Residential Building Technology Program

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


# Building America
# Test Methods STC
# BA Stakeholder Meeting

Leap Day, 2012
Austin, TX

# Test Methods STC: Roles Update

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**Field Test**:
Advanced Test / Audit Methods

**Key Role:**
Identify Needs for Field Test Methods & Sensors

**Targets:**
Field Performance Measurements: Accurate, Low-Cost & Simple Methods
Safety & Durability Checks
QA/QC Tools

**Laboratory Test**:
Support & Coordination

**Key Role**:
Identify Performance Data Gaps for Modeling/Simulation (with Analysis STC)

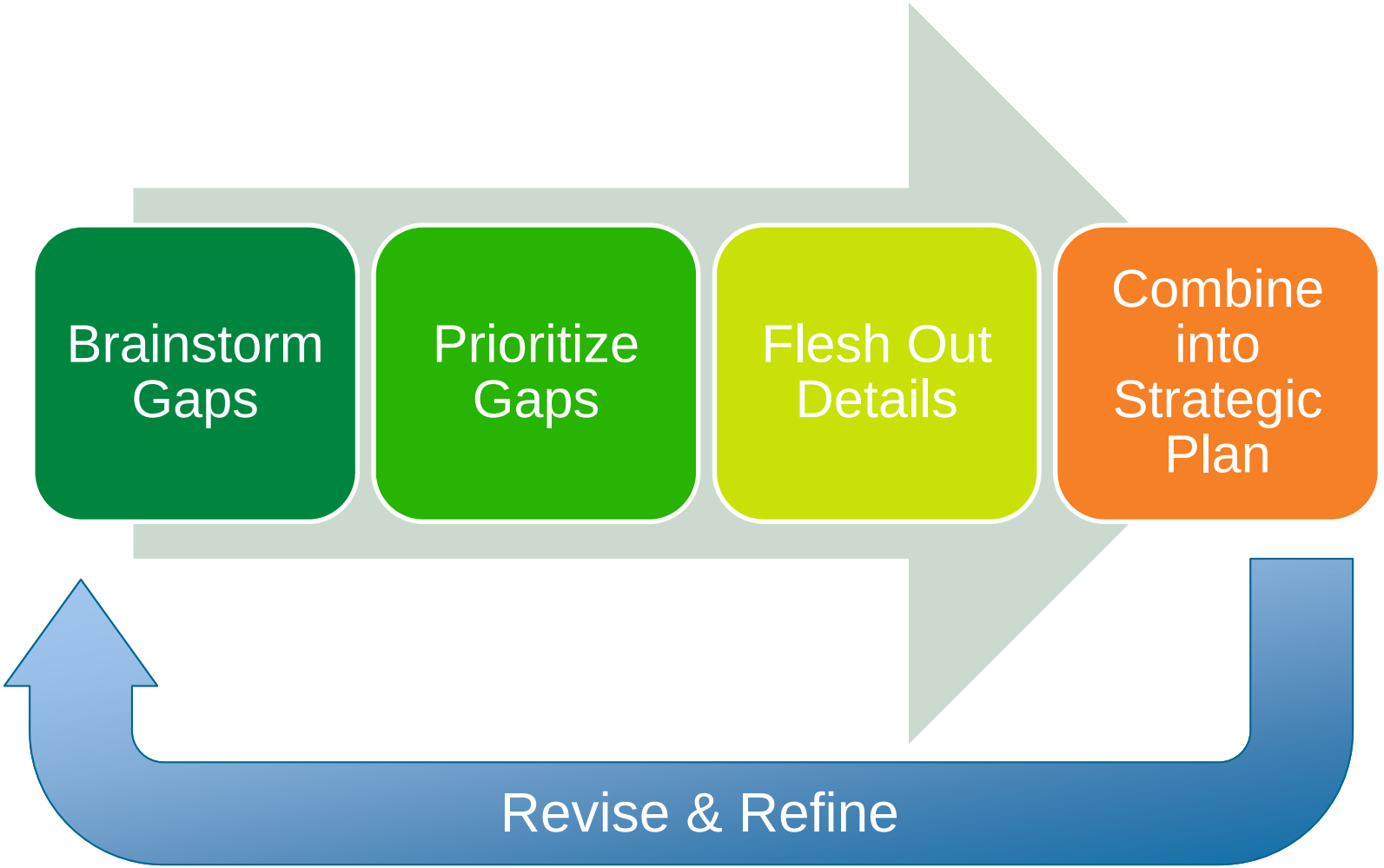
**Targets:**
Ensure Laboratory Data & Models Exist for Comparison to Field Test
Avoid Duplication of Efforts
Use Existing Lab Test Methods

