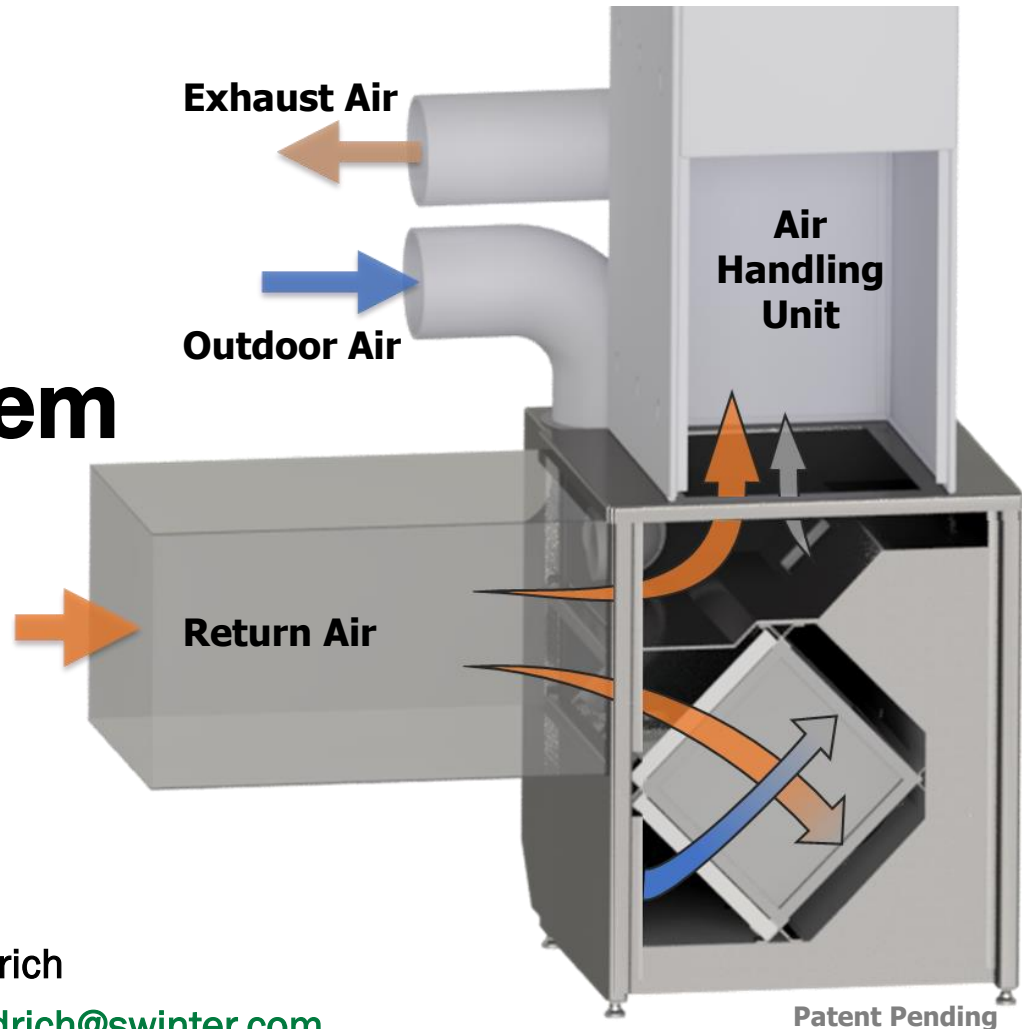


# Ventilation Integrated Comfort System (VICS)



Steven Winter Associates, Inc.

