Better Buildings
U.S. DEPARTMENT OF ENERGY

Maximizing Supermarket Refrigeration System Energy Efficiency—Day 2

Moderator: Bob Zogg, Navigant Consulting, Inc.

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Agenda

- Introductions/Session Overview (5 minutes)
- Set Team Goals (15 minutes)
- Measure Success (15 minutes)
- Status and Plans for Ongoing Team Activities (30 minutes)
- Proposed New Team Activities (20 minutes)
- Wrap Up Day 2 (5 minutes)

Session Overview

We will focus today's discussions on setting team goals, measuring success, and identifying actionable next steps.

- Set Team goals
- How to measure success
- Review past/ongoing activities and adjust/refine planned next steps
- Discuss new Team activities

Please orient your comments towards actions that the Refrigeration Team can take, and how external stakeholders can support our efforts.

Set Team Goals >> New Approach

Should our goals address supporting activities only, or actual energy savings?

- ***Past/Current Approach:***
  - We perform activities to support Team members as they pursue the goals set by their respective organizations
  - Each member organization tracks its own progress—no report back to the Team
  - Team sets goals based on completing supporting activities—no direct linkage to actual energy savings

- ***Potential New Approach for Discussion:***
  - Set goals as a Team
  - Report progress to the Team
  - Team sets goals directly linked to actual energy savings

- ***Discussion:***
  - ***What advantages/disadvantages do you see?***
  - ***Would your company support this potential new approach?***

Measure Success

DOE encourages us to focus on measuring success.

- Possible Metrics based on our Current Approach:
  - Testimonials
  - Added energy-efficient features, measured reductions in energy consumption
- Possible Metrics based on a New Approach:
  - Modeled or metered energy consumption? (per unit of refrigeration capacity, per unit volume of display case; per unit display area, other?)
  - Feet (or fraction) of display cases retrofitted?
  - Store consumption per unit floor area?
  - Sales per unit energy consumption (report aggregated results)?
- Need "baseline" against which to reference savings
- ***Action Item from Day 1: Richard Heath, Mike Guldenstern, and Jason Robbins to draft brief recommendation for metrics and baseline for the Team to review***

Status and Plans for Ongoing Team Activities >> ASHRAE Commissioning Guide

DOE and the Refrigeration Team supported development of ASHRAE's refrigeration commissioning guide.

- DOE/NREL and the Refrigeration Team supported development of the *Refrigeration Commissioning Guide for Commercial and Industrial Systems* (released January 2014)
- Guide is available at: Commissioning Guide
- NREL hosted February 27, 2014 Webinar (presented by Richard Royal of Wal-Mart, Caleb Nelson of CTA, and Doug Scott of VaCom Technologies)
- Appliance Magazine published March 2014 article: Article

Status and Plans for Ongoing Team Activities >> ASHRAE Commissioning Guide

Key activities are promoting the Guide and gathering feedback.

- Promotion Plan:
  - FMI Energy & Store Development Conference, September 7 – 9, 2014 (St. Louis): Energy Breakout Session will include Commissioning/Recommissioning (Paul Torcellini/NREL)
  - ASHRAE Annual Conference, Seattle, June 28 – July 2, 2014: *The Road to Success with the New Refrigeration Commissioning Guide* (Richard Royal/Wal-Mart, Jason Robbins/Walgreens, Bryan Beitler/Source Refrigeration & HVAC, Caleb Nelson/CTA)
  - ***Word of mouth—talk it up!***
- **Next Steps (from Day 1 discussion):**
  - ***Explore utility incentives for supermarket commissioning***
  - ***Explore a training and/or certifying commissioning agents, technicians, and others in the use of the Guide (EPA, ASHRAE, RSES)***
  - ***Explore referencing the guide in the California Green Building Standards Code (CAL Green), LEED, and/or Green Globes***
  - ***Encourage Team members to incorporate the Guide (or portions thereof) in their own specifications***
  - ***Explore developing electronic check lists and/or software that can facilitate use of the Guide***

Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Delhaize America is utilizing a transcritical CO_2 refrigeration system at its Hannaford store in Turner, ME, and has partnered with BBA.

