

# Advanced Occupancy Sensors for Better Buildings Workshop

**July 12, 2016**  
Portland, OR

Workshop Materials

- Day 1 Market Breakout



# DAY #1 BREAKOUT

## The Market Challenge

*Groups are asked to mock up and convey their ideal, dream occupancy sensing solution to a potential customer in either the A) Residential (temp control only – includes multi-residential) or B) Commercial (includes ventilation) market. This should include:*

- *the cost (\$/sq ft) of units*
- *installation cost or attributes (\$/sq ft or project)*
- *compatibility with retrofit systems*
- *performance attributes*

*The group should be prepared to say what barriers to adoption and deployment exist, and why the above helps to mitigate them.*

# Day 1 – Breakout Activity

In one slide describe your dream occupancy sensing solution

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## Example questions to help drive your slide development:

- ▶ What does your solution need to accomplish?
- ▶ Who is the customer? Who is the user?
- ▶ How and where would you like it installed?
- ▶ With what systems (and how) should it interface?
- ▶ What market sub-segments have the biggest returns and what are the minimum specs to meet them?
- ▶ What does the cost and ROI/Payback need to be to achieve scale (e.g., 50% penetration? 3 years? Something different?)
- ▶ What are the risks and barriers to market adoption?
- ▶ What other market drivers will influence adoption? (e.g. Personally Identifiable Information, Indoor Air Quality and Productivity)
- ▶ What is necessary to deploy *extremely low cost* quantitative measurement of occupancy/people counting? What is necessary to make sure this technology delivers the energy savings predicted?

# Group A– Breakout Activity

## Residential Space – Detached-Single-Family



### Floor Plan description:

- Ranch Style Home
- One level, small rooms w/ open living area



# Day 1 – Breakout Readout Group A

## Group A's Dream Solution for Single-Family Residential

<b>Market:</b>	Homeowner. Service providers. Utility incentive to make the program and installation affordable?
<b>Key Product Features</b>	<ul style="list-style-type: none"> <li>• Particular to user, keeps set-point stored per user in home, stored in the cloud and applied when occupancy– user profiles</li> <li>• Cloud service is add-on only, but technology is not cloud dependent for systems to continue ongoing operational settings</li> <li>• Privacy settings can be controlled and limited</li> <li>• Security must be upgradable, to avoid future risk</li> <li>• Behavior algorithm anticipates arrival and set-temp based on last 'set-back'- Ecobee already does this</li> <li>• Low-cost retrofit to get to zoning through modulation</li> <li>• Easy to install and maintain</li> <li>• Operation is intuitive with ability to reset and have manual override</li> <li>• Guide for placement of sensors – interior design</li> <li>• Comprehensive sensor system with interoperability with all existing home systems and multiple sensor types, (e.g., air quality, CO2, electric meter, water, damper)</li> <li>• Ability to customize and opt out of certain features</li> <li>• Takes in to account occupancy and activity</li> <li>• Flexible product offerings, scalable</li> </ul>
<b>Rationale for Selected Approach</b>	Make life easier, save money
<b>Barriers to Adoption</b>	Security, Install expense, interoperability, maintenance, reliability of operation and ongoing maintenance
<b>Expected Challenges</b>	Challenges for either Technology and Business Development

### Product Specifications

Occupancy Accuracy Promise	100% accuracy	Area coverage per sensor	
Cost target	2-3 year payback,	Field of View	
Market Driven Warranty	10 year lifetime	Operating Temperature	
Sensor lifetime (or battery replacement)	lifetime of hvac system	Power Rating	

# Group B – Breakout Activity

## Residential Space – Attached Multi-Unit Residential



### Floor Plan description:

- Small 1BR apt
- Single level,
- Open living area
- Single door w/ a balcony

# Day 1 – Breakout Readout Group B

## Group B’s Dream Solution for Attached Multi-Unit Residential



<b>Market:</b>	<p><b>Marketing to:</b> Building owner, who wants to advertise their property is technology savvy + energy efficient.</p> <p>Principle agent problem – split incentive - building owners rent the apartment but don’t have the incentive to improve the energy performance. Tenants pay energy bill but don’t own the apartments. It requires motivated building owner to push it further.</p> <p>Option B – sell directly to tenant</p>
<b>Key Product Features</b>	<p>1) Comfort 2) convenience 3) security 4) Energy savings; 5) ROI 6) consumer self installation. The connected devices in each home may be locally networked but the interactions will not be shared b/w apartments for security and privacy consideration.</p>
<b>Rationale for Selected Approach</b>	<p>Product are low-cost, self-installed and self maintained, which provides occupants the Customer prioritizes Comfort &gt; convenience &gt; security &gt; cost.</p>
<b>Barriers to Adoption</b>	<p>Owners and tenants have split incentives.</p> <p>Privacy issue – tenants’ energy use may not want to be visible to landlord</p> <p>It is not fair to count on tenants’ WiFi and devices</p>
<b>Expected Challenges</b>	<p>Challenges include privacy, security, who owns the data? who operates the building?</p>

