Smart Thermostats

Why Is Everyone Talking About Them?

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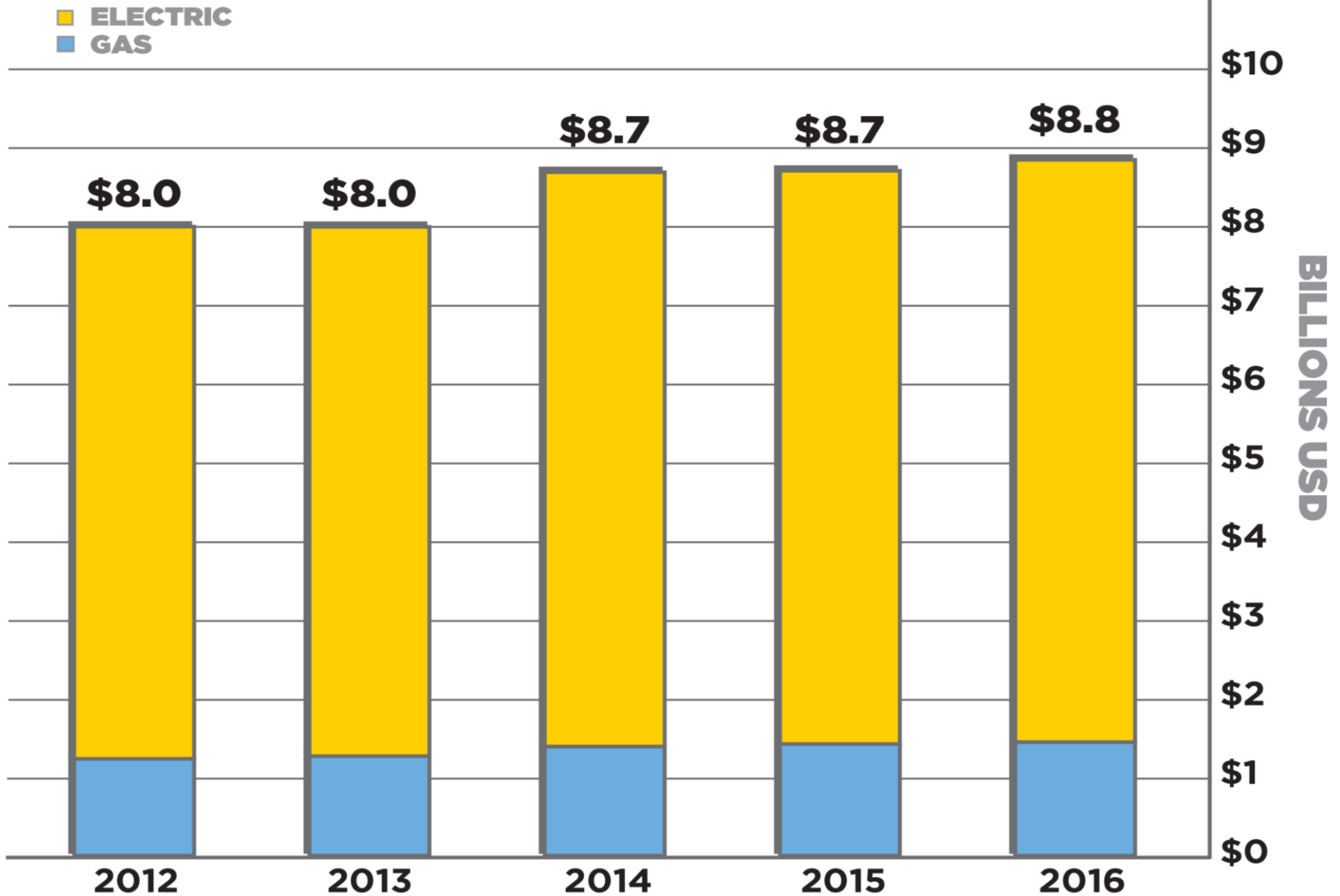
The Shifting Voluntary Program Landscape

