Finding the Next Big Thing(s) in Building Energy Efficiency: HIT Catalyst and the Technology Demo Program

November 4, 2014
3:00-4:00 PM EST
Overview and Agenda

- Welcome and Overview
- Department of Energy: High Impact Technology Program
- University of Colorado, Boulder: Ultra Low Temperature Freezer Demonstration
- Department of Energy: Technology Demonstration Opportunities
- Additional Resources
- Question & Answer Session
## Today’s Presenters

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<tr>
<th>Name</th>
<th>Organization</th>
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<tr>
<td>Amy Jiron</td>
<td>Department of Energy</td>
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<tr>
<td>Kathy Ramirez Aguilar</td>
<td>University of Colorado, Boulder</td>
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The High Impact Technology Catalyst Team

U.S. Department of Energy
Amy Jiron
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Navigant Consulting, Inc.
Collin Weber
Dan Chwastyk
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Melissa Voss Lapsa, ORNL
High Impact Technology (HIT) Catalyst

Images courtesy CREE, True Manufacturing, A.O. Smith, Bernstein Associates, Cambridge Engineering, Alliance Laundry Systems, NREL

U.S. Department of Energy
Energy Efficiency & Renewable Energy

Commercial Buildings Integration
Building Technologies Office
How can we catalyze the adoption of high impact commercial building technologies?

Stakeholder Engagement & Partnerships

Owners
Designers
Engineers
Managers
Occupants
Financial Institutions
Government
Utilities
Scientists
Manufacturers
Dealers
Suppliers
We look at a variety of factors... for example, RTUs

In the U.S., packaged units:

- condition **40 billion square feet** of the commercial building floor space
- consume **2,100 trillion Btu of primary energy** annually

**ENERGY FOOTPRINT**

**STATE OF THE MARKET**

Many RTUs are past their typical life span, functioning at much lower efficiency levels than new units, and are **ready to be replaced**.

**TECHNICAL SAVINGS OPPORTUNITY**

Current market conditions indicate more than **200-300 trillion Btu/year** at high penetration.

**NEED: DRIVE RTU EFFICIENCY**

DOE developed the **RTU Challenge Specification** to drive new efficiencies and launched the **Advanced RTU Campaign** to increase adoption of existing efficiencies.
Putting it all together: The HIT Catalyst

**Goal:** The High Impact Technology (HIT) Catalyst will identify and prioritize cost-effective, underutilized, energy-efficient technologies so that we can focus resource development and deployment activities.

**Methodology:** Cohesive step-by-step strategies move techs from newly commercialized to full adoption. Each step in the tech-to-market pipeline has a purpose and connection to the next step; all are integrated into existing BTO deployment networks.

**Target Market and Audience:** Deploy HITs through partnerships with the commercial buildings industry via the Better Buildings Alliance, federal leaders, regional non-profits and efficiency organizations.

**Outcome:** Provide commercial building stakeholders with resources and proven deployment paths to accelerate implementation and market acceptance of HITs.
Identification and Evaluation of HITs

Identify HITs through a rigorous prioritization process; characterize HITs based on their stage in the product life cycle; develop appropriate resources; evaluate and implement the most effective deployment activities.

1. Conduct Initial Screen
   (unit savings, total technical savings potential, commercialization status)

2. Conduct Secondary Screen
   (stakeholder input, criticality of CBI involvement, cost)

Broad technology list from:
- RFI
- Prioritization Tool
- Inter-Agency
- Market
- Manufacturers
- EERE emerging technologies
- Utility programs

High Potential Technologies

High Impact Technology List

HIT Identification
Market Transformation

3. Select Activities
   - Challenge
   - Demonstration
   - Specification
   - Campaign
What is the most effective market transformation pathway?

**Activities**

**Technology Demos**
- **Theory of Impact:** Building owners are uncertain about the performance of new technologies and risk adverse; real building performance information will make them more likely to adopt.

**Technology Procurement**
- **Theory of Impact:** Template language that outlines the performance characteristics of proven and cost effective HITs streamlines purchasing, enables “apples to apples comparisons potentially lowering overall cost of adoption.

**Technology Campaign**
- **Theory of Impact:** Once a company has successfully piloted a new technology through a campaign, they will replicate that technology throughout their building portfolio.

