ENERGY STAR® Connected Thermostats

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For more than 20 years, EPA's ENERGY STAR program has identified

the most energy efficient products, buildings, plants, and new homes –

all based on the latest government-backed standards and a rigorous third-party certification process.

ENERGY STAR TODAY

Brand Preference & Loyalty

Of the **87% of households** that recognize the ENERGY STAR label

75% recalled purchasing an ENERGY STAR-labeled product in the past year

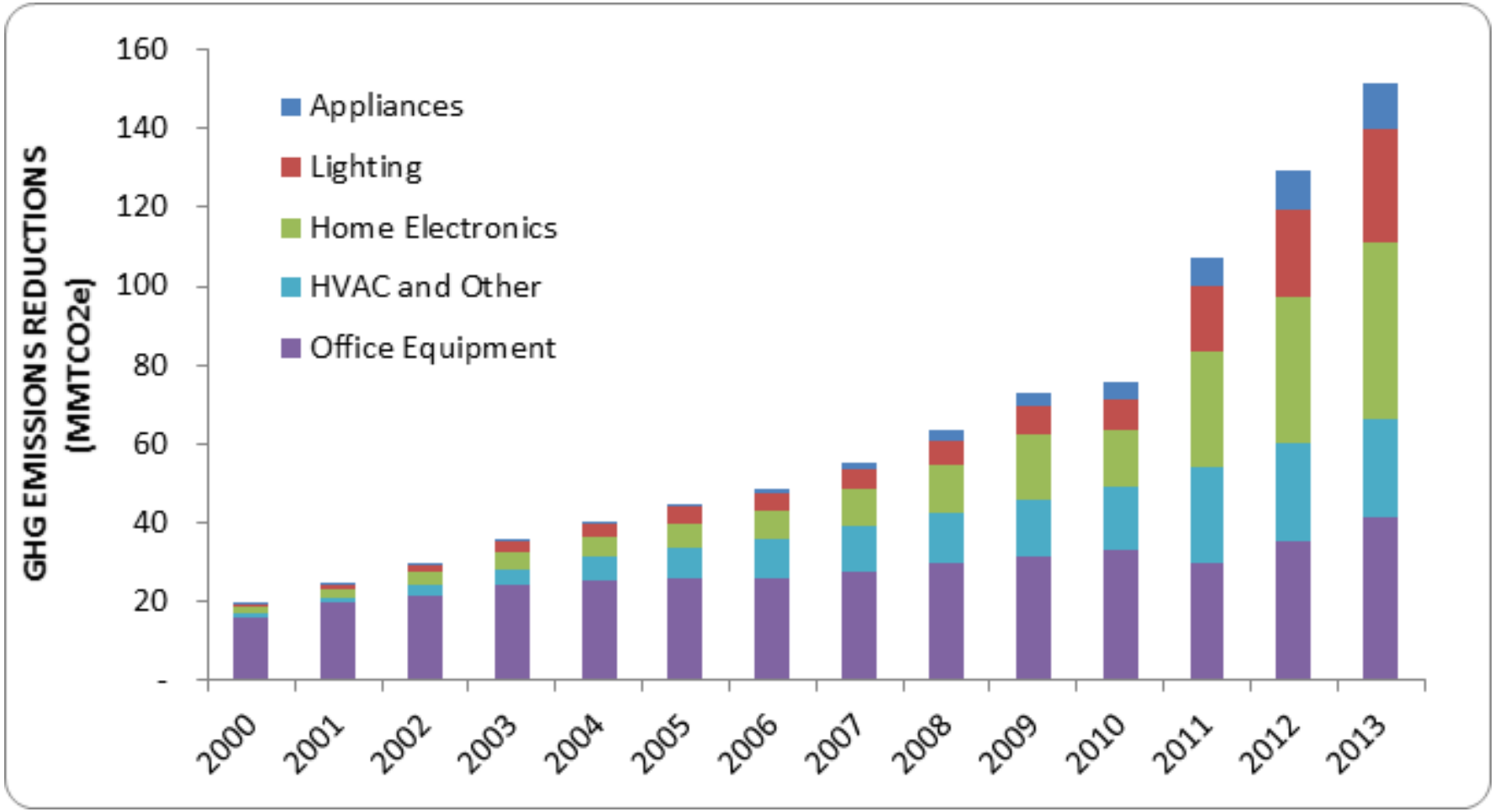
73% said the label influenced at least one of their purchase decisions very much or somewhat