CEE MISSION

As the **Consortium for Energy Efficiency**, United States and Canadian efficiency program administrators develop cutting-edge strategies to accelerate commercialization of energy efficient solutions to benefit gas and electric customers, utility systems, and the environment.
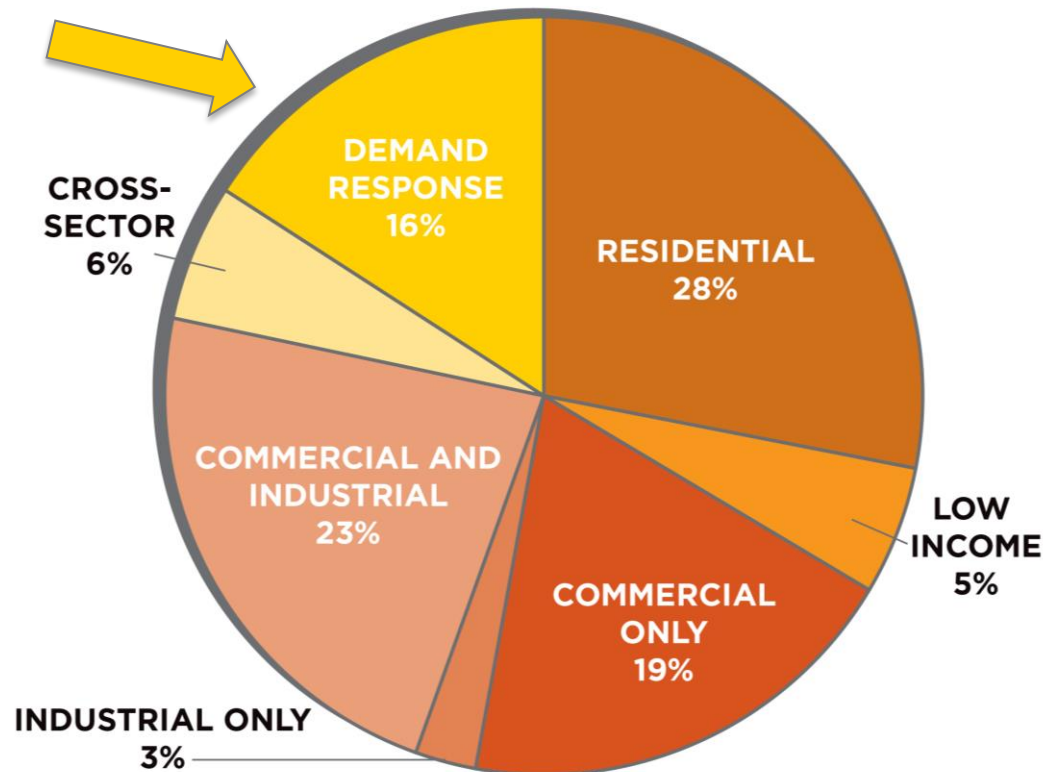
◄ CEE brings together 100 program administrators serving all or part of 45 states and 7 provinces

◄ CEE is a member-driven nonprofit, governed by a Board of Directors from member organizations

◄ Program administrators formed CEE to reach binational markets and accelerate market uptake of efficient products and services, which achieves lasting public benefit of energy efficiency

US and Canadian DSM Program Expenditures—Gas and Electric Combined 2012–2016
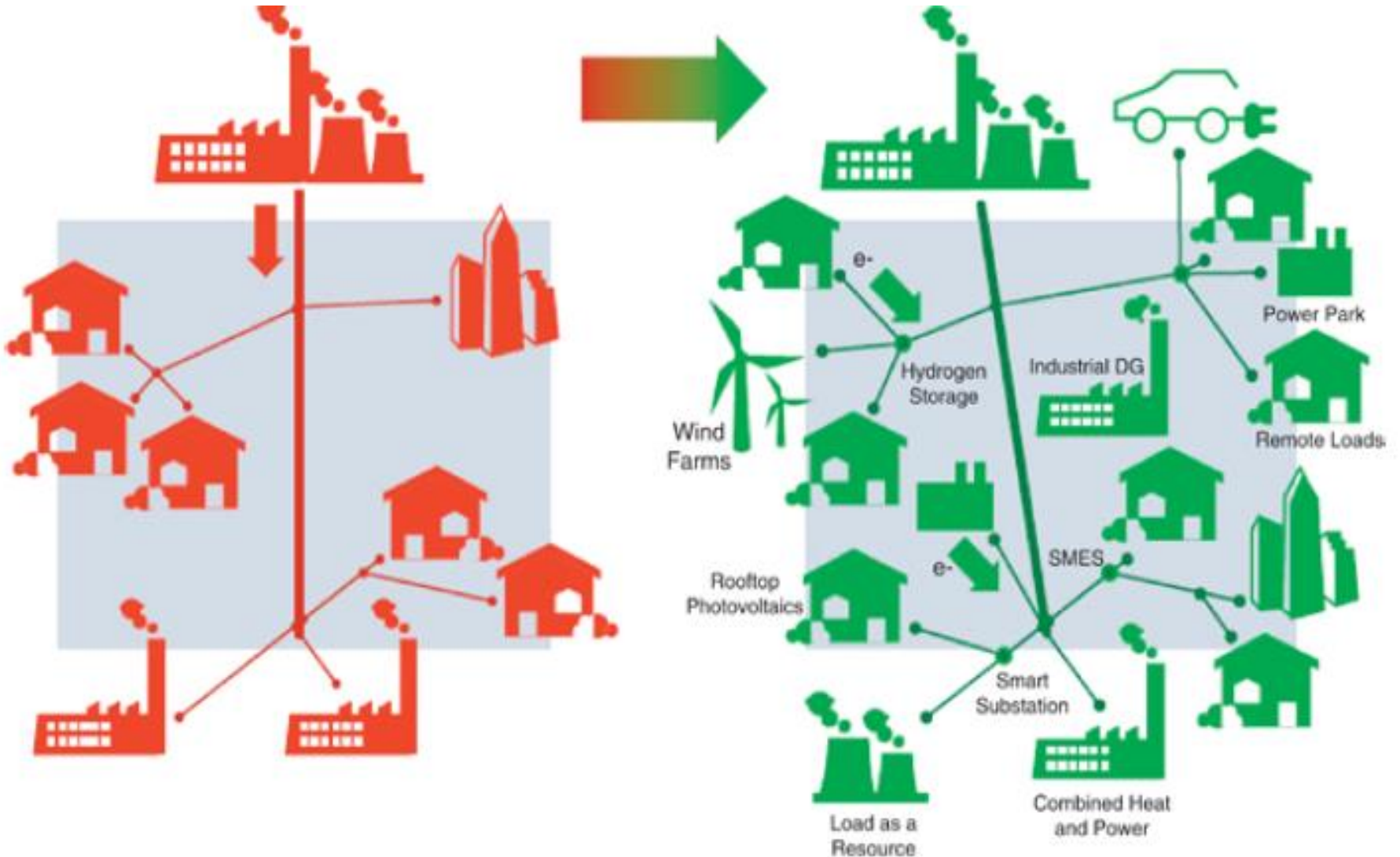
Legend:
- ELECTRIC
- GAS