**Outputs**

**Case Studies**
- **Metric:** Number of case studies published

**Specifications**
- **Metric:** Number of technical specs produced

**Installations**
- **Metric:** Number of sites/sf/orgs committed

**Key Outcomes**

- Greater organic adoption of HITs (leading to greater energy savings)
- HITs support voluntary programs (leading to greater adoption and energy savings)
- Collect HIT market transformation data (leading to higher efficiency candidate levels and energy savings)
### CBI DEPLOYMENT STRATEGY

**Direct resource development and demonstration**

**Market stimulation via leading organizations**

**Deployment through leaders’ portfolios and consideration for voluntary standards**

**Data influences cost reductions and wrap up via efficiency programs**

### ACTIVITIES

- **FY11-12:** Produced parking light SPECIFICATION via BBA.
- **FY12:** Conducted DEMONSTRATION via Caliper program.
- **FY13-15:** Campaign for uptake through the Lighting Energy Efficiency in Parking (LEEP) CAMPAIGN with market partners and BBA.
- **FY14-15:** Utilities, REOs and OEMs reference specs to deploy efficiency levels broadly through voluntary programs and/or certification.
- **FY15:** Participation in the LEEP Campaign provides reduces and information to help owners reduce energy costs.

### IMPACTS

**Measurement from demos prove average savings and reduce risk for owners; case studies help make the business case.**

By end of 2012, 10 BBA members representing <5% of US parking space were using spec.

**Campaign quantifies actual energy savings, market uptake trajectory, and adoption by market leaders.**

If **100% of parking lots and structures nationwide switched to spec-level lighting, we would save over .85 quads and $4 billion/year.**

- Measure penetration rates with market leaders
- Confirm tech penetration via market research
- Demonstrate sufficient uptake for codes and standards consideration

Parking lighting represents almost 1% of all US use or 900M parking spots with 160M light fixtures.

Data from LEEP supports the development of voluntary programs and efficiency program offerings.

Energy Efficiency & Renewable Energy
Steps to Prioritization

Phase 1: The **HIT Matrix** helps us identify market ready technologies including:

- information on technologies developed through work by the BTO Emerging Technologies team (P-Tool);
- technology-specific and national energy savings potential values;
- In total, over **400 measures** to evaluate.
- The Matrix includes two screens for: 1) energy savings opportunity and deployment readiness; and 2) market factors.

Phase 2: **Peer Workshops** provide perspective on market factors and feedback on priority technologies identified in the Matrix:

- Academia, Federal Agencies, Utility, Regional Energy Organizations
- 28 unique organizations and 50 individuals participated
- RFI open for input by building owners/end-users and technology providers
What We Heard: the Preliminary HIT List

- Remain aware of the need for **technology groupings, applications and packages** rather than specific technology types; address the synergies between technologies.

- **Controls** in general – across all load types – are an area where much work needs to be done. There are many competing platforms, protocols, etc. and many different ways to implement the control systems (individual fixture/load level, building level, etc.). **End users are confused by the choices, afraid of technology obsolescence, and need guidance in this space.**

- Don’t always assume that a pure technology solution is the answer. In some cases, **best practice or operational solutions can yield the same results at much lower costs.**

- Data on “real use” and end user behavior is extremely important in weighing the benefits of a technology, as the **gap between “real use” and “ideal use”** can be large.

- There is value in **enabling technologies** such as smart metering, though it may be difficult to quantify independently.

- Generally speaking, **there can never be too much independent, third-party demonstration data.**
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<tr>
<th>Measure Name</th>
<th>Description</th>
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<tr>
<td>LED Troffers with Controls</td>
<td>Deploy high-efficiency (solid-state) 2x4 troffers with added controls</td>
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<tr>
<td>Packages of Building Management and Information Systems and Whole Building</td>
<td>Optimize whole-building management systems that enable the operation of multiple systems to minimize consumption based on occupancy, weather, fuel prices, etc.; includes adjustment of thermostats, schedules, set points, calibration.</td>
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<td>Diagnostics</td>
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<td>Auto Sash Fume Hoods for Laboratories</td>
<td>Deploy restructured laboratory fume hoods with automatic sash closure. This technology has an automatic sash closure system on a VAV hood that is controlled by an occupancy sensor.</td>
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<td>Shading &amp; Awnings</td>
<td>Demonstrate energy reductions and other benefits to awnings and other shading devices on commercial buildings.</td>
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<td>Refrigeration Controls &amp; Display Case Retrofits</td>
<td>• Use variable speed compressors in select new commercial refrigeration equipment;</td>
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<td>• Retrofit display case doors with anti-sweat heaters, vinyl/composite door frames, and high-performance glass.</td>
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<tr>
<td>Heat Pump Water heaters</td>
<td>Deploy highest efficiency heat pump water heaters in residential and small commercial buildings</td>
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Next?