75% were likely to recommend ENERGY STAR-labeled products to a friend

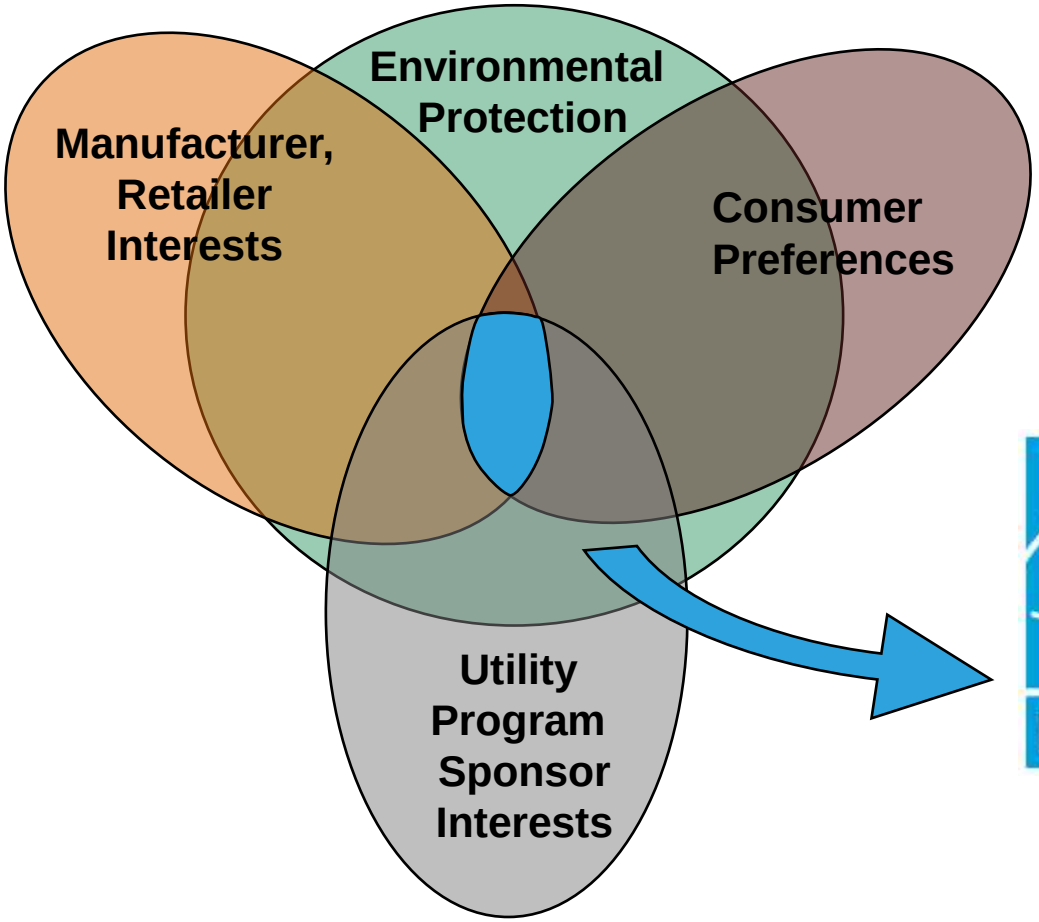
30% were extremely likely to recommend ENERGY STAR

Source: National CEE Household Survey 2012

Annual Greenhouse Gas Emissions Avoided



ENERGY STAR's Focus



- Cost-effective
- No Sacrifice in Performance
- Government backed

Consumer is Key

ENERGY STAR Guiding Principles

1. Significant energy savings
2. Product performance maintained or enhanced
3. Purchasers can recover investment in increased efficiency within a reasonable time period
4. Efficiency achieved through one or more technologies; products can be broadly available
5. Energy consumption can be measured and verified
6. Label provides meaningful differentiation

CT Provider Savings Claims

- (thermostats) Control Half of your home's energy bill
- 14% savings 26% savings 22% savings
- Saved an average of 11.3% of AC-related energy
- customers in the US saved an average of 23% on their heating and cooling costs