- ***Project Goal:*** Perform field case study of transcritical CO_2 refrigeration in a supermarket application
  - Compare performance to that of a conventional refrigeration system of comparable design and operation (operating hours, ambients, etc.)
  - Examine cost and energy benefits and tradeoffs compared to HFC systems

- Since the Turner store opened in Summer 2013, Delhaize has been collecting electric utility meter data, selectively submetered electricity data, and propane use (for building HVAC) data

Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Delhaize is also collecting analogous data for a Hannaford store in Bradford, VT to serve as a baseline.

- The Bradford store features a standard HFC refrigeration system
- These high-level specs indicate that the stores are very similar and well-suited to performance comparison
- Major specifications for the two stores are:

	Turner, ME (Transcritical)	***Bradford, VT (Conventional)***
Refrigeration System Capacity (MBtuh)	740	748
Building Heating Needs (MBtuh)	1298	1644
Heating Degree Days/Yr (5yr Avg, 65'F)	7271	7821

Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

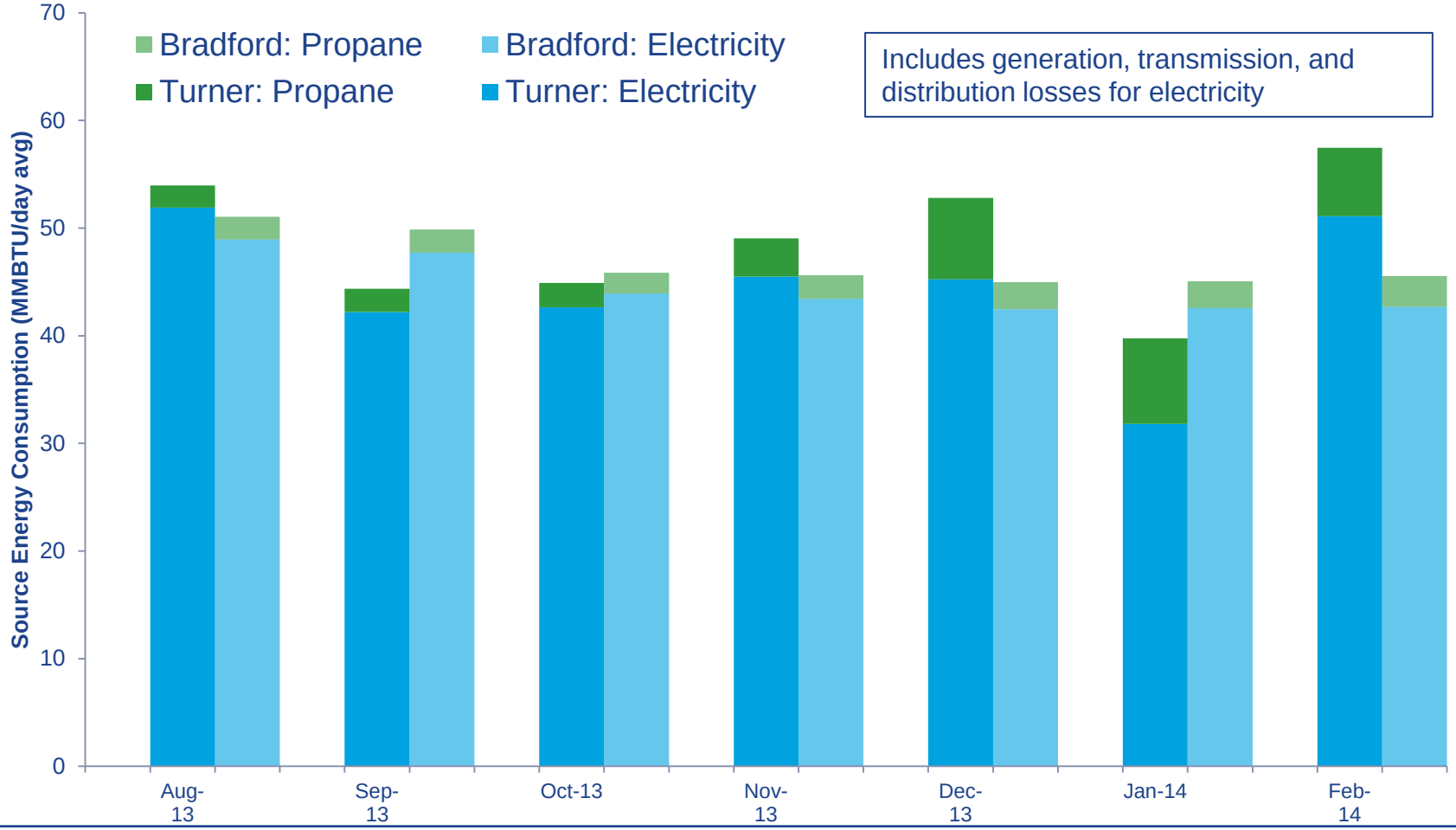
The table below shows raw whole-store energy consumption values for the Turner and Bradford stores.