Year	Total
2012	$8.0
2013	$8.0
2014	$8.7
2015	$8.7
2016	$8.8

BILLIONS USD

Y-axis: $0, $1, $2, $3, $4, $5, $6, $7, $8, $9, $10

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Investment in Load Management
US Electric DSM Expenditures By Customer Class

Pie chart: DEMAND RESPONSE 16%, RESIDENTIAL 28%, LOW INCOME 5%, COMMERCIAL ONLY 19%, INDUSTRIAL ONLY 3%, COMMERCIAL AND INDUSTRIAL 23%, CROSS-SECTOR 6%
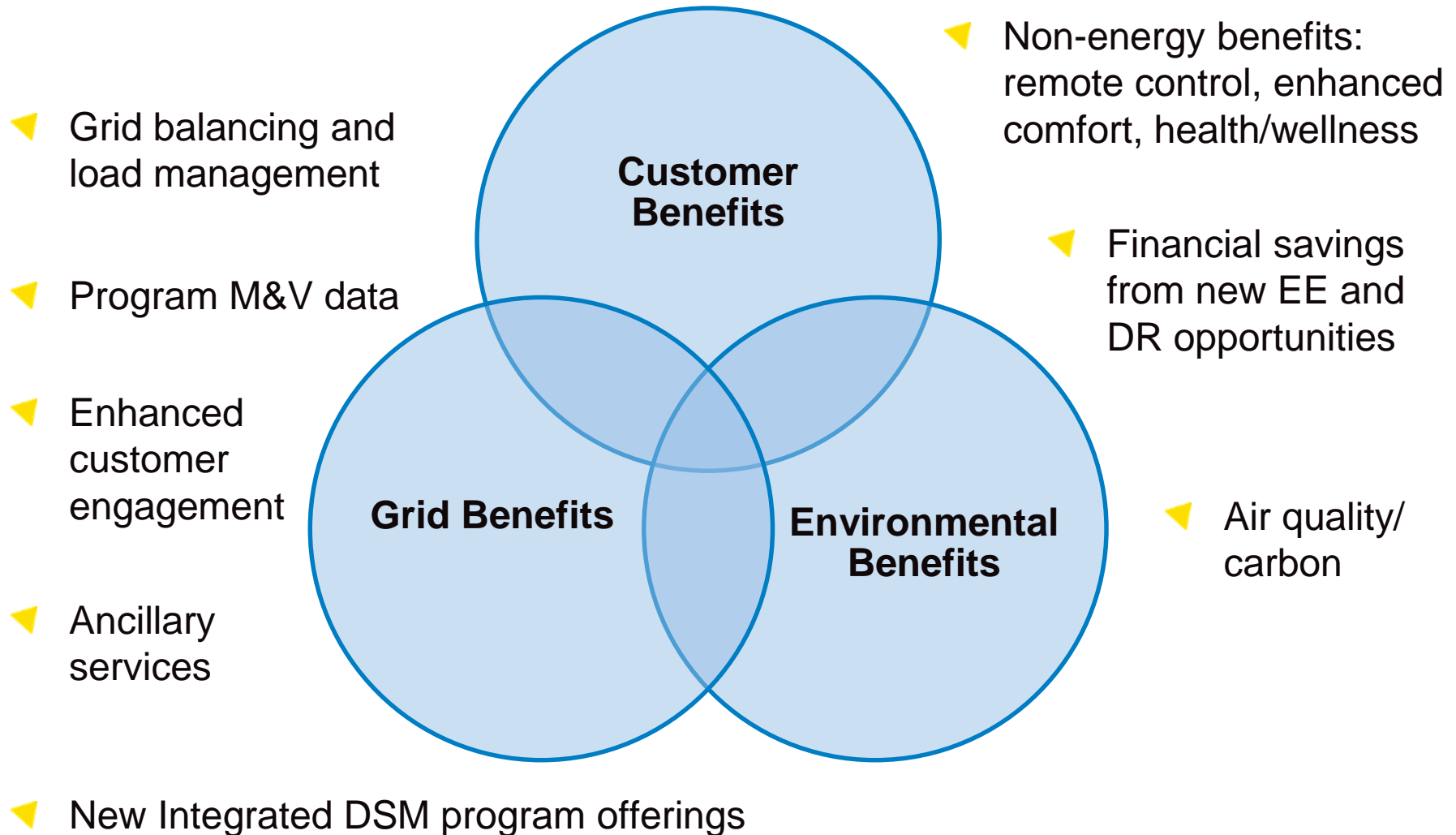
"In 2016 US electric demand response (DR) expenditures totaled **over $900 million** from ratepayer funded sources only"

