Better Buildings
U.S. DEPARTMENT OF ENERGY

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

Name		Organization
Amy Jiron		Department of Energy
Kathy Ramirez Aguilar		University of Colorado, Boulder

The High Impact Technology Catalyst Team

U.S. Department of Energy
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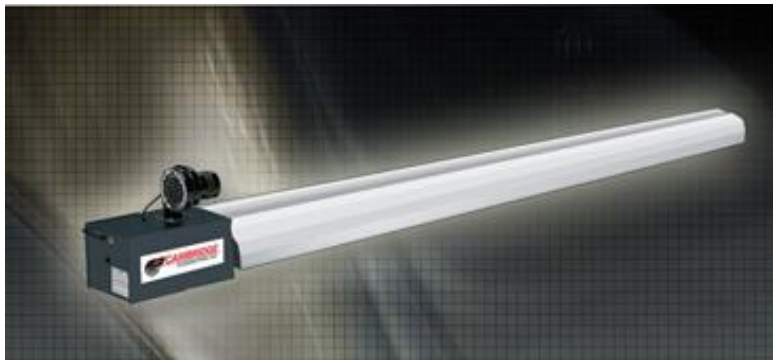
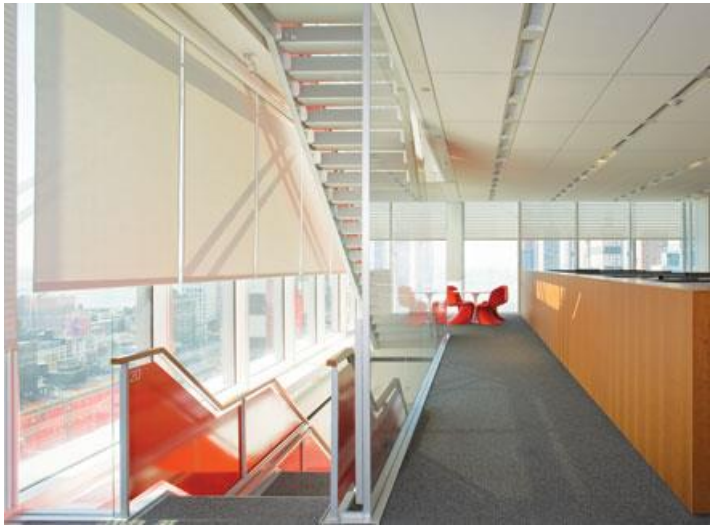
High Impact Technology (HIT) Catalyst





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

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Commercial Buildings Integration
Building Technologies Office


How can we catalyze the adoption of high impact commercial building technologies?
Owners
Managers
Designers
Engineers
Occupants
Financial Institutions
Government
Utilities
Stakeholder Engagement & Partnerships
Manufacturers
Dealers
Suppliers
Scientists

We look at a variety of factors… for example, RTUs

ENERGY FOOTPRINT

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

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.