- These figures were collected directly from electric and propane utility bill data.
- The utility bill data, coupled with submetering of specific system components, will drive the comparative analysis of the refrigeration systems

	Total Store Site Electricity Consumption (kWh/day avg)		Total Store Propane Consumption (gal/mo)		Total Store *Site* Energy Consumption (kBtu/day avg)	
	Turner	Bradford	Turner	Bradford	Turner	Bradford
Aug-13	4845	4569	681	698	18,599	17,710
Sep-13	3939	4452	715	723	15,611	17,385
Oct-13	3979	4099	751	643	15,855	15,939
Nov-13	4246	4054	1180	727	18,065	16,036
Dec-13	4223	3964	2499	829	21,974	16,038
Jan-14	2968	3973	2638	829	18,112	16,070
Feb-14	4771	3984	2099	950	20,833	16,757

Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Raw data suggest similar overall energy performance for the two stores.



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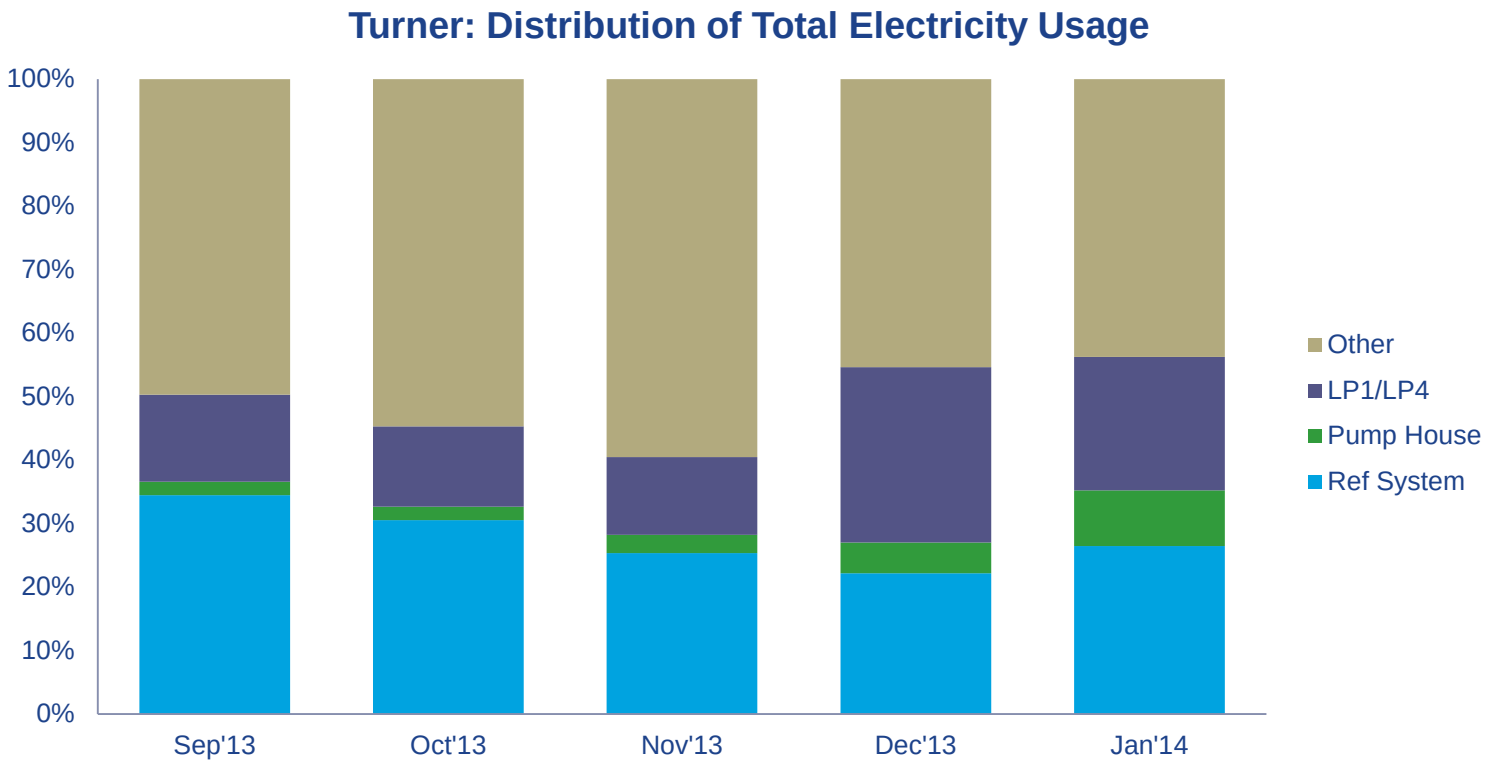
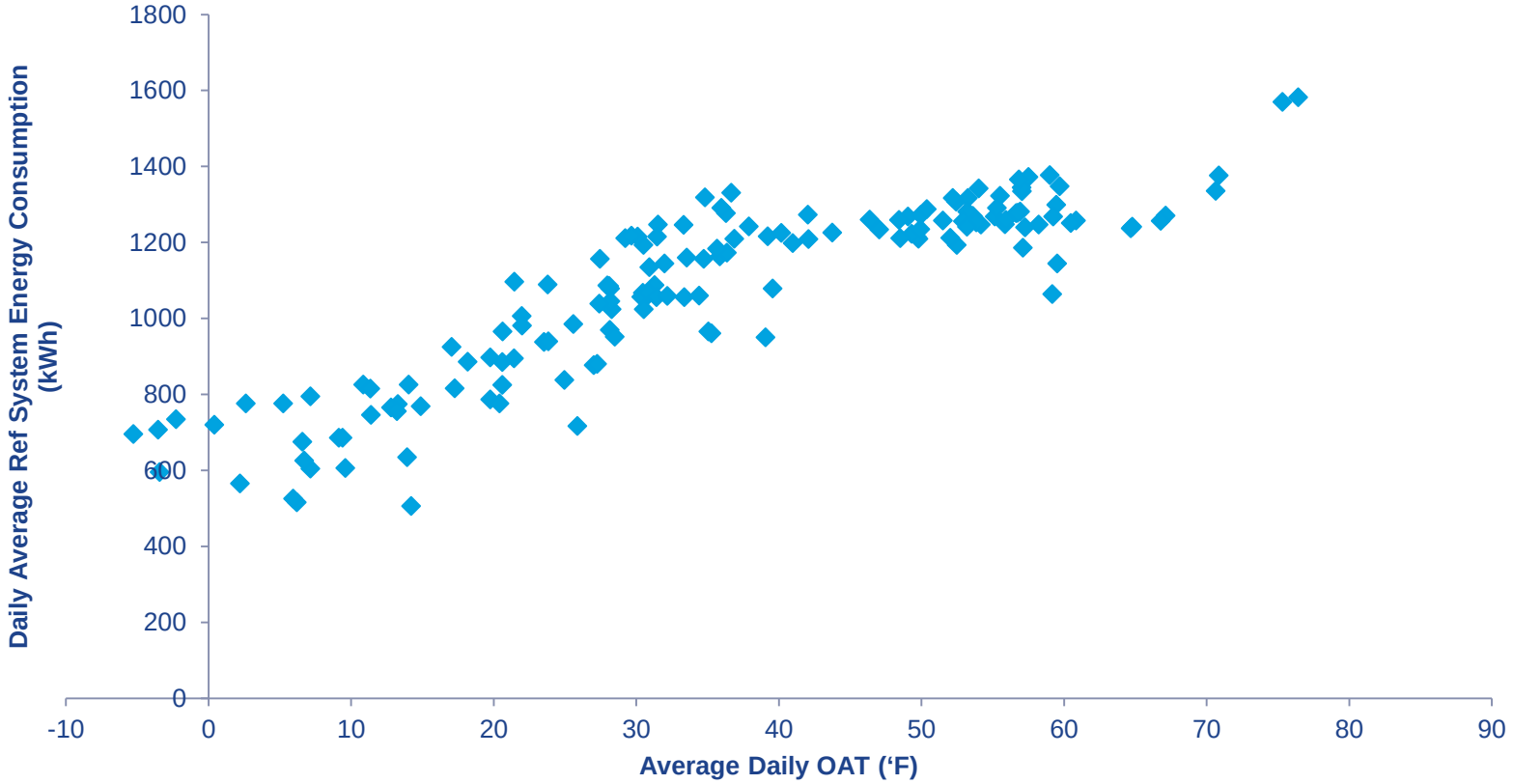
Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Delhaize is submetering electricity consumption for the refrigeration system, lighting panels, and on-site water treatment system and pump house.



Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Daily energy consumption of the transcritical refrigeration system correlates fairly well with daily average outdoor temperature.



Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Delhaize and the Refrigeration Team will continue to collect energy use data through Summer 2014.

- We will normalize data as appropriate to ensure a fair comparison between the two sites
  - May normalize electricity consumption over capacity to compare the power costs directly associated with transcritical and HFC systems
  - May normalize propane consumption for HVAC over heating degree days at each store location (to account for savings from heat reclaim)
  - May apply other adjustments for store-specific factors or discrepancies if warranted

- Will develop a report detailing any subjective benefits and concerns about the new technology and comparing the performance and operational costs of the refrigeration systems

Status and Plans for Ongoing Team Activities >> Alternative Refrigerants Case Studies

Would additional case studies be helpful?

- Plan:
  - Complete Delhaize/Hannaford monitoring and case study
  - Complete two additional case studies—discussions continue, but no data collection yet

- Discussion:
  - ***How will you use these case studies?***
  - ***Would additional case studies be helpful? If so, what technologies and what host sites?***

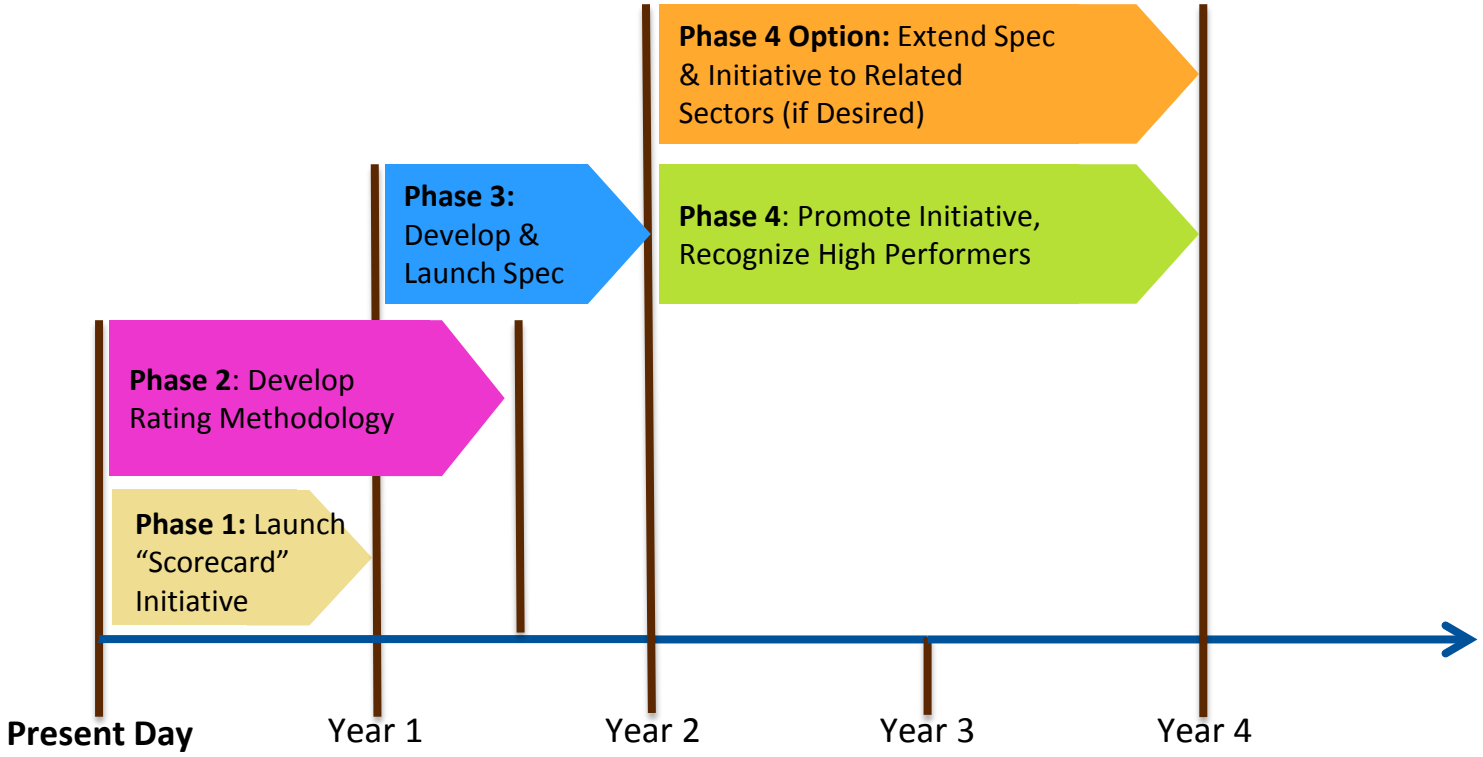
Status and Plans for Ongoing Team Activities >> Supermarket Refrigeration Initiative

We've conceptualized a short-term and long-term approach to rating refrigeration systems.

- We are developing an initiative to promote improved efficiency of supermarket refrigeration systems
  - The initiative will encourage end users (owners and operators) to improve energy efficiency and recognize successful end users
- Our approach includes several stages of development of increasingly quantitative measures of refrigeration system performance
- ***Short-Term Goal:*** Develop an initiative based on a simple refrigeration system asset rating system (AKA, "scorecard")
  - In 2013, the Refrigeration Team developed an initial scorecard, and vetted it with several members and suppliers
  - The scorecard assigns points for energy-saving features, most of which can be confirmed through inspection
  - The scorecard sets threshold point scores needed to demonstrate performance leadership
- ***Long-Term Goal:*** Develop a rating metric for refrigeration systems, similar to SEER or other metrics used in the HVAC industry

Status and Plans for Ongoing Team Activities >> Supermarket Refrigeration Initiative

We anticipate a project duration on the order of four years.[1]



[1]Timeline will depend on available resources, stakeholder involvement, and level of collaboration with other entities.

Status and Plans for Ongoing Team Activities >> Supermarket Refrigeration Initiative

We are engaging key industry groups to help ensure the success of this effort.