**Annual HIT Matrix and Peer Reviews:**
- Incorporate stakeholder feedback (including today’s workshop)
- Select HITs to focus

**Deployment Plan and Resource Development:**
- Evaluate existing resources, gaps, barriers and potential partners
- Determine the most effective deployment channels

**Select & Execute Deployment:**
- Campaigns, Technology Demonstrations, Specifications
- Strategic Partnerships
- Better Buildings

...Hand Off and Start Over

Evaluate and update each year to reflect evolving market conditions and advances in technology.
And, continue work with Better Buildings Partners!

+200 members from the private sector

Controlling +10 billion square feet of commercial building space

Working together through 4 sector groups and 13 Technology Solutions Teams

Making commercial buildings 20% more efficient by 2020
Leading Edge to Market-Ready: How Does Technology fit within the Federal Technology Framework?

- The roles of different federal agencies in accelerating efficient building technologies.
- Representatives from ARPA-E, ESTCP, GPG, FEMP and BTO

Innovative Energy Saving Technologies on the Market Now

- Updates on new real building demonstrations,
- Dynamic glazing, touchless audits and data centers.

What’s next? Tech-to-Market Projects for Next Generation Results.

- A suitcase that retro-commissions small buildings,
- Advanced control systems for plug and play devices,
- New easy-to-install air barriers,
- Promising technologies from ARPA-E’s Building Energy Efficiency Through Innovative Thermodevices (BEETIT) program.
Kathy Ramirez Aguilar
Green Labs Program Manager

University of Colorado, Boulder
The purpose of the demonstration was to evaluate the energy use of high-efficiency ULTs.

- **Goals included:**
  - Examine the effect of field conditions on ULT energy use
    - Collected energy, temperature, and door opening data for each ULT freezer in the study over a period of 5 months
  - Provide more information to purchasers seeking energy-efficient products
  - Support U.S. Department of Energy (DOE) and Better Buildings Alliance efforts to increase market penetration of high-efficiency ULTs
Why CU-Boulder Green Labs was Interested

- Aware of need for market change for lab equipment
- ULT freezers have been a focus of the CU Green Labs Program
- ~150 ULT freezers at CU-Boulder
- We wanted to help!
What was required?

- Permission to participate
- Locating the right freezers
- Engaging stakeholders
- Working with campus legal
- Responsibility for loaner
- On-site set-up with Navigant
- Troubleshooting
- Being point of contact

(Above pictures from Navigant)
We observed that the demo ULTs used between 20% and 66% less energy than the average baseline ULT.

Calculated Daily Energy Use at Standard Set of Conditions: Set-point -80°C, External temp 22°C, Door opening time 90 s
Taking the Project Further

Engaged scientists to raise the temp from -80 to -70°C to include those impacts in the study

4 kWh/day is more energy than a full-size Energy Star Freezer consumes!

(Modified Graphic from UC-Davis)
Thoughts on the Experience

- Positive, learning experience for Green Labs
- Many pieces had to fall into place at CU-Boulder to enable participation
- Plan for more time than you think
- Worth our time to help influence market changes for lab equipment
HVAC Energy Savings through Novel HLR Air Treatment Technology from enVerid Systems.

- **Company**: enVerid Systems, Inc., based in Houston.
- **Offering**: HLR (HVAC Load Reduction)
  - Novel “Intelligent scrubber” modules added to HVAC systems
  - Eliminates most of the outside air ➔ double digit % savings
- **DOE Program Objectives**:
  - Deploy HLR retrofits in several representative commercial buildings/sites
  - Carefully monitor, document and analyze the performance, to demonstrate the energy savings and reliability.
- **Technology**: HLR modules continually and automatically remove CO₂ and VOCs from indoor air, thereby greatly reducing the need for air replacement and saving much of the power that HVAC systems use to treat the outside air intake.
  - Uses novel sorbents, automatically regenerated with intelligent algorithms
  - A scalable, easy-to-retrofit module that can be added to the existing HVAC system,
  - Cooling power savings can exceed 40% at peak and indoor air quality is improved.
Predictive Energy Optimization (PEO) and Automated Demand Response for Commercial Building HVAC

**GOALS:**
- Show PEO’s impact in driving building energy/peak load savings
- Show PEO’s ability to work with a variety of buildings
- Show that PEO can be taken to market at scale by partners

- > 10% HVAC Energy Savings and > 5% HVAC Peak Load Reduction
- 15 buildings
- 7.5m Sq Ft
- Around the USA
- 27 Months
Northeast Energy Efficiency Partnerships
Commercial Advanced Lighting Control (CALC) Demonstration and Deployment

- Networked, Intelligent Lighting Control Systems
- 10 demonstration projects across Northeast Region
- 40,000 Sq. Ft. average project size
- New Training and Incentive Programs to support technology packages

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- Visit [www.neep.org](http://www.neep.org) or email CALC@neep.org for more information
**Goal:** To achieve 275 TBtu in annual source energy savings in commercial buildings via large scale deployment of µCHP in North America.