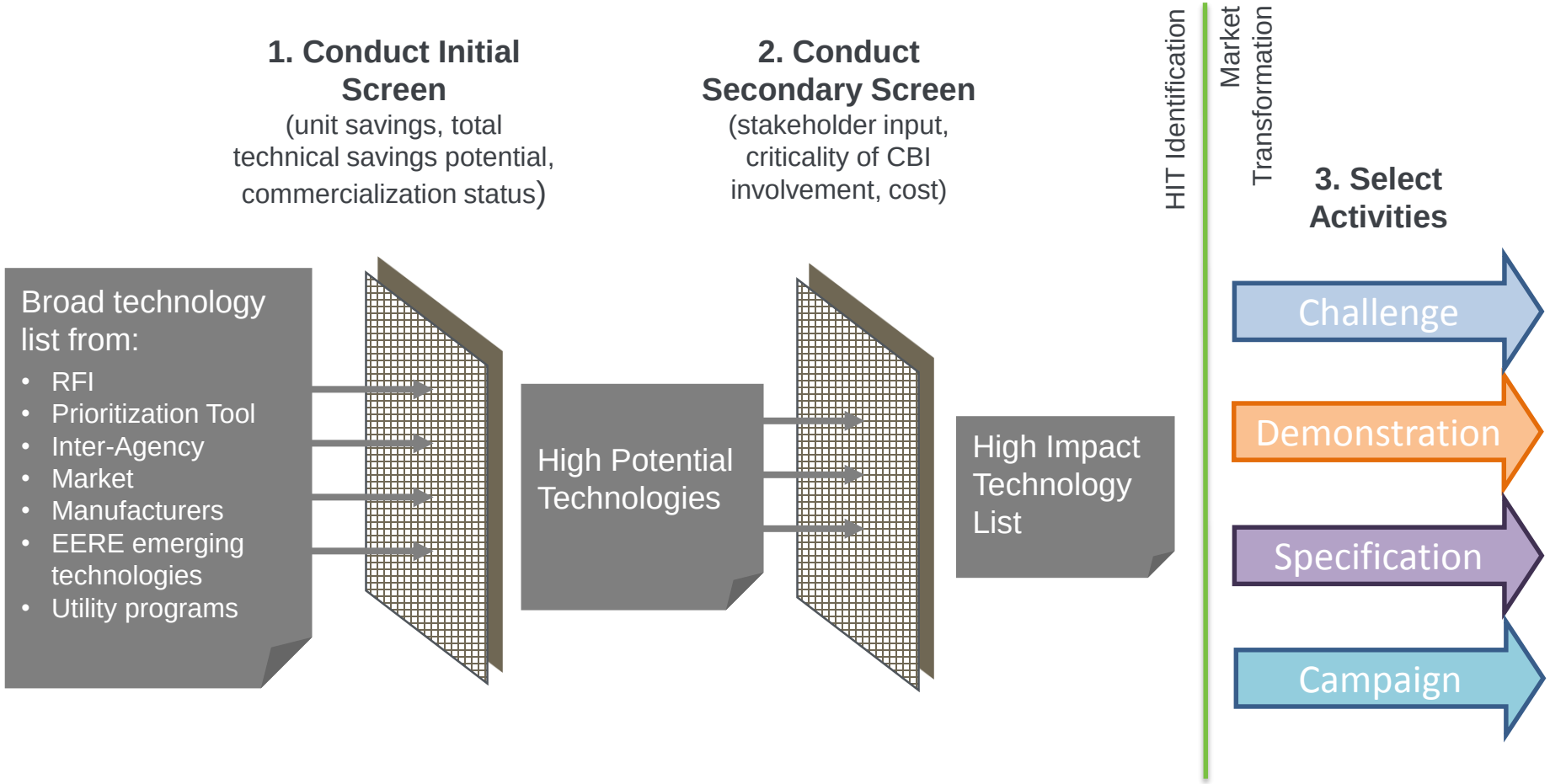
Methodology: Cohesive step-by-step strategies move techs from newly commercialized to full adoption. Each step in the tech-to-market pipeline has a purpose and connection to the next step; all are integrated into existing BTO deployment networks.

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.



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)*

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Ongoing Example - How HITs move through the Pipeline

Screen → Plan & Develop → Implement → Track Market Uptake → Reduce Energy Consumption (BTO goal)

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 owner s 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.

Steps to Prioritization

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

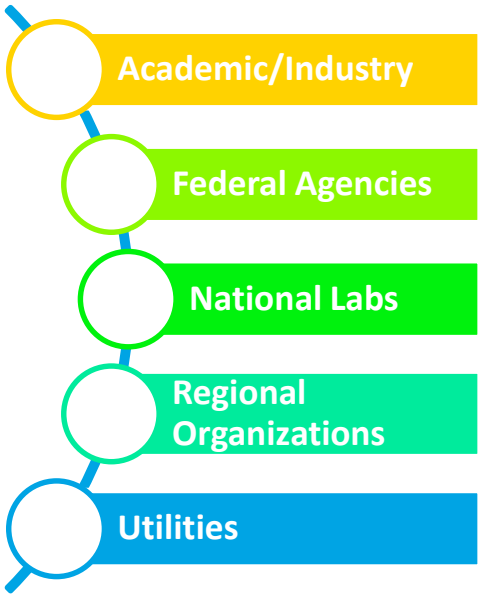
- information on technologies developed through work by the BTO Emerging Technologies team (P-Tool);
- technology-specific and national energy savings potential values;
- In total, over **400 measures** to evaluate.
- The Matrix includes two screens for: 1) energy savings opportunity and deployment readiness;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