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The Utility of the Future Concept

Potential Benefits of Connected

Customer Benefits

Grid Benefits

Environmental Benefits

◀ Grid balancing and load management

◀ Program M&V data

◀ Enhanced customer engagement

◀ Ancillary services

◀ New Integrated DSM program offerings

◀ Non-energy benefits: remote control, enhanced comfort, health/wellness

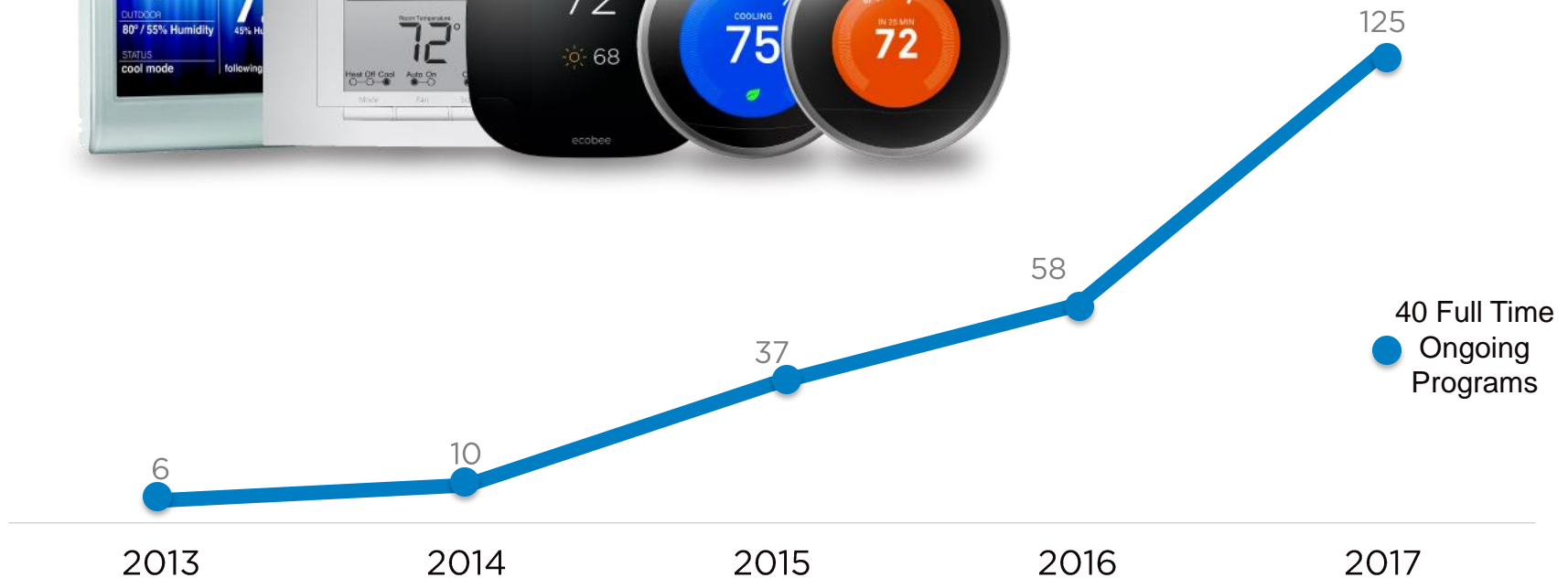◀ Financial savings from new EE and DR opportunities