•Utility Not Required: xxxxx Saves 6% on Summer Electricity Bills
•$100 annual savings for consumers
•Saving consumers 10 – 15%
•4kW Demand Savings per Home
•9000+ MWh in Energy Savings

Current field of products is highly diverse

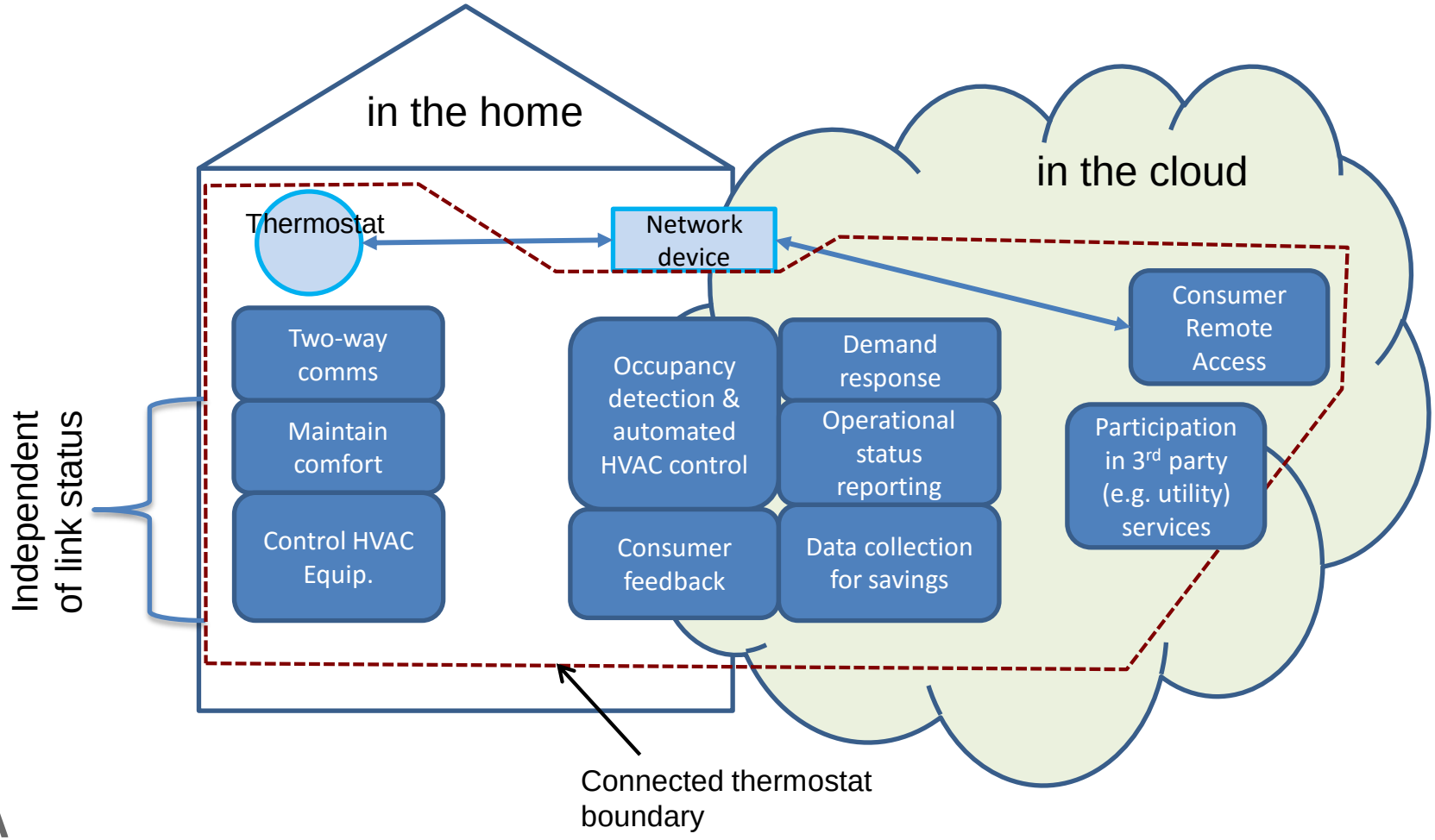
- Strategies for energy savings
  - Savings through occupancy detection & automation, or
  - optimization of HVAC control; use less energy for equivalent comfort, or
  - through encouraging occupant behavior change
- Cloud based vs. in the home
  - Solutions may rely on cloud analytics and/or cloud control, or
  - may have extensive capabilities in the hardware&firmware in the home
- Stand alone product vs. relying on integration with HEMS or security systems
- Delivery channels: Retail; HVAC contractor; Home security, telecom or other service provider, or EEPS (in partnership with any others)