**Equipment & Audit Test Standards**:
Supporting Role

**Key Role:**
Identify Gaps in Standards and Audit Methods

**Targets:**
Improved, Cheaper Audit Methods
Better Equipment Test Standards Which Serve Efficiency Program Needs

# Gaps & Needs: Process



# Primary STC Focus

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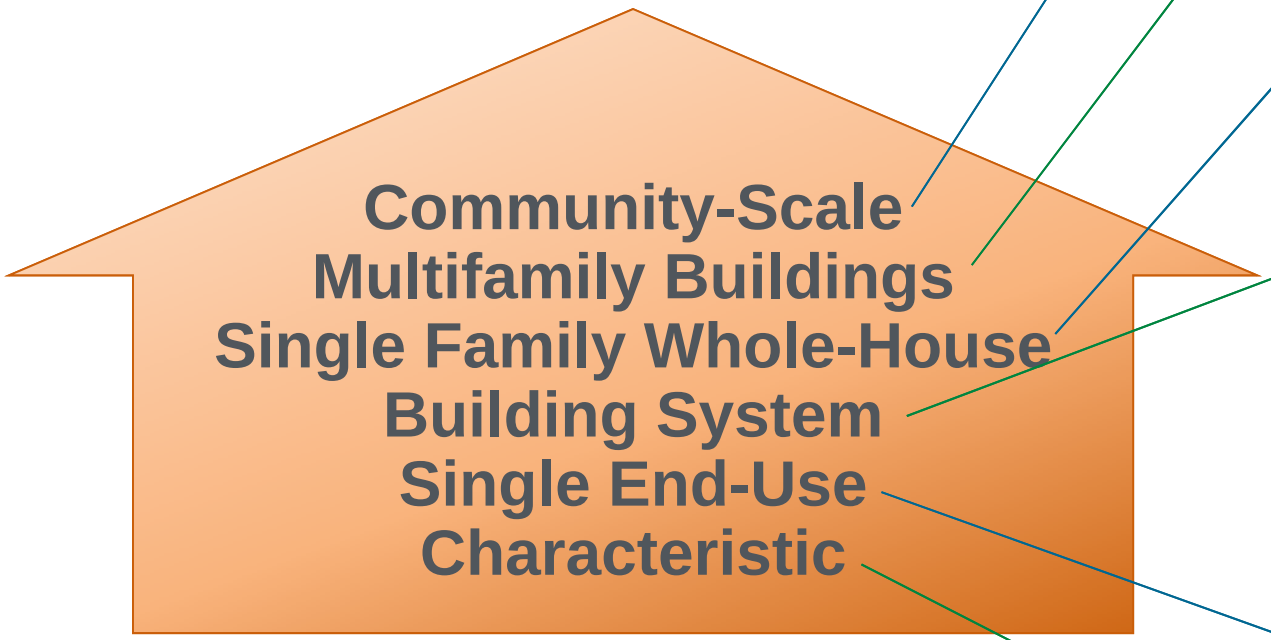
- Sensors for Field Applications
- Field Test Methods/Protocols
  - Audit / Short-Term Test / Commissioning
  - Long-Term Monitoring




Smart-Grid Impacts
Community Renewables
Utility Programs

Unit-Unit Interactions
Common Space
Common Utilities
Whole-Building Retrofits

Comparison to Analysis
Population Variations

Wall Systems (R-value, Infiltration, etc)
HVAC
Hot Water Distribution

Plug Loads/AHEM
Gas End Uses
Major Appliances
Latent Load Generation
Occupancy
Lighting

Thermostat Set Point
Foundation Type

# Identified Gaps & Needs

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## Sensors Gaps/Needs

1. Method to measure airflow of mini-split heat pumps in the field
2. Stand-Alone data logger with much larger on-board storage capacity to allow for longer-term deployment
3. Develop an inexpensive sensor to measure MDI levels from spray foam
4. Minimally intrusive method for measuring flow in ducts
5. Low cost option for measuring formaldehyde rather than generic VOC sensors
6. Sensor for natural gas field measurement: higher accuracy, lower intrusiveness, lower cost