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# Project Summary

## Timeline:

Start date: August 2016

Planned end date: July 2019

## Key Milestones

1. Fully-functional Prototype Testing – Aug 2018
2. Second Prototype Complete – Nov 2018

## Budget:

### Total Project \$ to Date:

- DOE: \$729,993
- Cost Share: \$210,346

### Total Project \$:

- DOE: \$902,438
- Cost Share: \$231,262

## Key Partners:

Therma-Stor LLC
Mitsubishi Electric Trane US
CORE Energy Recovery Solutions

## Project Outcome:

- Enable **heating, cooling**, and whole-building **ventilation** in one **integrated system**.
- Improve **Indoor Air Quality (IAQ)** – critical for **air-tight** homes.
- Achieve up to **10%** energy savings by reducing heating & cooling loads from ventilation;
- Reducing **installed cost** by **30%** over separately ducted HRV/ERVs

# Team

## MITSUBISHI ELECTRIC TRANE HVAC US



***Therma-Stor***<sup>®</sup>

**core**

ENERGY RECOVERY SOLUTIONS



# Challenge

Per MYPP, Building America is solving challenges related to:

- “optimal **comfort systems** for low-load homes”
- “optimal **ventilation** systems and [IAQ] solutions for low-load homes”
- “solutions for homes with a high latent load (**high moisture**)”

BA Research to Market Plan, Ventilation Roadmap: “**Heat recovery is not required or encouraged in ASHRAE Standard 62.2, and it is less commonly specified.**”

As homes get more efficient, ventilation is a bigger fraction of overall home energy.

**40%-60% Savings Target - Up to 10% from H/ERVs**

Balanced, distributed ventilation → better IAQ

# Challenge

Why is heat recovery not standard?

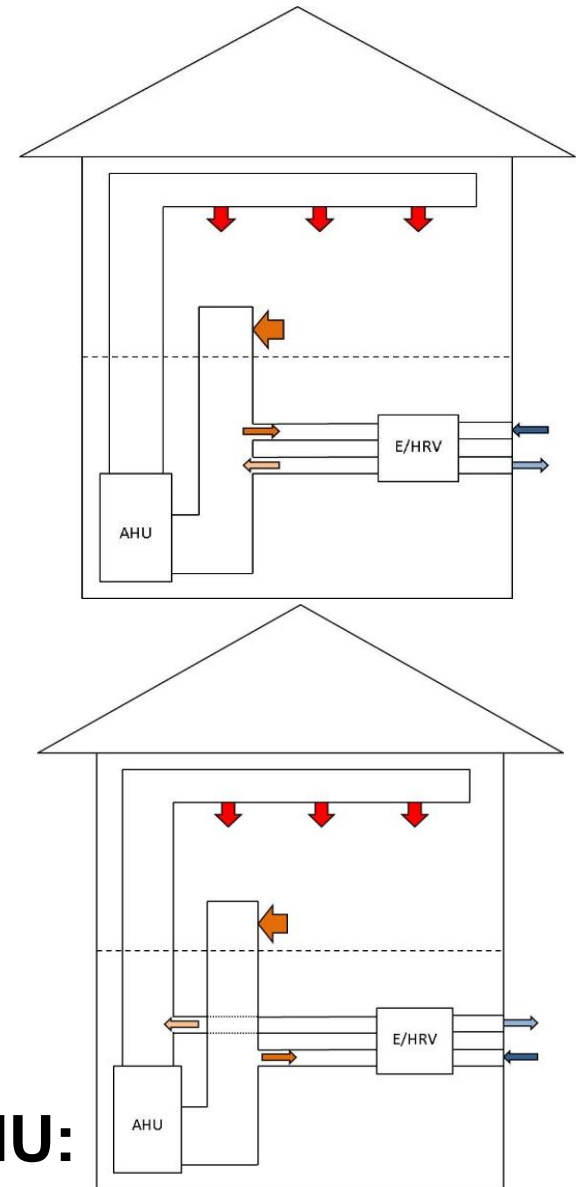
#1 Reason: **COST**

(median \$2,000 - \$3,000 installed)

Other reasons:

- Space constraints
- Maintenance
- Reliability
- Uncertain about energy benefits
- Wall penetrations
- **Not required by codes/programs**

**Inconsistent flow when adding to AHU:**



# Approach

VICS strategy made possible by:

