Offermann, CEC-500-2009-085

Problem: Kitchen ventilation standards insufficient

Standard	Fraction of people exposed above std.	Estimated # impacted in California	Estimated # impacted across U.S.
CO, 1-h CAAQS	9%	1.7M	10M
NO_2, 1-h NAAQS	62%	12M	66M

Based on simulations of 6634 SoCal homes. Typical Week in Winter. (Logue et al., 2014)



*Singer et al., 2012

- Kitchen ventilation not required by many states
- ASHRAE 62.2 standard requires 100 cfm & 3 sone
- Many hoods ineffective; no way to know
- Lack of awareness about need.

Purpose and Objectives

Problem Statement: Concerns about indoor air quality (IAQ) and moisture problems are a market barrier for airtight efficient homes. Interest in improving health through IAQ is a motivator for retrofits that reduce energy. Industry needs guidance supported by research & demonstrations.

Target Market: New homes and homes undergoing renovation/retrofit.

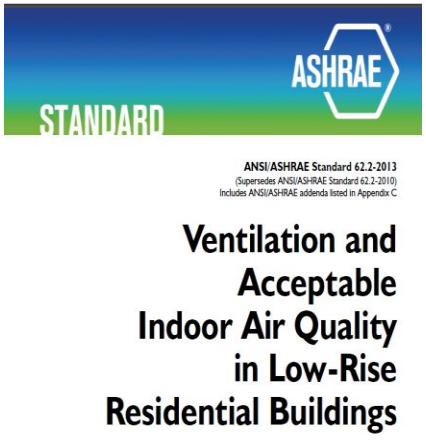
Audiences: Designers, builders, contractors, utility programs, code authorities, public health & housing agencies, ventilation and IAQ equipment manufacturers.

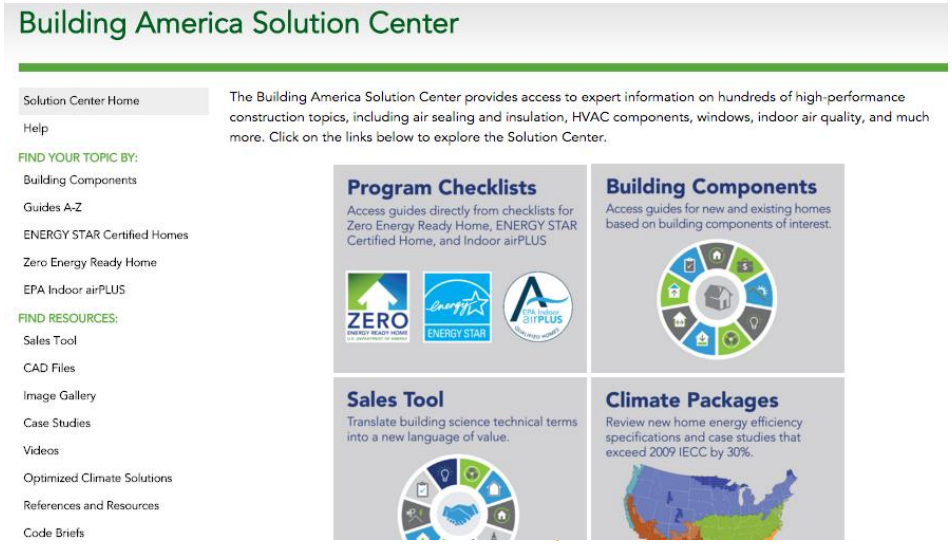
Goal is to enable air sealing to reduce heating and cooling energy of residential stock by 15-30% (0.7–1.4 quads).