HIT Priority List

Measure Name	Description
LED Troffers with Controls	Deploy high-efficiency (solid-state) 2x4 troffers with added controls
Packages of Building Management and Information Systems and Whole Building Diagnostics	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.
Auto Sash Fume Hoods for Laboratories	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.
Shading & Awnings	Demonstrate energy reductions and other benefits to awnings and other shading devices on commercial buildings.
Refrigeration Controls & Display Case Retrofits	• Use variable speed compressors in select new commercial refrigeration equipment; • Retrofit display case doors with anti-sweat heaters, vinyl/composite door frames, and high-performance glass.
Heat Pump Water heaters	Deploy highest efficiency heat pump water heaters in residential and small commercial buildings

Next?

Annual HIT Matrix and Peer Review

- Incorporate stakeholder feedback (including workshop)
- Select HIT focus

Evaluate and update each year to reflect evolving market conditions and advances in technology.

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

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**

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Join us for Tech Day at the Better Buildings Summit

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

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Ultra Low Temperature (ULT) Freezer Demo

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

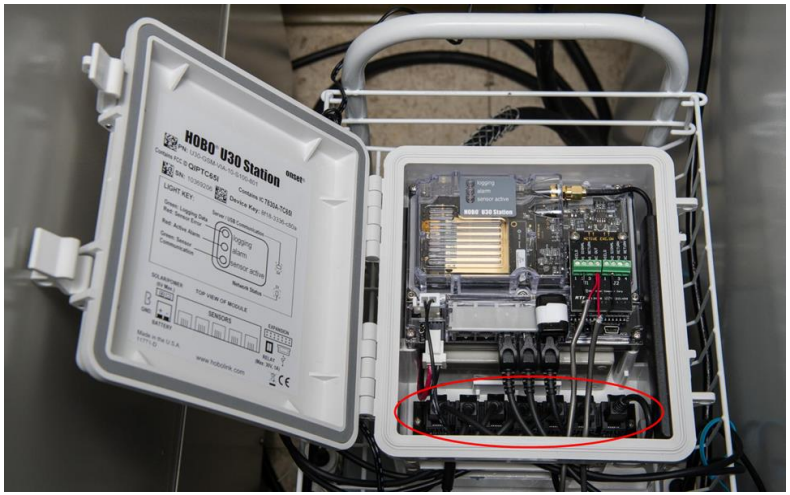
Why CU-Boulder Green Labs was Interested

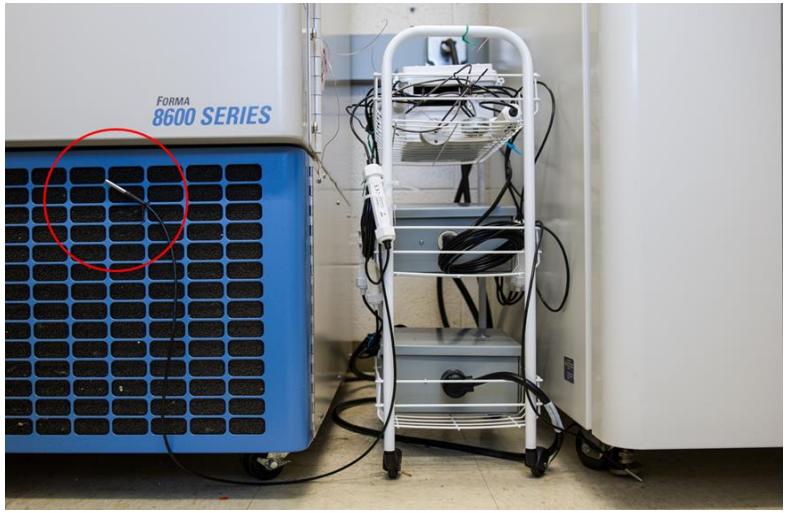
- Aware of need for market change for lab equipment
- ULT freezers have been a focus of the CU Green Labs Program
- ~150 ULT freezers at CU-Boulder
- We wanted to help!