**Objective:** Address identified market barriers via deployment of 8 field demonstration sites in NA

- Northeast, Midwest and California;
- >3000 gal/day, restaurants, hotels, healthcare, multi-family housing

**Expected Outcome:** Provide stake-holders with the information needed to build a sustainable market. Specifically:

1. Verify value proposition of <3 year installed cost payback
2. Identify and simplify installation and service issues
3. Create effective training for installation & service personnel

**Year 1:** Site selection, market assessment, engine EPA regulatory approval

**Year 2:** Site installation, refinement, sub-contractor training
High Efficiency Motors for Refrigerated Open Display Cases

**Company:** QM Power, Inc.

**Technology:** advanced Q-Sync fan motor technology for 7-16 watt commercial refrigeration fan applications

**Objective:** to install and verify performance for approximately 12,000 high efficiency Q-Sync fan assemblies in over 50 grocery sites throughout the US

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<tr>
<th>Type</th>
<th>Efficiency</th>
<th>Q-Sync advantage</th>
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<tbody>
<tr>
<td>Q-Sync</td>
<td>75%</td>
<td>----</td>
</tr>
<tr>
<td>Shaded Pole</td>
<td>19%</td>
<td>+295%</td>
</tr>
<tr>
<td>PSC</td>
<td>35%</td>
<td>+114%</td>
</tr>
<tr>
<td>ECM</td>
<td>60%</td>
<td>+25%</td>
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Phase 1: Demonstration and Commercialization Planning, OEM Testing

Phase II: Limited Site Testing

Phase III: Site Demonstration, Testing and Deployment

If fully commercialized and adopted, Q-Sync motor applications have the potential to achieve over 0.6 quads and over $1 billion of energy savings in building applications.
Other Real Building Technology Demonstrations

- Alternative Refrigerant Systems
- Multi-load Washing Machines
- Ultra-low Temperature Freezers
- Daylighting and Lighting Controls Retrofits in Office Perimeters
- Gas Unit Heaters
- Heat Pump Water Heaters
- LED Downlights
- RTU Challenge Units
- Advanced RTU Controls with Automated Fault Detection and Diagnostics
Participate in a Real Building Demonstration

- **enVerid HVAC Load Reduction**: looking for office, education, retail spaces or airport terminals without demand controlled ventilation or an Energy Recovery Ventilator.

- **BuildingIQ Predictive Energy Optimization**: already partnering with GSA and District of Columbia, looking for office, healthcare and enclosed retail malls, 100,000 sq. ft. or greater and digital controls at least on air handling units.

- **A.O. Smith micro-Combined Heat and Power**: looking for restaurant, healthcare, hospitality, multifamily or other with hot water demand greater than 3,000 gals/day in the Northeast, Midwest and California.

- **Contact**: techdemo@ee.doe.gov
Additional Resources
For More Information

- Participate and Find Out About Field Demonstration Projects
  - http://www4.eere.energy.gov/alliance/activities/demonstrations

- Updates from the High Impact Technology Catalyst
  - http://energy.gov/eere/buildings/high-impact-technology

- Request For Information (RFI) on High Impact Commercial Building Technologies
  - https://eere-exchange.energy.gov/

- Commercial Buildings Funding Opportunity Announcement
Question & Answer Session
Join Us for the Next Better Buildings Webinar

Making Utility Efficiency Funds Work for You

**Date:** Tuesday, December 2  
**Time:** 3:00 – 4:00 PM EST

**Overview:** A grocery chain, major city, and manufacturing organization each describe how they have collaborated with utilities to bring big energy savings to their portfolios and help reduce the overall peak electricity demand for the utility. Presenters will offer recommendations for working with utilities to create innovative energy savings opportunities customized to your portfolio type.

Register [here](#).
**Today’s Presenters**

| Kathy Ramirez Aguilar  
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