Purpose and Objectives

Impact of Project:

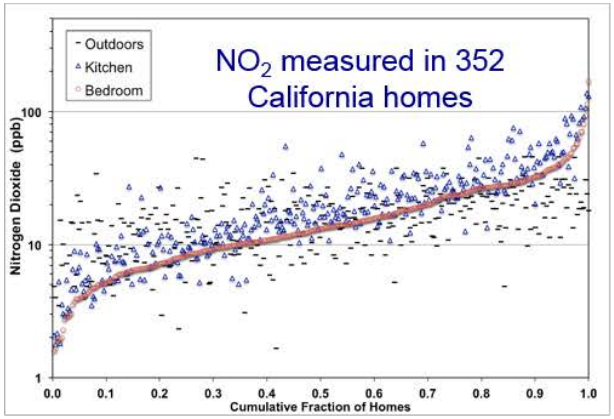
1. Products are peer-reviewed technical reports and scientific papers guiding practice, standards, codes, and product development.
2. Progress measured by published codes and standards, expanded use of best practices, and improved technologies.
3. Success is zero-energy ready new homes and deeply retrofitted existing homes without adverse IAQ and health impacts.



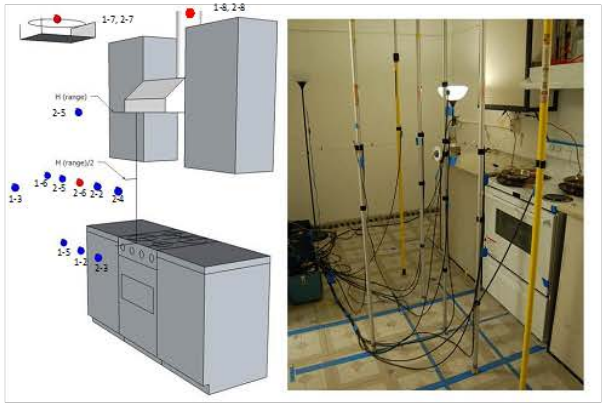


Approach – R&D Methods

Laboratory experiments

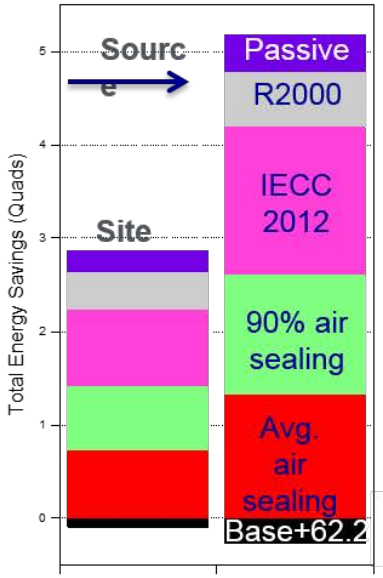


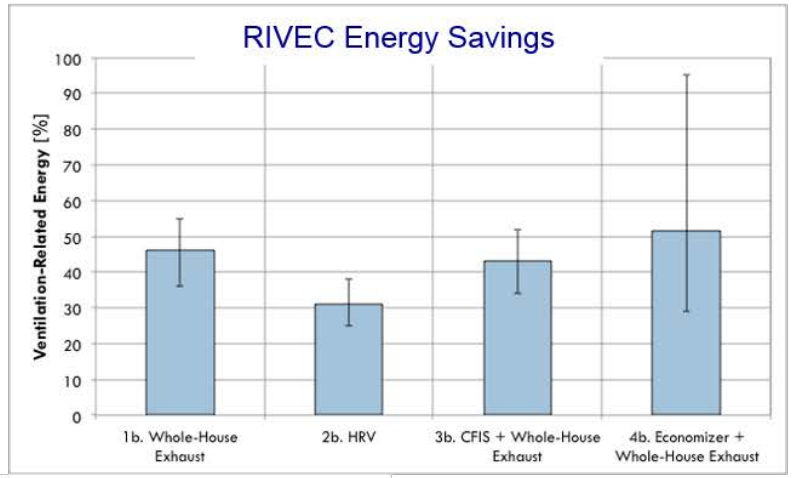
Surveys and data collection



Test method development & demos

Controlled experiments in homes

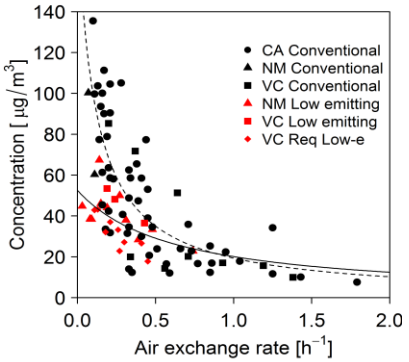




Analysis & Simulations

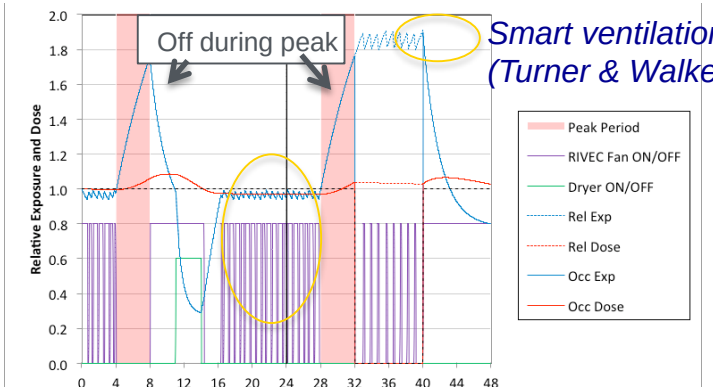
Approach – Key Issues from Tech to Market Roadmap

- **Targeted pollutant solutions:** source reduction & task ventilation to reduce general dilution ventilation.



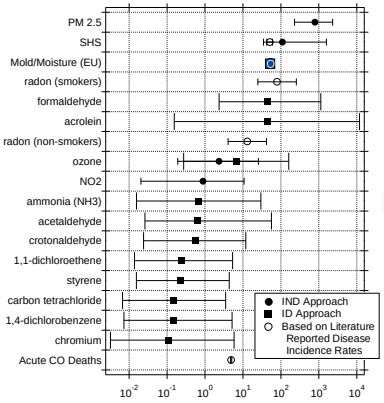
Formaldehyde 42% lower in homes built with low emitting materials (Hult et al. 2014)

- **Smart ventilation technologies** that reduce energy and peak loads. Sensors and controls to integrate all ventilation equipment for optimal energy and IAQ.

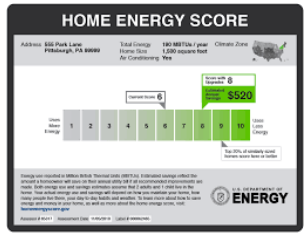


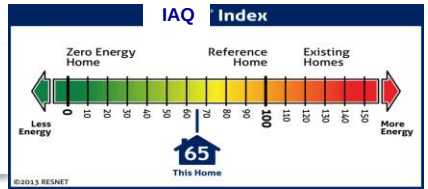