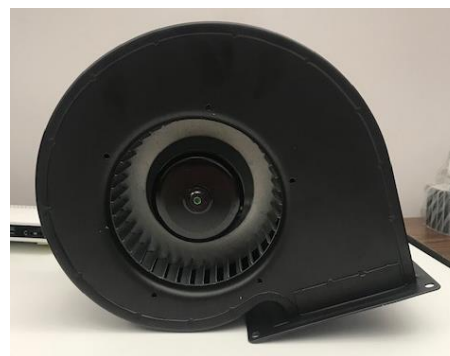
1. Lower heating/cooling loads in high-performance homes
2. Small, efficient H/C equipment

**Manufacturers Develop Low-Load HVAC and Dehumidification Equipment** (For whole-house comfort. Address design and installation issues)

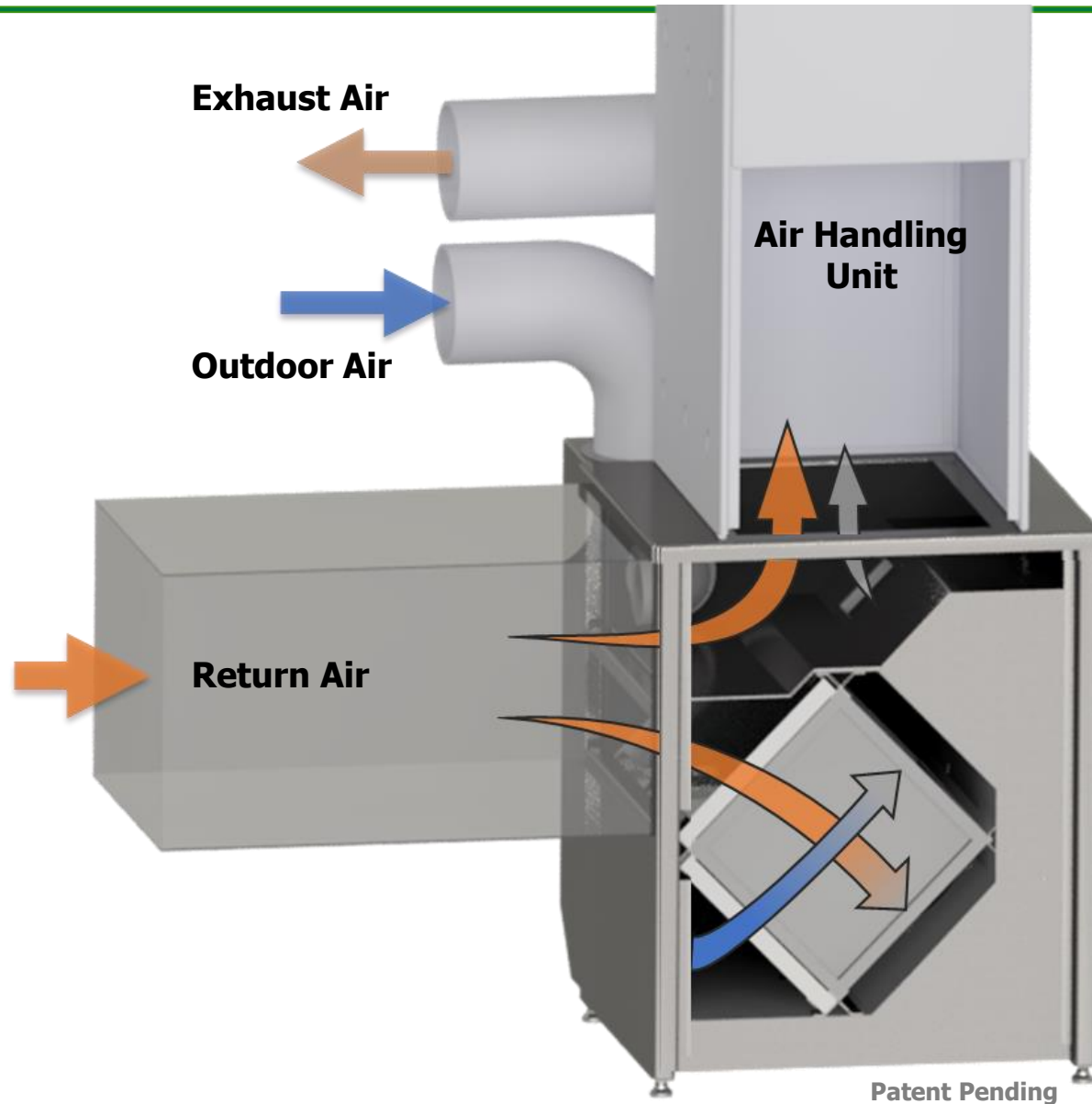
**H/C flow rates now more similar to ventilation flow rates.**