The service and the energy used to deliver it

- The same fundamental service is being delivered: help us control our HVAC systems to keep our homes comfortable.
  - Use the least energy to do so, by the way
  - And make it convenient
- The potential for savings remains high
- Can we measure energy used for that service?
  - Past approach relied on identifying certain features of the controls (programmability)
  - The presence in the home of a control with features that enable energy savings has not reliably led to energy savings

- **EPA has always relied on laboratory tests as a proxy for energy savings in the field – is there another, better proxy available now?**

What do we mean by connected thermostat?



Outline of EPA approach

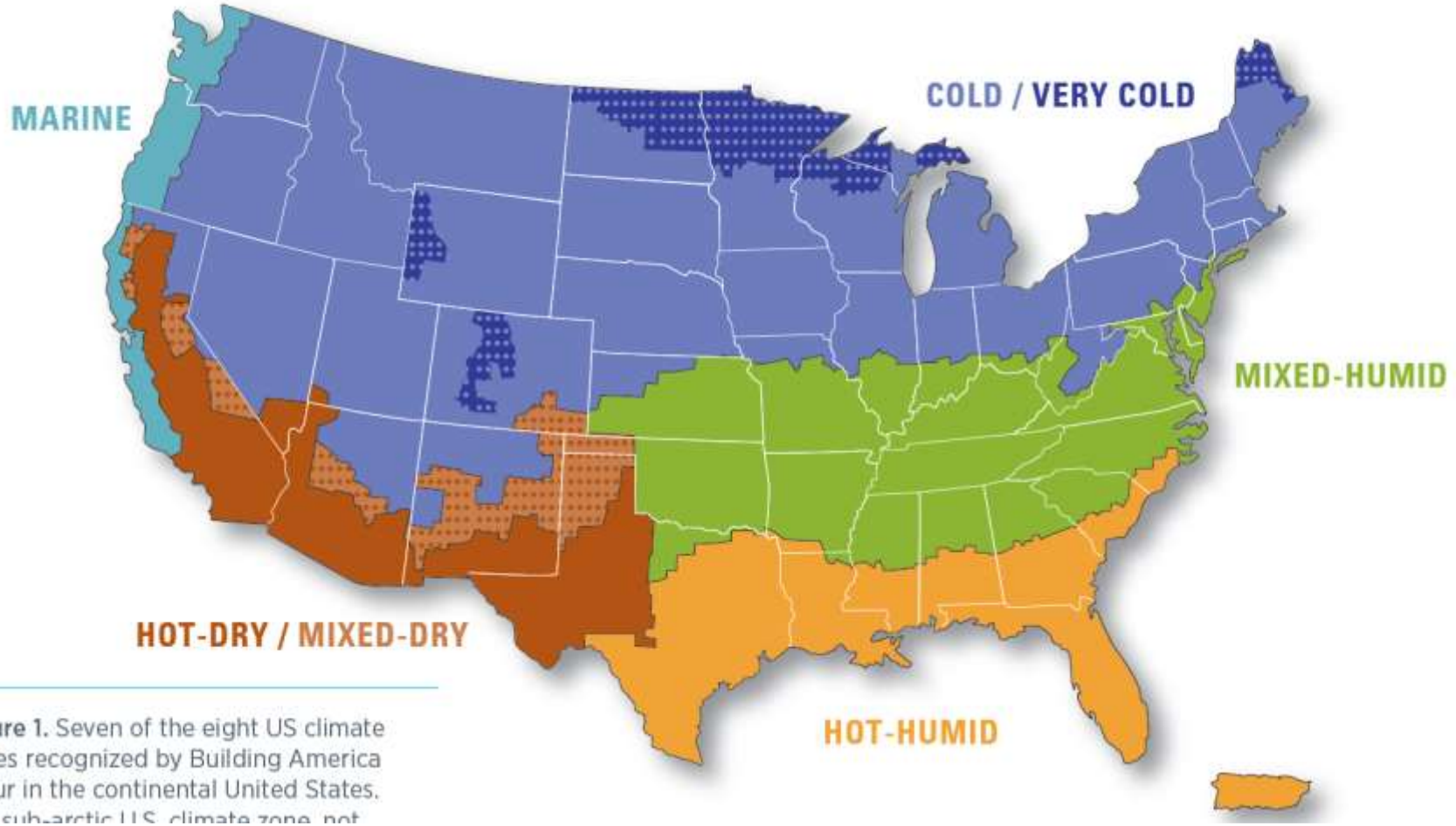
- The ENERGY STAR product would encompass both device (hardware) and service (software) aspects
- That's enabled by basing recognition of connected thermostats on data from the field
- The service provider is the ENERGY STAR partner
- To earn the ENERGY STAR:
  - Meet criteria that enable savings
  - Periodic reporting of metric that indicate savings