University of Colorado Boulder

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)

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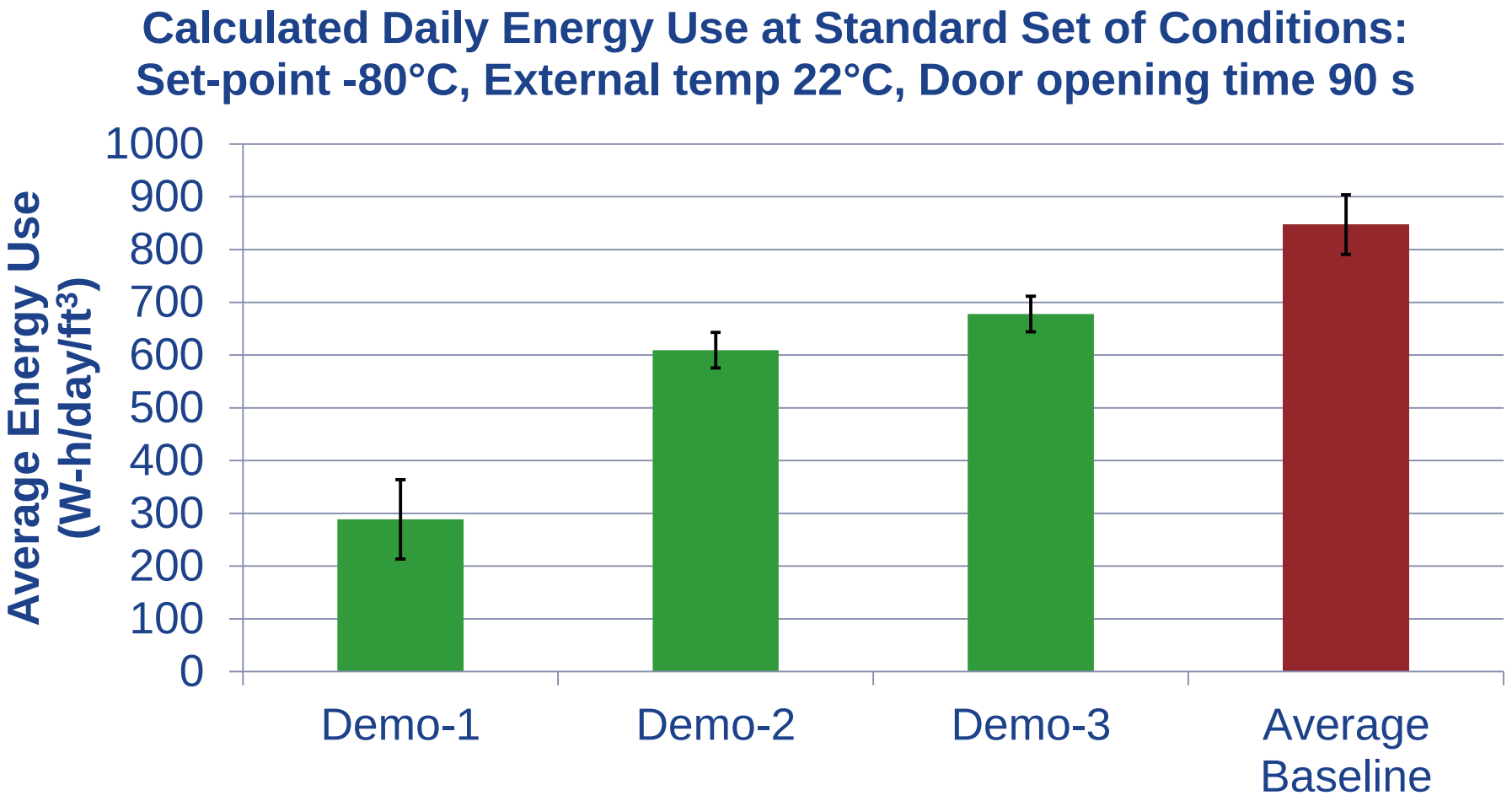
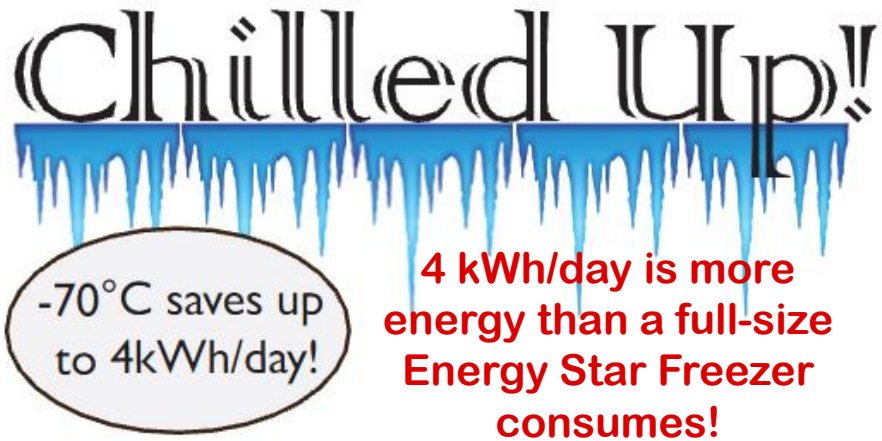
Preliminary Results from DOE Demo