3. Efficient, variable-speed fans

- Smaller
- Lower cost
- Constant flow



# Approach, cont'd



# Impact

## Energy savings example:

- **VICS** compared to 10-Watt exhaust fan
- 65 cfm continuously
- Home heated/cooled with efficient ASHP

	Annual Savings
Chicago	950 kWh
DC	600 kWh
Orlando	70 kWh

Up to **10%** savings towards BA's **40-60%** goals.



# Impact

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Balanced, distributed, filtered ventilation supports  
Building America **IAQ** goals

Lower installed cost: **\$1,500 - \$2,000**  
(current median ~\$2,000 - \$3,000)

From Census & AHRI data (2017):

**120,000** ducted HP in new homes <22 kBtu/h  
**Growing!**

# Progress

**80% complete - on budget, on schedule  
Ending July 2019**

- ✓ **Market & Stakeholder Assessment**
- ✓ **Prototype #1 Design**
- ✓ **Prototype #1 Benchtop Testing**
- ✓ **Prototype #1 Full testing (with heat pump)**
- ✓ **Prototype #2 Design**
- ✓ **Prototype #2 Construction & Testing**
- ✓ **Cost & “Manufacturability” Assessment**

# Progress - Performance Overview

## ERV matched CORE spec's

- 70% Sensible eff. @ 120 cfm
- 50% Total eff. @ 120 cfm
- Both ~10% higher at 60 cfm