Smart ventilation savings (Turner & Walker, 2013)

- **IAQ valuation** based on health benefits to standardize assessment, prioritize measures and create market demand for high performance homes.



Health impact





Approach: Distinctive Characteristics

1. *Strong industry connections*.
2. *Building science principles and rigorous research methods.*
3. *Appropriate methodologies to achieve technical innovations*.
4. *Deep and broad experience* in residential energy, ventilation, and IAQ science and methodologies.


Max Sherman


Iain Walker


Brett Singer

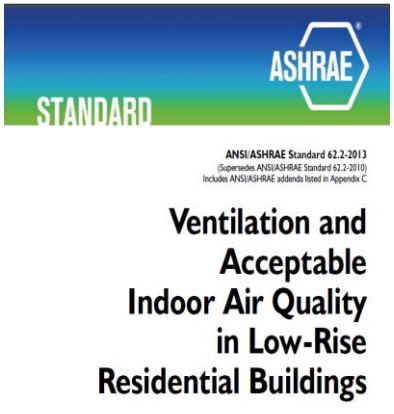

Woody Delp


Rengie Chan


Brennan Less

Progress and Accomplishments

- RESNET Standard 380 on diagnostics for home energy ratings
- ASHRAE 62.2 allowance for smart ventilation controls
- Developed smart ventilation controls to reduce moisture risks in humid climates
- Draft ASTM standards for kitchen range hood and HVAC air flow diagnostics



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Progress and Accomplishments

Market Impact:

- RESNET standards affect about 40% of all new homes.
- ASHRAE 62.2 affects hundreds of thousands of hew homes and all homes from the DOE weatherization program.
- Smart ventilation equipment just starting to emerge.
- Expanded recognition of need for kitchen exhaust ventilation. Industry engaged in developing standard test.