◀ Air quality/ carbon

Connected Thermostats
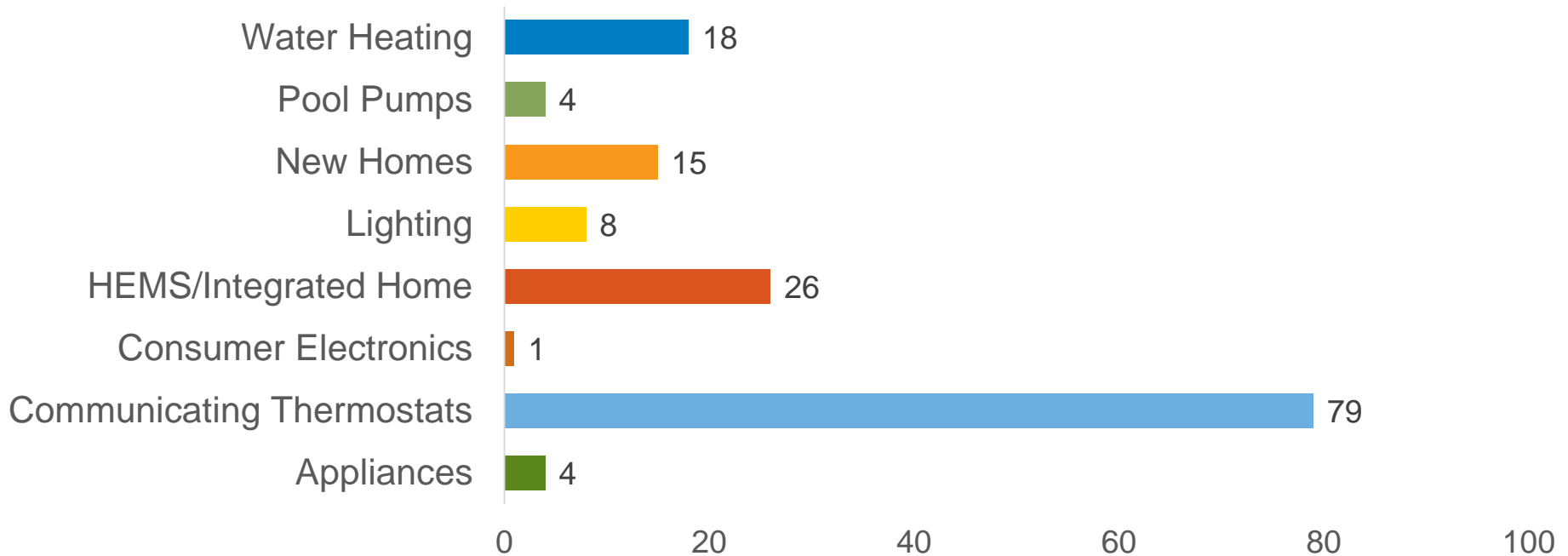
A Role for Binational
Market Transformation?

Member Activity is Growing

▼ Connected Thermostat Pilot and Program Efforts

6 — 2013

10 — 2014

37 — 2015

58 — 2016

125 — 2017

40 Full Time Ongoing Programs

Connected Pilots or Programs (2017)

Horizontal bar chart showing number of connected pilots or programs by category:

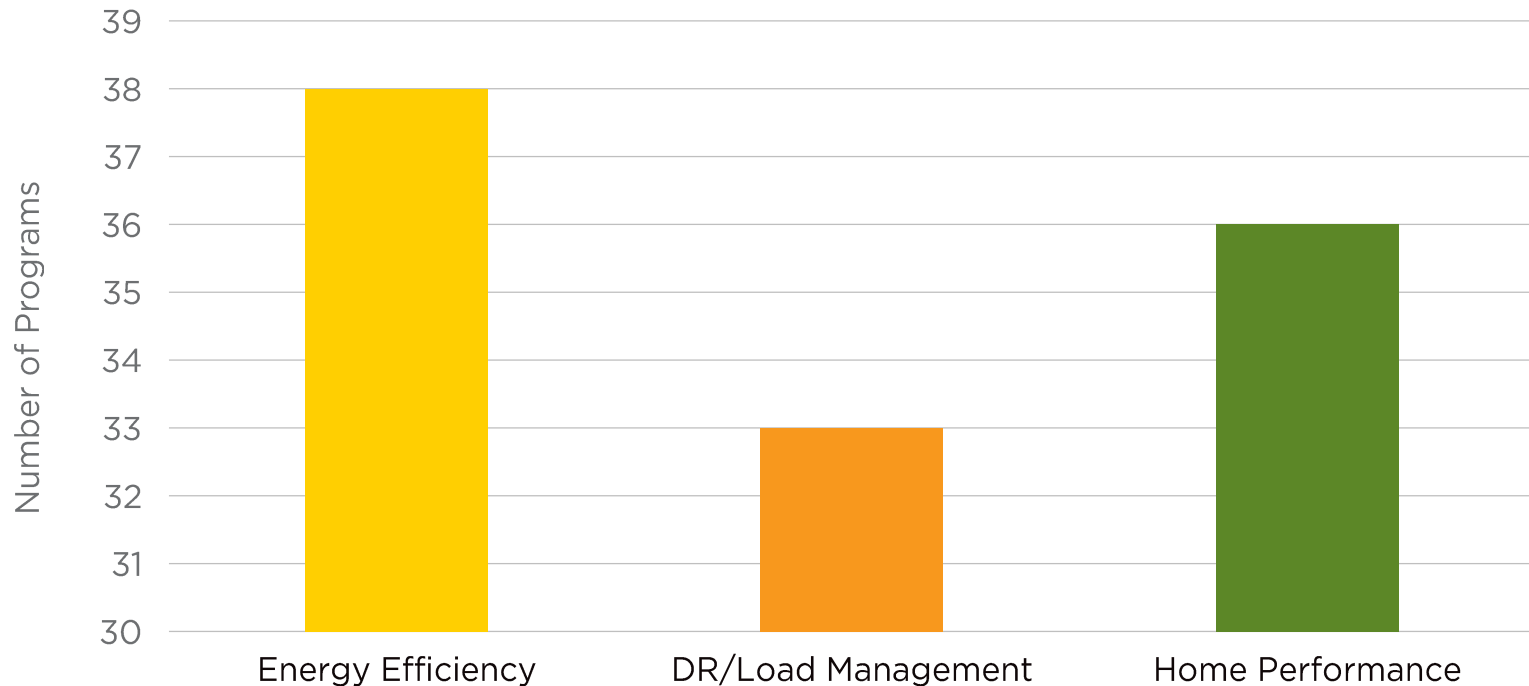| Category	Value
Water Heating	18
Pool Pumps	4
New Homes	15
Lighting	8
HEMS/Integrated Home	26
Consumer Electronics	1
Communicating Thermostats	79
Appliances	4