## Power

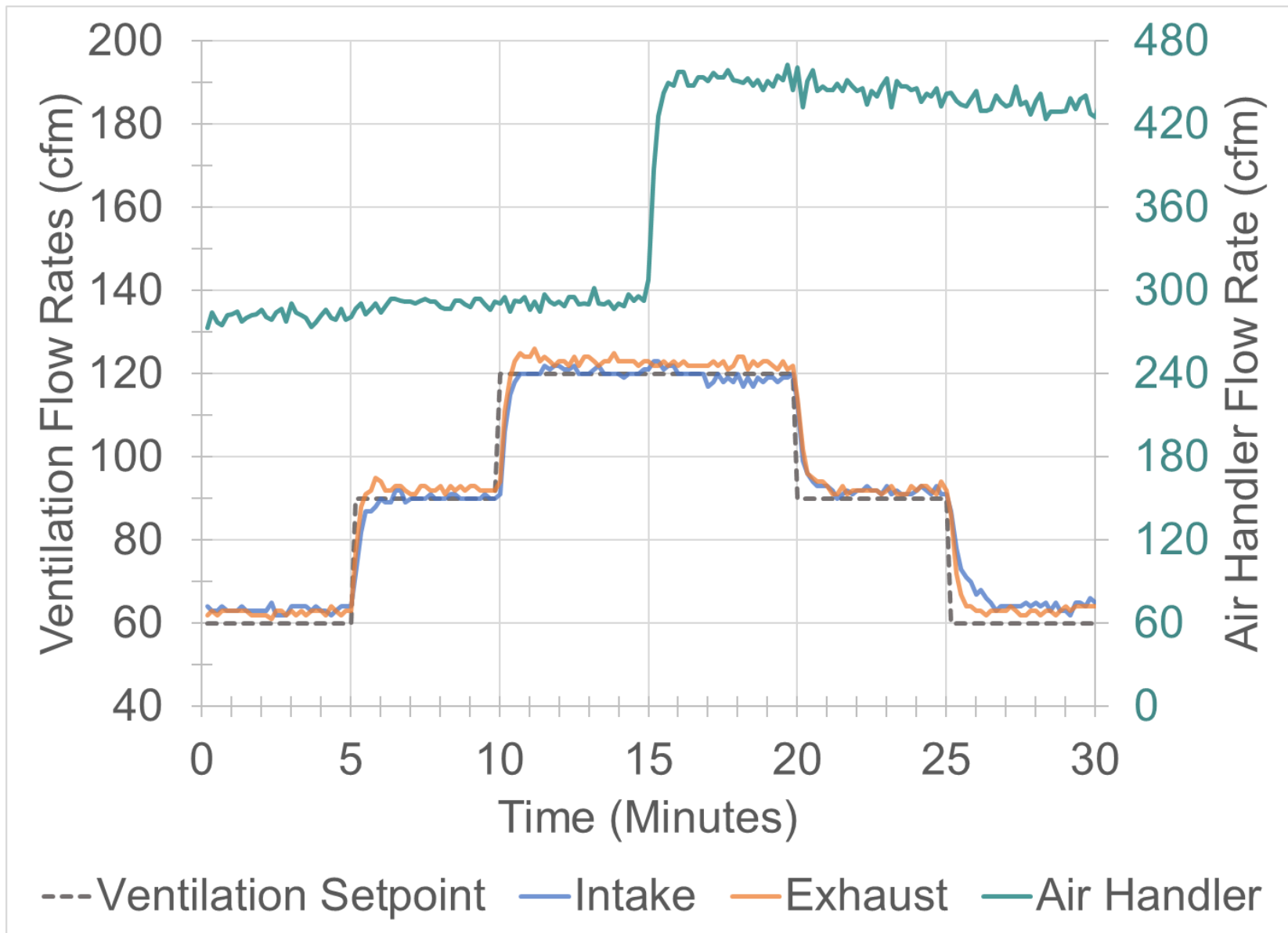
- 50-120 cfm using 40-80 Watts including AHU

## Flow Control

- Independent control of outdoor air and exhaust
- Maintains ventilation rates regardless of h/c operation
- Maintains flow rates during frost prevention



# Flow Control



# Stakeholder Engagement

Worked with partners throughout design & testing:

MITSUBISHI ELECTRIC  
TRANE HVAC US




Therma-Stor®

core  
ENERGY RECOVERY SOLUTIONS

Distributing information and a survey:


- SWA [press release](#), [blog article](#), contacts, and clients
- NYSERDA affiliates and contractors
- [Green Building Advisor](#)
- Energy Design Update
- EEBA Newsletter
- BTO Peer Review Poster
- Builder Magazine (pursuing)

In Development:  
**Integrated Energy Recovery Ventilator**

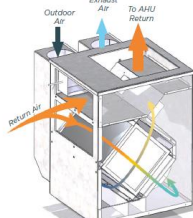
Steven Winter Associates, Inc.   
U.S. Department of Energy

For too often we see frustrating and difficult ERV installations that fail to meet ventilation requirements. With support from the DOE Building America program and industry partners, Steven Winter Associates is working to address this issue by developing an integrated ventilation system that makes balanced ventilation easier in homes.

Designed to fit into mechanical closets, the small-footprint ventilator will integrate with efficient forced-air systems. ECM fans maintain ventilation rates regardless of heating and cooling operation over a wide range of system configurations.



**Integrated Energy Recovery Ventilator**



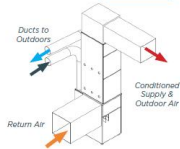
Compact: Connects to the return side of an air handler. Fresh air is distributed throughout the home through heating and cooling ducts. All maintenance needs are executed through the front panel.