Lessons Learned:

- Tortuous path from concept to approved standard, even when starting with consensus on goal and approach.
- Long lead times develop new products and change practices.

Partners, Subcontractors, and Collaborators

Industry

Codes and Standards

Communications

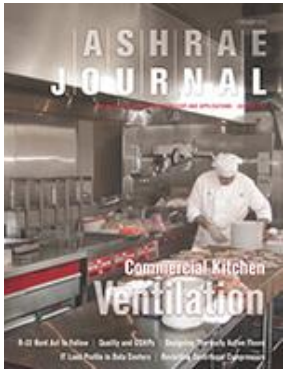
Scientific Journals

ehp ENVIRONMENTAL HEALTH PERSPECTIVES

Environmental Science & Technology

INDOOR AIR
International Journal of Indoor Environment and Health

Practitioner Journals



Presentations to Industry & Practitioners

ASHRAE

EEBA

Home Performance Coalition

INDOOR AIR QUALITY ASSOCIATION

PHIUS
Passive House Institute US

RESNET
RESIDENTIAL ENERGY SERVICES NETWORK

FORUM ON DRY CLIMATE
HOME PERFORMANCE

International Society of Indoor Air Quality and Climate

AIVC Air Infiltration and Ventilation Centre

12TH REHVA WORLD CONGRESS CLIMA2016

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Next Steps and Future Plans

Next Steps:

- Finalize test for wall-mount range hoods; add island and downdraft.
- Draft IAQ scoring tool
- Pollutant removal (filtration) credit in ASHRAE 62.2.
- Continue to develop smart ventilation algorithms. Support industry to incorporate into homes. Investigate occupancy and pollutant sensors.

Future Plans:

- Metrics & test for automatic range hoods.
- Revise kitchen ventilation standards for improved capture and sound.
- Pilot and finalize IAQ scoring tool and related resources.
- Tech support to credit smart ventilation in codes and standards

REFERENCE SLIDES

Project Budget

Project Budget: Level funding at $1.3m/year
Variances: There are no variances from planned budget. Some tasks have been expanded – key example is the IAQ Score/valuation task has been expanded to investigate emerging sensor technologies
Cost to Date: $500k
Additional Funding: Bonneville Power Administration: $300k, CEC HENGH project: $1.25m, CEC Attics: $1m, EPA/HUD $275k, NEW CEC Project SVACH $1.5 m

Budget History					
FY 2014 – FY 2015 (past)		FY 2016 (current)		FY 2017 – FY2020 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$2.6m	$2.4m	$1.3m	$1m	$3.9m	$2.6m

Project Plan and Schedule

- Go/no-go decision point: move on to island and downdraft range hood test development only if draft test method for wall mount hoods is complete
- Future work: complete ASTM test methods for range hood capture efficiency and register flow measurement, develop IAQ score, study IAQ sensors, develop smart ventilation control strategies

Project Schedule

Project Start: FY14

Projected End: FY19

Completed Work

Active Task (in progress work)

Milestone/Deliverable (Originally Planned)

Milestone/Deliverable (Actual)

Task	FY2014				FY2015				FY2016			
	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												
Q1 Milestone: Progress report on residential IEQ research being conducted with joint support from HUD and EPA	◆											
Q2 Milestone: Published report on experimental assessment of capture efficiency for cooking-generated particles in comparison to exhaust gases		◆										
Q3 Milestone: Complete simulations for temperature controlled smart ventilation			◆									
Q4 Milestone: Submit materials to BA best practices website for smart ventilation				◆								
Q1 Milestone: Proposed language for 62.2 revisions to include air filtration					◆							
Q2 Milestone: Report on temperature controlled ventilation						◆						
Q3 Milestone: Draft ASTM Range Hood Capture Efficiency Standard							◆					
Q4 Milestone: Draft Report on Range Hood Capture Efficiency Rating Development								◆				
Current/Future Work												
Q4 Milestone: Technical Report on Occupancy Controlled Smart Ventilation												◆
Q4 Milestone: Completed ASTM Range Hood Capture Efficiency Standard												◆
Q4 Milestone: Report on IAQ Benefits and Energy Costs of Various Filtration and Air Cleaning Strategies												◆