We observed that the demo ULTs used between 20% and 66% less energy than the average baseline ULT.



Taking the Project Further

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



(Modified Graphic from UC Davis)

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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

Amy Jiron
High Impact Technology Catalyst

Department of Energy

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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 CO_2 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.

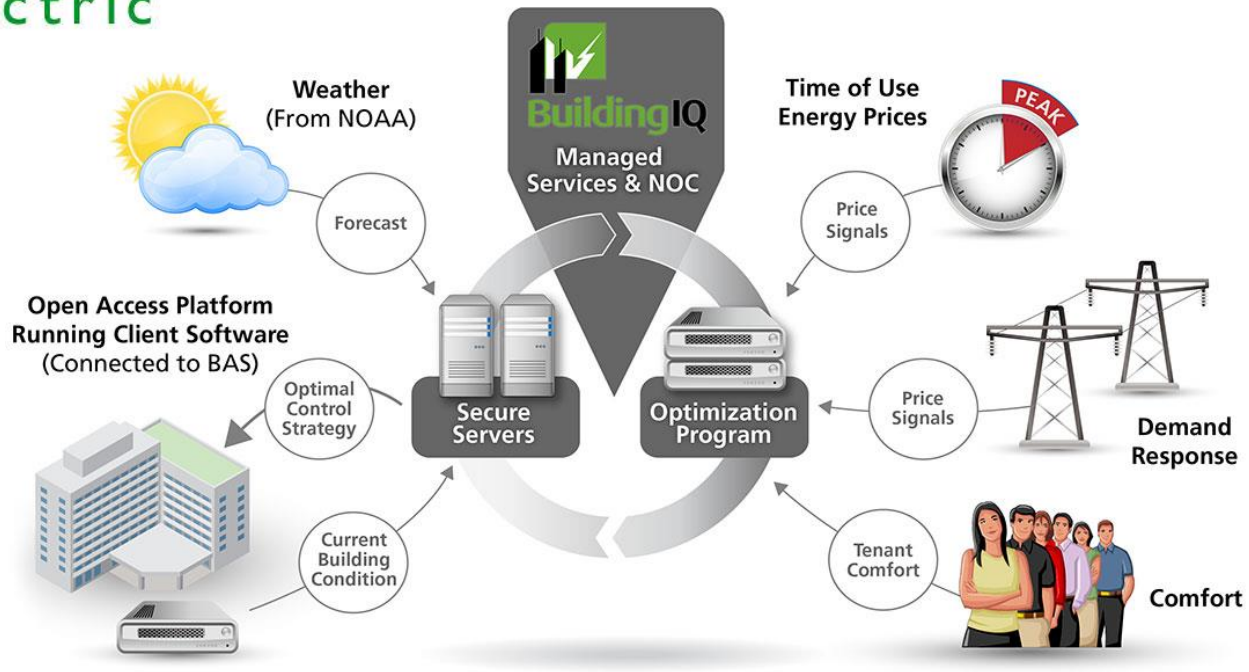
Predictive Energy Optimization (PEO) and Automated Demand Response for Commercial Building HVAC