## Test Method Gaps/Needs

1. Standardized RMS or other error analysis techniques
2. Analysis of the uncertainty of indirect measurement methods
3. How to best instrument a room (unoccupied) to measure temperature/flow and assess thermal comfort?
4. Standardize a test method for measuring HVAC energy use
5. Accurate, detailed, field test methods for measuring total, sensible, and latent cooling
6. Accurate, robust, easy & consistent method for HPWH field testing/monitoring *(3 gaps were combined)*
7. What data is needed, what end uses, what data granularity, what sensors to use, what format to collect date to enable standardized processing of data
8. Final consensus agreement on standardized base methodology
9. How to measure whole house comfort in occupied and unoccupied test houses
10. How to best instrument a home to measure/quantify indoor air quality?
11. Accuracy of field test equipment and methods of test used for refrigerant charge and airflow may not be sufficient to deliver savings from HVAC replacements and maintenance
12. How to field characterize the air flow characteristics (three dimensional throw) of individual air supply outlets (ducted) and unitary systems

# Gap: Heat Pump Water Heater Field Test Protocol

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**Builders, plumbers, and homeowners have not readily adopted energy-efficient HPWH products due to anxiety about reliability, cost, installation requirements and user expectations.**

Building America U.S. Department of Energy can demonstrate that the products…

- Are ready for prime-time (i.e. reliable and meet homeowner needs)
- Meet program energy efficiency & cost targets (i.e. incremental first cost is overcome by utility savings)
- Have established "Best Practices" for implementation (i.e. installation requirements are resolved)

Photo Credit: Bethany Sparn, NREL PIX# 18919

# Gap: Heat Pump Water Heater Field Test Protocol

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**Builders, plumbers, and homeowners have not readily adopted energy-efficient HPWH products due to anxiety about reliability, cost, installation requirements and user expectations.**

We Need…

- Consistent evaluation
- Robust, data-driven analytics
- Accounts for externalities
  - Space Conditioning
  - Installation Space/Location/Issues
  - Operating Modes

How? Standardized Test Method, a.k.a. **Field Test Protocol**

Photo Credit: Bethany Sparn, NREL PIX# 18919

# Gap: Method for infinitely variable fan airflow measurement

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**HVAC product rating conditions are seldom representative of real-world operating conditions, so the installed energy benefits of variable speed fans are unclear (and thus so is their cost-effectiveness).**

Building America U.S. Department of Energy can demonstrate that variable speed fans…

- Meet program energy saving targets
- Are (or aren't) cost-effective in their multiple applications

... but we need to measure operational performance

- Power is easy to measure.
- How to continuously monitor air delivery?
  - Commissioning
  - FDD
  - Efficiency Monitoring
  - Controls

# Gap: Non-Intrusive Natural Gas Flow Measurement



**No practical, low-cost and accurate natural gas flow meter is available to meet the needs of researchers, appliance manufacturers, and AHEM system designers.**

Building AMERICA® U.S. Department of Energy is charged with demonstrating the incremental benefits of efficient appliances, & defining Best Practices.

- Large turn-down ratios
- Small “vampire” consumptions (pilot lights, etc)
- Retrofit buildings
- Safety
- Cost (including installation)
- Removal/Retrieval

# Gap: Data Logger with Increased Data Capabilities

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**<u>Limited product versatility</u> in small and low-cost data loggers limits Building America from achieving efficiency validation at the necessary <u>speed and scale</u>.**

Building America® U.S. Department of Energy is charged with demonstrating that cost-effective energy savings can be achieved at Community Scale.

- Cost of monitoring many homes simultaneously
  - Manpower (setup & periodic access)
  - Hardware cost
- Continuous data aggregation & summarizing (or larger on-board storage)
- Remote access, verification, & troubleshooting
- Mesh Networking

# Gap: Room Air Mixing Analysis



**The demand for improved envelope technologies and best-practice space conditioning systems is limited partly by the inability to easily visualize their benefits.**

Building AMERICA® U.S. Department of Energy is charged with demonstrating that cost-effective energy savings can be driven by market demand.