Minimal Connections: Need only to provide ventilation inlet and outlet ductwork, resulting in two field connections (in addition to the normal AHU setup) instead of four connections typical of non-integrated ERVs.

Versatile: The unit will be able to accommodate systems up to 2 tons. Exhaust air can be diverted from return air as shown or ducted separately to provide targeted exhaust.

Steady Flow: Constantly modulating ECM fans ensure the delivery of the desired amount of exhaust and outdoor air under

Patent Pending



**Integrated ERV**

- Compact, small footprint
- Minimized connections
- Consistently maintains desired flowrates (even during frost prevention)
- Low electrical power
- Wide range of flow rates

**40-120 CFM** Single Unit Specification: delivers ventilation flow rates from 40 cfm up to 120 cfm.

**Energy Recovery:** 70% sensible effectiveness, 50% total recovery efficiency at 120 cfm.

**Enhanced Frost Prevention:** During very cold weather, ventilation flow rates are continuously maintained by mixing return air into the OA stream. There is no need for recirculation, unbalanced ventilation, or power hungry electric preheat.

**High Filtration:** Designed for at least MERV 13 filtration of outdoor air.

**Low Power:** Prototypes delivered 100 cfm of ventilation with 40-80 Watts, including the AHU.

Prototype testing in occupied homes is scheduled for Q1 2019.

Send feedback or inquire to [vc@swwinter.com](mailto:vc@swwinter.com)