Program Objectives are Diverse

◀ Dimensions of Pilot and Program Efforts

Industry and Savings Keep Evolving

Global smart thermostat market valued at $1.1 billion USD in 2017, projected $3.4 billion USD by 2023

Energy savings potential has not been explored across all HVAC system types

Savings from member pilots and programs have ranged from zero (and even negative savings) to upwards of 20% savings

Revenue is expected to expand at a compound annual growth rate of 18.7 percent between 2016 and 2022

ENERGY STAR thermostats will reduce energy use by more than 8 percent *on average*

Point of sale cost down from $400 for first generation models to $150-$200 in 2018

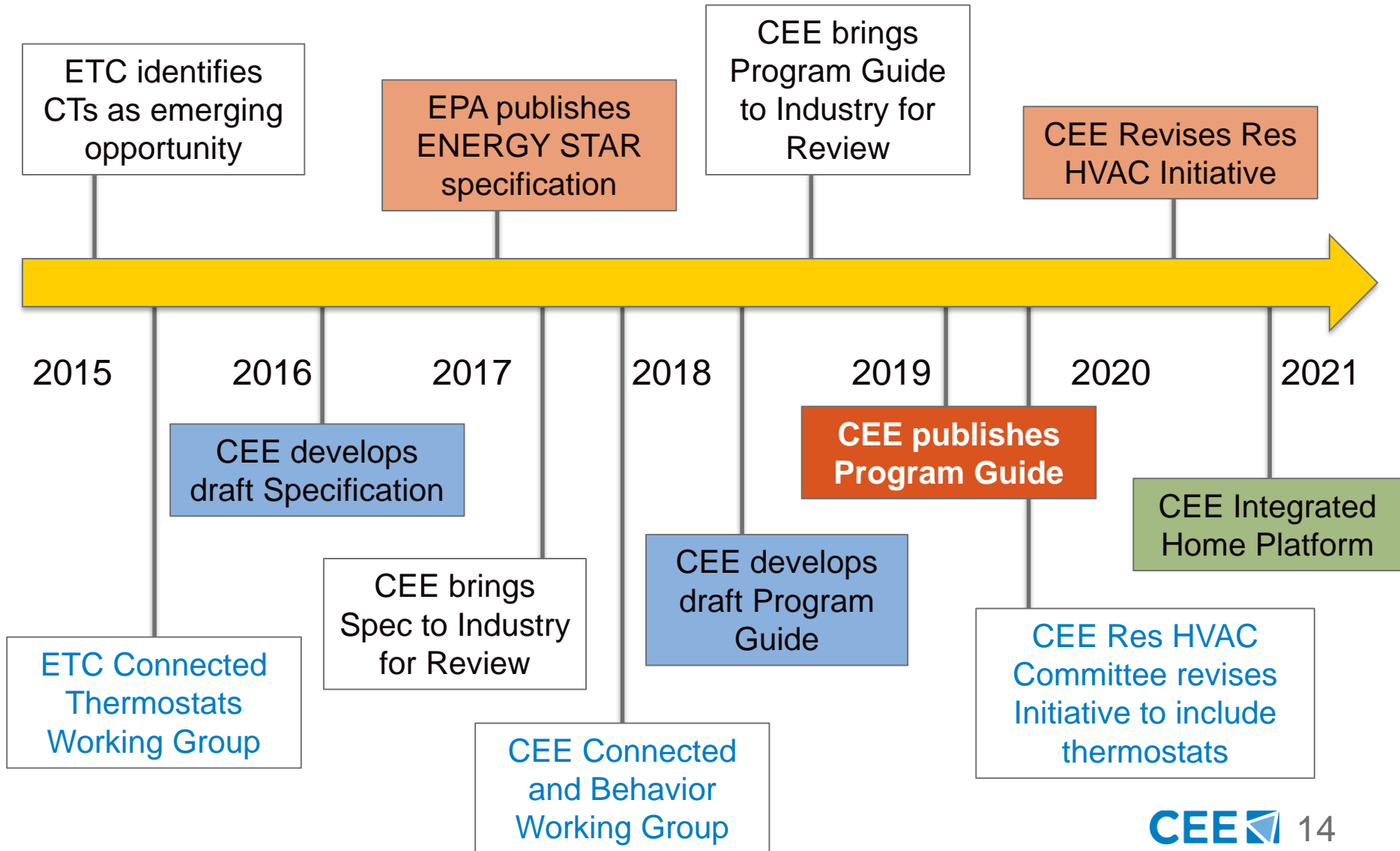Installation, connectivity, and compatibility issues influence savings