- Tools to analyze thermal comfort exist
  - Limited to use by experts
  - Results are highly sensitive to (unknown) boundary conditions
- Factors of thermal comfort aren't broadly understood
- Easy to market granite, stainless steel, hardwood
- Develop simplified tools to help sell these "upgrades"
  - Field validation of the initial tools

# Gaps' Status

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| # | Title | Project Name | Project Description | Orgs | Status |
|---|---|---|---|---|---|
| 1 | Heat Pump Water Heater Field Test Protocol | HPWH testing protocol;<br>Select test home and community projects;<br>West Village Field Test | NREL FY12 Task to develop & validate HPWH Field Test Protocol, for comparison to BEopt Models;<br>BA-PIRC measuring performance of HPWHs;<br>ARBI measuring performance of HPWHs;<br>CARB ongoing HPWH monitoring projects | NREL<br>BA-PIRC<br>ARBI<br>CARB | |
| 2 | Method for Infinitely Variable Fan Airflow Measurement | Mini-split field test protocol,<br><br>Validation of field test protocol | NREL to publish revised MSHP protocol to clarify some confusion and to address recent stakeholder comments;<br>Several 2012 CARB projects will be utilizing MSHPs for space conditioning. | NREL<br><br>CARB | |
| 3 | Non-Intrusive Natural Gas Flow Measurement | Atlantic Housing; Natural Gas Feedback devices | BA-PIRC has several related projects,<br>ARIES to measure fuel oil flow in several homes (related) | BA-PIRC<br>ARIES | |
| 4 | Data Logger with Increased Data Capabilities | | | | |
| 5 | Room Air Mixing Analysis | Simplified HVAC | IBACOS to incorporate | IBACOS | |

11/12 Project expected to meet Gap | Partly addressed in 11/12 Projects | Need to Address in 13/14

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# Gaps' Linkage to other STCs' Gaps

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| Test Methods STC Gap Title | Other STC Gap Title | STC |
|---|---|---|
| Heat Pump Water Heater Field Test Protocol | Research on distributed space conditioning equipment<br>Installed Performance of Water Heaters; Heat Pump Water Heaters<br>HPWH performance; Track maintenance/reliability/customer acceptance issues on emerging technologies; Validate HPWH, tankless, condensing storage, hybrid models with lab/field data | Space Conditioning<br>Analysis Methods<br>Hot Water |
| Method for Infinitely Variable Fan Airflow Measurement | Identify key disconnects between heat pump industry and homeowner perceptions of key issues, terminology, and metrics<br>Need better fan motor efficiency and fan blade efficiency for ventilation equipment; Lack of availability of centralized small capacity heating and cooling equipment for low load situations; Research on distributed space conditioning equipment; Inability to assess performance of existing heating and cooling equipment<br>High Efficiency Heat Pumps and Air Conditioners; Installed Performance of Furnaces; Installed Performance of Air Conditioners | Implementation<br>Space Conditioning<br>Analysis Methods |
| Non-Intrusive Natural Gas Flow Measurement | High Efficiency Heat Pumps and Air Conditioners; Installed Performance of Furnaces; Installed Performance of Water Heaters<br>Characterize tankless and high efficiency gas water heater performance | Analysis Methods<br>Hot Water |
| Data Logger w/ Increased Data Capabilities | | |
| Room Air Mixing Analysis | Develop simple educational and marketing campaigns/materials aimed at consumers; Address software inaccuracy issues, develop certification procedures for software tools, and use data from very well-instrumented houses<br>Protocol to assess and correct deficiencies in RH control in homes; Ventilation control technologies to optimize intermittent ventilation; Inability to assess performance of existing heating and cooling equipment<br>High Efficiency Heat Pumps and Air Conditioners | Implementation<br>Space Conditioning<br>Analysis Methods |

# Gaps & Needs areas requiring attention

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- Multi-Family Building test methods/protocols
  - Airtightness
  - Shared Utilities
  - Common-Space Occupancy Profiles
  - Energy Savings of whole-building (i.e. envelope, etc.) retrofits
- Non-Intrusive Duct Flow Measurement
- AHEM
  - Audit enhancement/replacement by AHEM
  - Energy Savings Potential
  - How to test/evaluate?  Occupancy, plug loads, etc.
- BA Field Test – minimum test requirements
  - Hot Water usage
  - HVAC (Set points, energy)
  - Occupancy

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# Join Us

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**Building America Standing Technical Committee on Test Methods & Protocols**

https://sites.google.com/site/bastctestmethods/home

Chair: Dane Christensen

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