Schneider Electric

SIEMENS

> 10% HVAC Energy Savings and > 5% HVAC Peak Load Reduction

15 buildings
7.5m Sq Ft
Around the USA
27 Months



DC.gov

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

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

	Q4 2014	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016	Q2 2016
Select Technologies							
Select Sites							
Install Sites							

- Visit www.neep.org or email CALC@neep.org for more information

DEMONSTRATION OF µCHP IN LIGHT COMMERCIAL HOT WATER APPLICATIONS

AO Smith Corporation

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

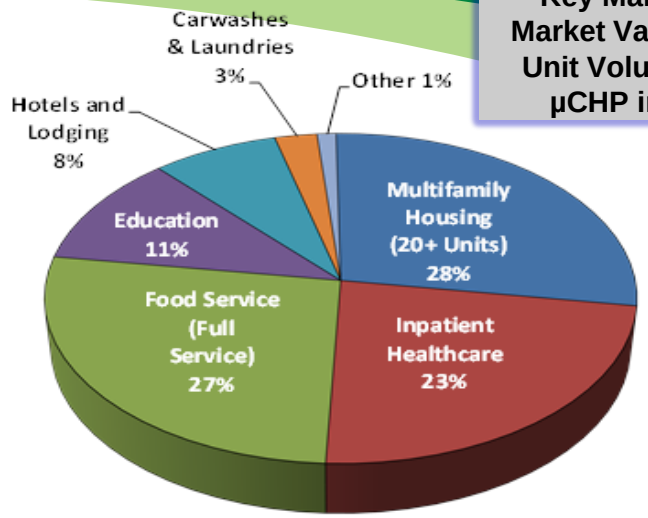
Expected Outcome: Provide stake-holders with the information needed to build a sustainable market. Specifically:

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

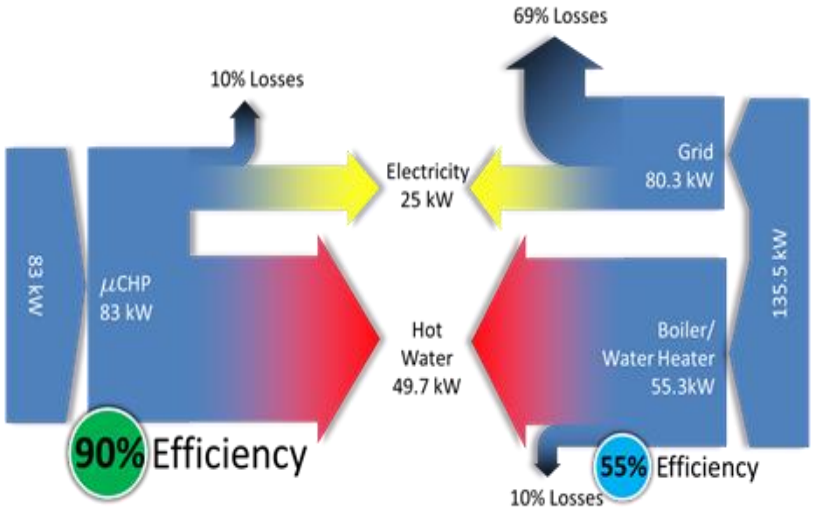
Year 1: Site selection, market assessment, engine EPA regulatory approval

Year 2: Site installation, refinement, sub-contractor training

Key Markets, Market Value and Unit Volume for µCHP in NA



Overall Efficiency Comparing Conventional Electricity/Hot Water Production with a µCHP System



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

Phase 1: Demonstration and Commercialization Planning, OEM Testing

Phase II: Limited Site Testing

Phase III: Site Demonstration, Testing and Deployment

Type	Efficiency	Q-Sync advantage
Q-Sync	75%	----
Shaded Pole	19%	+295%
PSC	35%	+114%
ECM	60%	+25%

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

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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
  - http://energy.gov/eere/buildings/articles/apply-funding-opportunity-advancing-solutions-improve-energy-efficiency

Question & Answer Session

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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.

Additional Questions? Feel Free to Contact Us

betterbuildingswebinars@ee.doe.gov

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