Several variables can impact energy savings

Manufacturers claim savings of 10% and even 20%

What is the Role for CEE?

▶ Shared strategy to approach program needs for members and industry to leverage:

- Reduce market and customer confusion through common definitions and background data

- Credibly differentiate products that save energy and enhance consumer satisfaction

- Provide consensus program design considerations and recommendations

Timeline

ETC identifies CTs as emerging opportunity

EPA publishes ENERGY STAR specification

CEE brings Program Guide to Industry for Review

CEE Revises Res HVAC Initiative

2015   2016   2017   2018   2019   2020   2021

CEE develops draft Specification

CEE publishes Program Guide

CEE Integrated Home Platform

CEE brings Spec to Industry for Review

CEE develops draft Program Guide

CEE Res HVAC Committee revises Initiative to include thermostats

ETC Connected Thermostats Working Group

CEE Connected and Behavior Working Group

Program Guide Content

◀ **Energy Savings**

- **Recommends a performance-based approach**
  - Aligns with ENERGY STAR Version 1.0
- Offers outline for alternative feature-based approach
  - Features prescriptive requirements for energy savings

◀ **Data Reporting**

- Recommends series of components

◀ **Load Management Functionality**

- Recommends series of components

◀ **Incorporation of Behavioral Science Insights**

- Outlines relevant insights for consideration

Intended Impact

- Support members' ability to design and deliver effective connected thermostat efforts that serve a broad range of portfolio objectives

- Inform industry partners of common member considerations as the market evolves and grows

- Serve as a foundational resource for future CEE work that leverages opportunities associated with connected thermostats
  - Residential HVAC Initiative
  - Integrated Home Platform

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Contact

Consortium for Energy Efficiency
Connected Thermostats Program Guide

CEE
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https://www.cee1.org/content/programs-dial-connected-thermostats   CEE
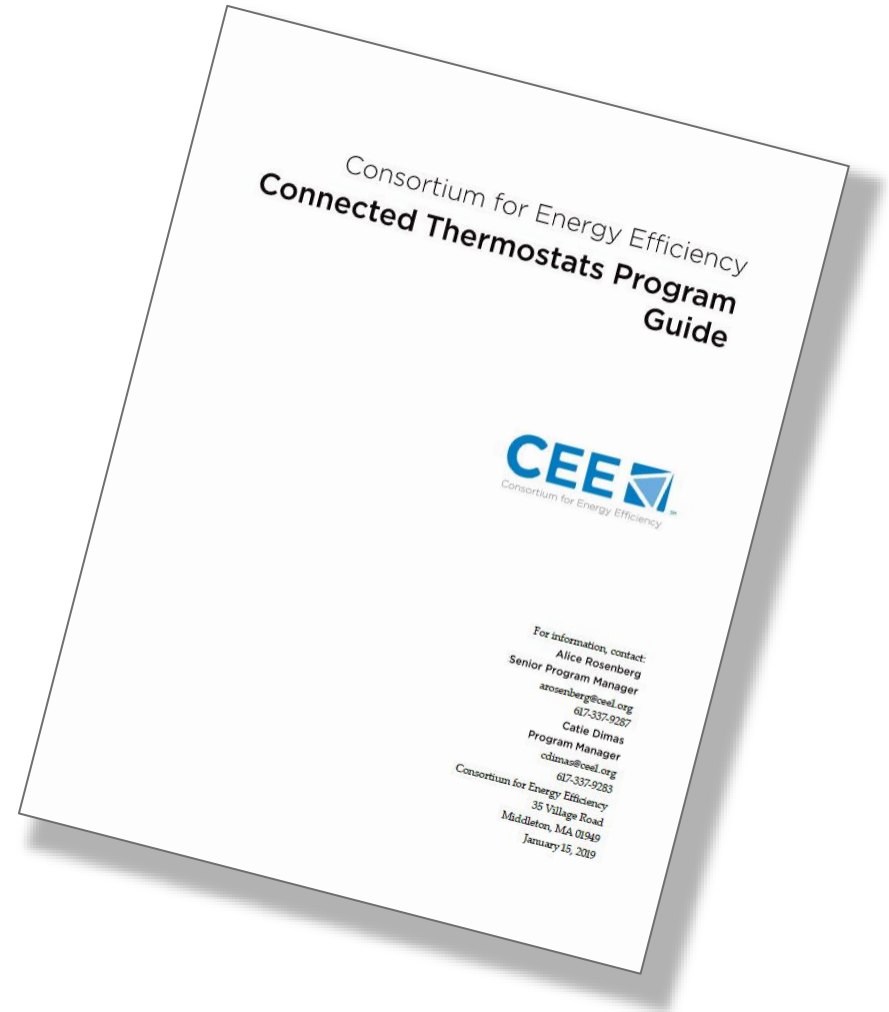
Additional Slides