Steven Winter Associates, Inc.   
U.S. Department of Energy

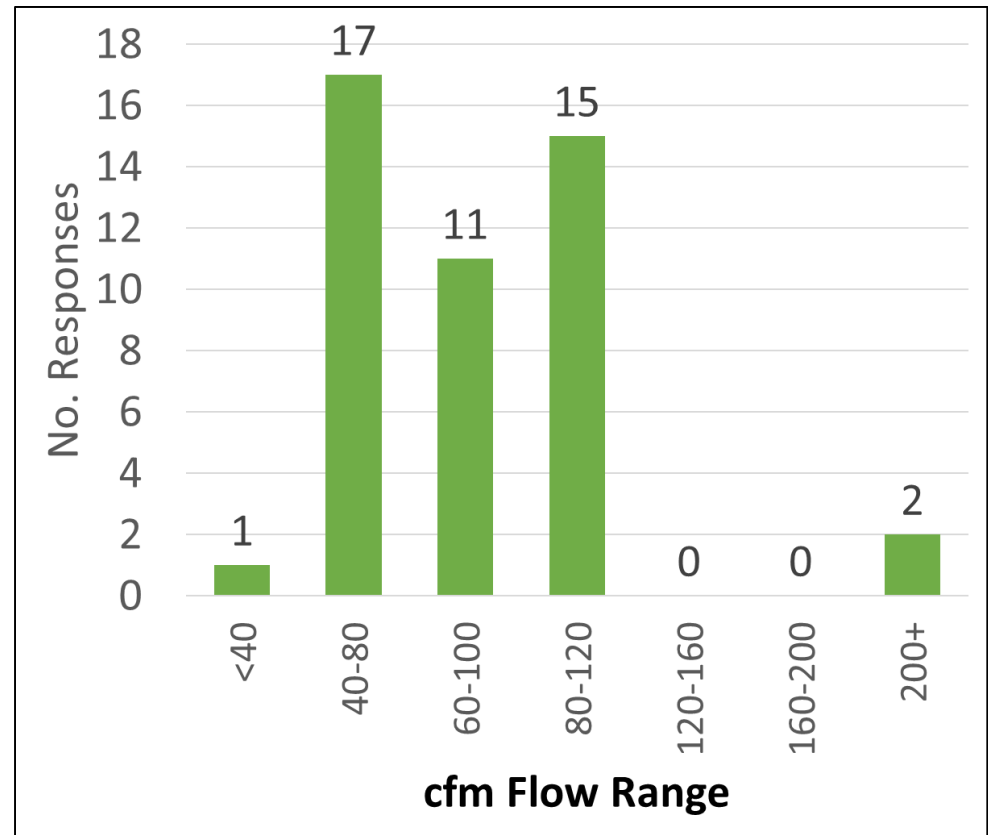
  
**core** MITSUBISHI ELECTRIC  
TRANE HVAC US

# Stakeholder Engagement

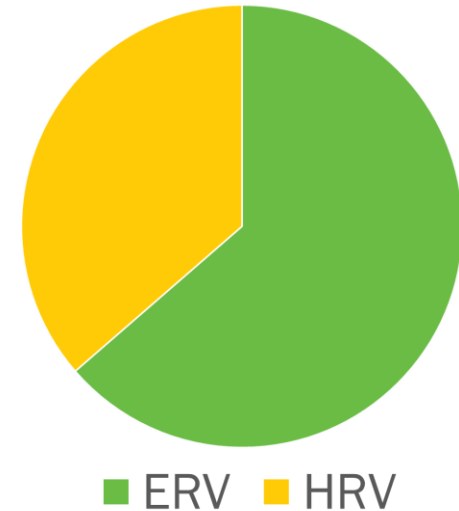
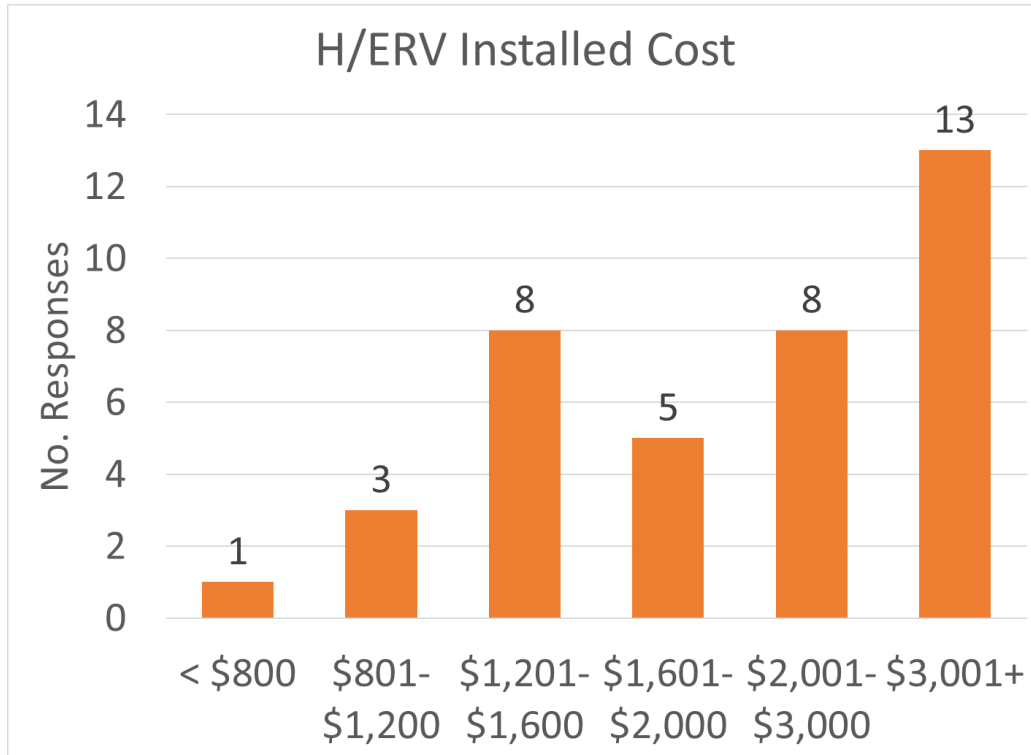
## Market Feedback:

- Initial interviews with builders & developers
- Current survey:
  - builders
  - developers
  - contractors
  - designers
  - other stakeholders

*What range of whole-building ventilation capacity do you most often specify or install?*