- Air-Conditioning, Heating, & Refrigeration Institute (AHRI):
  - Briefed two AHRI Product Sections (Commercial Refrigeration Manufacturers, and Compressors and Condensing Units), and AHRI's new System Efficiency Committee
  - AHRI confirmed interest in participating, especially in metric development
  - Identified 3 specific AHRI members interested in participating
  - Will re-connect with AHRI in May 2014
- ASHRAE:
  - Discussing with Standard 90.1[1] Committee at ASHRAE Annual Conference (June/July 2014, Seattle)

[1] *Energy Standard for Buildings Except Low-Rise Residential Buildings*

Status and Plans for Ongoing Team Activities >> Supermarket Refrigeration Initiative

How will we engage Team members in developing and launching this initiative?

- Plan:
  - Regroup with AHRI in May
  - Present to 90.1 committee at ASHRAE Annual Conference (June/July 2014 in Seattle)

- Discussion:
  - ***Are Team members willing to evaluate a sample of their stores to test the "scorecard"?***
  - ***How else can Team members engage in the process?***

Status and Plans for Ongoing Team Activities >> Retrofitting Open Display Cases

In 2012, in response to member needs, the Refrigeration Team developed a guide to best practices for retrofitting open cases with doors.

- Members expressed concerns over barriers
  - Disparities between anticipated and actual energy benefits
  - Cost concerns – food retailers very sensitive to capital costs
  - Perceptions that door retrofits may hurt product sales
- Many of these barriers resulted from knowledge gaps
  - Poor retrofit performance often due to inadequate planning or improper execution
  - Need for system-wide changes in conjunction with retrofits is often overlooked
  - Financial impact and payback are often misunderstood
- BBA action: Develop best practice guide to overcome knowledge gaps
- Developed with input from numerous stakeholders, including major equipment manufacturers and installers
  - DC Engineering
  - Hill Phoenix
  - Hussmann Corporation
  - REMIS America, LLC and REMIS GmbH
  - Zero Zone, Inc.

Status and Plans for Ongoing Team Activities >> Retrofitting Open Display Cases

The Refrigeration Team has taken significant steps to raise awareness of the technology and the guide.

- Developed and published best practices guide: Case Retrofit Guide
- Developed a calculator to estimate economic benefits
- Published series of articles in *ACHR News* and the *RSES Journal* (Refrigeration Service Engineers Society)
- RSES adopted the guide as a Service Application Manual
- Hosted 2013 webinar
- Developed case study with Fresh & Easy
- Worked with Southern California Gas Company (SoCalGas) to develop a rebate package. SoCalGas is negotiating with Southern California Edison (SCE) to develop an implementation plan administered by SCE. If implemented, it would make SoCalGas one of few utilities to offer a gas rebate for retrofits

Status and Plans for Ongoing Team Activities >> Retrofitting Open Display Cases

What are our next steps to accelerate case retrofits?

- Current Activities:
  - Discussing additional case studies with end users

- Discussion:
  - ***How can we address specific data needs?***
    - Potential sales impact is a key driver, and data are lacking
    - Are members willing to work with the Team to develop sales impact case studies (using relative sales impacts, not actual sales data)?
  - ***Is a member progress tracking database of interest***?
    - Might include the number of retrofits conducted to date, retrofit project targets, equipment types used, etc.
    - Would allow for information sharing and learning through other adopters' experiences
  - ***What additional tools and resources can the Team develop?***

Status and Plans for Ongoing Team Activities >> Webinars

The Team periodically conducts Webinars on topics of interest to Team members.

- DOE/NREL held February 2014 Webinar on ASHRAE Commissioning Guide
- Refrigeration Team held April 2014 Webinar on refrigeration system design (Presented by DC Engineering)
- Identified other Webinars of interest:
  - Improving Energy Performance in Distribution Warehouses
  - Distributed Generation, including Combined Heat and Power
  - Lowering Energy Costs (Benchmarking Energy Use; Utility Bill Audits; Tariff Options; Load Shifting to Lower Peak Demand)
- Discussion:
  - ***What Webinars would you attend (topics and presenters)?***
  - ***Can you help outline Webinar content?***

Status and Plans for Ongoing Team Activities >> ASHRAE 50% AEDG (Related Activity)

ASHRAE seeks peer review of the Advanced Energy Design Guide (AEDG) for Grocery Stores.