Section 4.1 – Energy Savings

Feature-Based Energy Savings Requirements

◄ Provides customers with the **option of an energy-saving mode**; default operations mode is energy-saving mode if customer chooses not to otherwise configure it upon setup

◄ Includes **ongoing, active management of settings** through features like automatic scheduling or learning-based schedule creation based on customer preferences/habits; must specify strategies used

◄ Able to reduce HVAC use (change setpoints) when it detects that the home is unoccupied through some form of **occupancy discernment** such as sensors or geofencing; must specify strategies used

◄ For heat pumps with electric resistance backup systems, able to **minimize electric resistance heat runtimes**; must specify strategies used

◄ **Controllable by the customer** through a product interface and a remote interface

◄ **In the absence of connectivity**, has the ability:

- To follow a schedule; also, if sensors are either hardwired to or contained within the thermostat, to optimize schedule based on occupancy
- To allow customers to locally view the room temperature, view and adjust setpoints, and switch between off, heating, and cooling

◄ **Specifies HVAC system type compatibility**: AC only (electric), heating only (gas furnace or boiler), heat pump (electric heating and cooling), dual fuel (electric AC and gas heating), or line voltage

◄ **Able to collect, aggregate, and analyze HVAC performance data** that enables ongoing energy savings measurement and verification, while being mindful of consumer personal privacy concerns

Section 4.2 – Data Reporting
Recommended Components

◀ **Runtime data**; specific runtime for each stage as well as auxiliary or emergency heat runtime

◀ **Set point** (often for both cooling and heating)

◀ **Indoor air temperature**

◀ **Operation mode** (heating, cooling, fan-only, or off)

◀ **Programmed mode** such as schedule, hold, sleep, or away

◀ **Online or offline status**

◀ **Thermostat serial number, MAC address, or device ID, as well as customer ID**

◀ **Thermostat deadband**

◀ **Date of installation or connection**

◀ **Installation zip code**

Additional Data Reporting Components, if Available:

◀ **Outdoor temperature**

◀ **Relative indoor humidity**

◀ **Thermostat make and model**

◀ **Operation mode status** (characterizing variable capacity operation for products capable of it)

Section 4.3 – Load Management
Recommended Components

◄ **Ability to receive and respond to demand response and load management events** called by the utility or other authorized third party through one or both means listed below:
- Open standards communication protocols (must specify)
- Open access

◄ **Ability to communicate directly with the customer about load management events** and help customers understand when an event is managing their device

◄ **Ability to allow consumer override of events** via the device or another user management interface

◄ **Ability to provide consumer-level feedback** to the load management entity upon request, including:
- Verification of load management signal receipt and response
- Timestamp data
- Whether the condenser or compressor is on or off
- Temperature setpoint (and relative humidity, if available)
- Indoor temperature
- Notification of consumer override

◄ **Indication of whether the product enables open standards connectivity is direct and on-premise**;

Additional Load Management Functionality Components, if Available:

◄ Ability to pre-heat or pre-cool prior to a load management event

◄ Ability to ping device connection status on the customer level

◄ Ability to report operating mode, such as heating or cooling

◄ Stage of operation, if capable (applicable to variable capacity systems)

Section 4.4 – Behavioral Insights

Behavioral Elements

◀ **Higher Priority Behavioral Insights**

- Social Norms
- Goal Setting
- Combined Social Norms and Goal Setting
- Progress Tracking
- Prompts about Current Use Relative to Goals
- Alerts and Notifications

◀ **Lower Priority Behavioral Insights**

- Commitment
- Tailored Choices
- Prompts about Current Energy Use Relative to Current Costs
- Gamification
- Enhanced, User-Friendly Graphical Interface-Features
- Other Features that Leverage Social Science