# Stakeholder Engagement



## Other Survey Topics:

- Local Exhaust
- Filtration
- Geography
- Building type, volume
- VICS features
- Control features
- Home certifications

# Remaining Project Work

**Initial Plans:** Build, install, and evaluate prototype in home

**Revised Plans:**

- **Fully functional prototype(II) in office**
- **Market Assessment & Survey**
- **Work with Therma-Stor (manufacturing partner)**
  - Tune frost prevention (test chambers)
  - Fan selection(s)
  - Core size
  - Control capabilities
  - Assessing product ratings & certifications
  - Price point

**FY2018 award: Working with Therma-Stor to develop integrated heating, cooling, and dehumidification.**



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# Thank You

Steven Winter Associates, Inc.

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# REFERENCE SLIDES

# Project Budget

**Project Budget:** 3-year project divided into two 18-month Budget Periods. Total budget \$1,133,700 including cost share.

**Variances:** No variation in budget, but late stage tasks shifted to work more closely with Therma-Stor on commercialization challenges.

**Cost to Date:** \$940,339 - 83% of total project cost. Cost Share contribution to date is 22%.

**Additional Funding:** None.

## Budget History

FY 2017 – FY 2018 (past)		FY 2019 (current)		FY 2020 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$614,246	\$191,119	\$288,192	\$40,143	NA	NA

# Project Plan and Schedule - BP1

Project Schedule												
Project Start: 8/1/2016	Completed Work											
Projected End: 7/31/2019	Active Task (in progress work)											
	◆ Milestone/Deliverable (Originally Planned)											
	◆ Milestone/Deliverable (Actual)											
Task	Q1 (Aug-Oct 2016)	Q2 (Nov 2016-Jan 2017)	Q3 (Feb-Apr 2017)	Q4 (May-Jul 2017)	Q5 (Aug-Oct 2017)	Q6 (Nov 2017-Jan 2018)	Q7 (Feb-Apr 2018)	Q8 (May-Jul 2018)	Q9 (Aug-Oct 2018)	Q10 (Nov 2018-Jan 2019)	Q11 (Feb-Apr 2019)	Q12 (May-Jul 2019)
Past Work												
Q1 Milestone: Project Management Plan	◆											
Q1 Milestone: Test Plan		◆	◆									
Q2 Milestone: Market Assessment			◆									
Q3 Milestone: Design Specifications				◆								
Q4 Milestone: Alpha Prototype - Interior Components					◆							
Q5 Milestone: Sensor/Control Strategies						◆						
Q5 Milestone: Prototype Benchtop Testing						◆						
Q6 Milestone: Go/No-Go Decision for Successful Indoor Components of Prototype						◆						
Q7 Milestone: Alpha Prototype Completion (Interior Components)							◆					

# Project Plan and Schedule - BP2

Project Schedule												
Project Start: 8/1/2016	Completed Work											
Projected End: 7/31/2019	Active Task (in progress work)											
	◆ Milestone/Deliverable (Originally Planned)											
	◆ Milestone/Deliverable (Actual)											
Task	Q1 (Aug-Oct 2016)	Q2 (Nov 2016-Jan 2017)	Q3 (Feb-Apr 2017)	Q4 (May-Jul 2017)	Q5 (Aug-Oct 2017)	Q6 (Nov 2017-Jan 2018)	Q7 (Feb-Apr 2018)	Q8 (May-Jul 2018)	Q9 (Aug-Oct 2018)	Q10 (Nov 2018-Jan 2019)	Q11 (Feb-Apr 2019)	Q12 (May-Jul 2019)
Q7 Milestone: Alpha Prototpe Completion (Operational with Outdoor Components)							◆					
Q9 Milestone: Alpha Prototype Performance Evaluation								◆	◆			
Q9 Milestone: Cost and Manufacturability Opportunities									◆			
Q10 Milestone: Completion of Beta Prototype										◆		
Current/Future Work												
Q12 Milestone: Testing in Office/Lab and Environmental Chamber - Draft Technical Report												◆