ASHRAE Advanced Energy Design Guide for Grocery Stores—50% Energy Savings
• Easy-to-use guidance for achieving energy savings—includes: Refrigeration Systems, Cooking, Grocery Lighting, and Plug Loads
• Next in a series of guides (www.ashrae.org/freeaedg)
• First draft is in progress
• First (of two) Peer Reviews is scheduled from May 26 to June ***6—if you would like to peer review, contact*** eric.bonnema@nrel.gov
• Final publication March 2015
• Funded by DOE/NREL, in cooperation with ASHRAE/AIA/USGBC/IES
• Chaired by Paul Torcellini, National Renewable Energy Laboratory (NREL)

Status and Plans for Ongoing Team Activities >> Baseline for Modeling (Related Activity)

NREL, CTA, and Energy Studio are developing a Supermarket Refrigeration Baseline for Benchmarking Energy Performance.

- ***Title:*** *A Supermarket Refrigeration Baseline for Benchmarking Energy Performance*
- ***Authors:*** NREL / CTA Architects Engineers / Energy Studio
- ***Goal:*** Define a typical - circa 2013 - parallel rack, direct expansion (DX) supermarket refrigeration system to be used as a baseline for determining energy savings associated with refrigeration system efficiency measures for both existing buildings and new construction
- ***End-Users:*** Design engineers and modelers looking to evaluate refrigeration system energy conservation measures

Status and Plans for Ongoing Team Activities >> Baseline for Modeling (Related Activity)

NREL, CTA, and Energy Studio are developing a Supermarket Refrigeration Baseline for Benchmarking Energy Performance. (Cont.)

- ***Defines:*** High Side (e.g., comp, condenser fans, subcoolers…) & Low Side (e.g., case lighting, anti-sweat, walk-in evaporator fans); Cases configured according to DOE 2012 requirements

- ***When:*** Summer 2014 (We will notify Refrigeration Team members when it is publically available)

- ***Contact:*** Ian Doebber, NREL: ian.doebber@nrel.gov

Discuss Possible New Team Activities—Alternative Refrigerants

What do you need to learn about alternative refrigerants?

- Current Team activities focus on documenting energy impacts of alternative refrigerants (CO_2 systems to date)
- Does the industry need multiple alternative refrigerant options?
  - What if R-404A is delisted?
- What do you need to learn about ammonia for supermarkets?
  - Are you open to considering this?
  - What would convince you that it can be sufficiently safe?
  - What do you need to know about energy performance, cost, operation, maintenance?
- What do you need to learn about distributed propane for supermarkets?
  - Is enough information available?
  - What can we learn from Europe?

Discuss Possible New Team Activities—Standardized Design / Service Specifications

Would the industry benefit from standardized refrigeration system design and service specifications?

- What industry benefits do you see?
  - Lower costs?
  - Higher reliability?
  - Improved energy efficiency?
- Do you have formal design specifications? Service specifications?
- Would you be willing to share them with the Team?

Discuss Possible New Team Activities—Distribution Warehouses

Should we investigate refrigeration efficiency improvements for Distribution Warehouses?

- Do you own and operate your distribution warehouses?
- What refrigeration issues/problems do you currently experience, and how do they impact energy efficiency?
- Can this Team address these issues/problems?

Discuss Possible New Team Activities—Energy Benchmarking

Do you know how your energy performance compares?

- Do you know how each of your stores compares to your typical store?
- Do you know how your stores compare to the industry average?
- What is your experience with EPA's Portfolio Manager?

Discuss Possible New Team Activities—Ongoing Commissioning

The ASHRAE Commissioning Guide covers planning through first year of operation—do we need more information on ongoing commissioning?

- Supplement to current Guide?
- Case studies?
- Other information?

Discuss Possible New Team Activities—Other?

What other activities can this Team tackle to help lower energy use?

- What additional ideas do you have?
- Can this Team effectively address those ideas?

Wrap Up Day 2

We will summarize the session and agree to next steps.

- Recap Decisions
- Recap Action Items
- Next steps