Advantages of proposed approach

- Bypasses question of HOW energy savings are achieved, concentrates on WHETHER they are
- Accommodates wide variety of system architectures, business models and delivery channels
- Can credit services, which provide much of the potential for savings (e.g. remote control, sophisticated predictive algorithms, feedback to consumers)
- Service providers have access to rich data stream
- Wide scope for innovation – may be able to credit products that deliver behavioral savings

Metric to demonstrate savings based on field data

- Based on publicly available weather data and data available from CT after installation: how it is wired, indoor temperature history, set temperature history, on/off times of controlled equipment.
- Score for each home expresses run time reduction from baseline run time.
- Baseline run time assumes counterfactual indoor temperature history and derives baseline run time from it using a model of that particular home's relationship between HVAC run time and ΔT.
- Metric score for each home is aggregated regionally for comparison to a more realistic aggregate baseline.
- National score is average of regional scores, weighted by % of national heating or cooling energy in each EIA region.



gure 1. Seven of the eight US climate
ones recognized by Building America
:cur in the continental United States.
ue sub-arctic U.S. climate zone, not

Model of home (Heating)

$$HRT = \alpha_h \cdot (\Delta T - \tau_h)$$

Indoor temperature changes affect ΔT, which drives energy savings through reduced heating run time HRT.

ΔT is indoor minus outdoor temperature

τ_h reflects "free heat" from solar gain + equipment/activities in home

α_h represents the responsiveness of the home to heating equipment

The model is derived for a particular home through a linear fit to the data.

EPA has developed open source Python code to implement these calculations – the intention is that service providers integrate it into their data environments

Proposed requirements

- A few device (hardware) requirements
  - Static temperature accuracy
  - Operates as dumb thermostat when disconnected
- A few product (hardware + software) requirements
  - Feedback to resident of energy impacts of their choices
  - Some ability to react to presence
  - Scheduling
  - Ability to collect data for metric calculation
  - Ability to be used for DR
- Field savings
  - Minimum mean and 20th percentile metric scores
  - (Or demonstrate with a series of studies)
  - Metric scores reported every 6 months for previous heating/cooling season

Proposed alternative method to demonstrate savings

- Current metric rewards limited savings strategies. Even with refinement, innovation may continue to stay ahead of the metric.
- Therefore, proposed ability for CT providers to use a series of A/B field studies to demonstrate savings
- Basically parallel to metric scores
  - Have national relevance
  - Earning the ENERGY STAR based on mean and 20th percentile of run time reduction or energy savings results
  - Include a sufficient # of homes
- Process encourages success
  - Study design (baseline, geographic variation, etc) must be pre-approved by EPA
  - Results of all approved studies proposed to be publicly posted

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Current status

- Draft 3 will be released May 2016, with Draft 2 Method to Demonstrate Savings
- Labeled products expected as soon as late summer
- By the way, EPA also has optional connected criteria for the full suite of appliances, as well as pool pumps

Backup material

Connected Status in ENERGY STAR specifications

Specification	Connected Criteria	Demand Response Test Method
Refrig/Freezer	Final	Final
Clothes Dryers	Final	In Development
Clothes Washers	Final	In Development
Room AC	Final	In Development
Dishwashers	Final	In Development
Pool Pumps	Final	Final
Lighting (Lamps and Luminaires)	Final	N/A
Connected Thermostats	In Development	N/A