### Product Specifications

Occupancy Accuracy Promise	Accuracy would be low.	Area coverage per sensor	1 sensor covers the whole apartment
Cost target	\$20 - \$30 installed cost (currently from \$90 to \$150)	Field of View	Cover the whole apartment, or just the entrance, or the hallway
Market Driven Warranty	Covers the lifetime	Operating Temperature	Freezing point to 110 F
Sensor lifetime (or battery replacement)	5 – 10 years	Power Rating	Nano-milliWatts

# Group C – Breakout Activity

## Commercial Space Office



### Floor Plan description:

- Older envelope
- Renovated interior
- Open interior w/ exterior offices





# Day 1 – Breakout Readout Group C

## Group C's Dream Solution for Commercial Office Space

### Market:

- **Primary Market: Building Owners and tenants**
- **Secondary/Enabling: Facility manager, Building Engineer, and Design/Build Contractors are key advisors to primary targets**

### Key Product Features:

- Needs to collect basic data that is flexible enough to inform multiple end uses
  - Number of people, time stamp
- Interoperable with a wide range of system types (e.g., controls, lighting, security etc.)
- No personal ID (for privacy reasons), or limited personal ID optional contingent on legal parameters
- Minimum 10 year lifetime (with equivalent 10 year life on battery if battery powered)
- Reliable power supply across the board (esp. in energy scavenging scenario)
- Standby power has to be less than 0.1W/sensor (or highly minimal)
- Easy to calibrate and commission
- Can utilize existing infrastructure or otherwise minimize installation cost
- Payback = 3 years or less (18 months optimal)
- Wireless or powered over ethernet
- Sensor type needs to vary depending on space zone (e.g., single office v. conf room)
- High accuracy across system (composite multi-modal sensor package)

### Rationale for Selected approach:

- Need to include multiple value drivers to improve ROI beyond just energy savings
- Flexibility of approach allows for inclusion of sensor “backbone” in a typical retrofit (e.g., lighting upgrades) – allows for small incremental cost of sensors to be folded into larger package
- Space optimization capability
- Minimize labor cost
- Maximize ease of installation
- Maximize reliability
- Reduce cost per square foot

### Barriers to Adoption:

- Cost (short term = unit cost, long term = labor cost)
  - Recouping of R&D costs drive up current prices
- Lack of standards
- Incremental savings decreasing as base energy using tech gets more efficient (e.g., lighting, HVAC)
- Persistence of performance (both equipment reliability and user error)
- User acceptance (or lack thereof)
- Bad publicity from early failures of new tech

# Group D – Breakout Activity

## Commercial Space with Highly Dynamic Occupancy



### Floor Plan description:

- Newer Construction
- Small open layout
- 24/7 Occupancy
- Complex thermal system and ventilation needs
- Multiple occupants enter per door opening

# Day 1 – Breakout Readout Group D

## Group D's Dream Solution for Highly Dynamic Commercial Spaces



*Security- or Lighting-integrated sensors with count in main room.*

*No count in back room.*

<b>Market:</b>	National Chain / Brand. OR Franchise Owner. Both served by System Supplier.
<b>Key Product Features</b>	Auto / mobile commissioning – must be EASY. Multi-functional – security, analytics, space utilization (cost-effectiveness) Energy Saving Priorities: 1) Ventilation 2) Htg / Clg 3. Lighting Occupant Counting - # of people in zone (various technologies possible)  Distributed Logic - HVAC logic in Tstat or controller, lighting logic in lighting controller. Simple PIR sensors in enclosed spaces. Optional subscription-based monitoring/maintenance.
<b>Rationale for Selected Approach</b>	Note – Lighting control is simpler with on-board luminaire sensors. Decouple lighting from HVAC control.
<b>Barriers to Adoption</b>	Lack of common standard interface. Cost / Benefit & Performance validation required. Complexity of installation / CX.
<b>Expected Challenges</b>	

### Product Specifications

Occupancy Accuracy Promise	Low false positive/negative.	Area coverage per sensor	1 per zone
Cost target (\$/zone is better metric at this stage)	3-year payback (max.)	Field of View	120 degree / 20 meter range
Market Driven Warranty	10-year	Operating Temperature	
Sensor lifetime (or battery replacement)	10-year (min.) Tying into existing electrical is reliable, but install cost is higher.	Power Rating	If battery powered, need 10-year life.