



AUGUST 21-23, 2018 • CLEVELAND, OHIO

New Innovations in Energy Efficiency Technology and Smart Homes

Thursday, August 23rd
2:00 – 3:30 PM



Panelists:

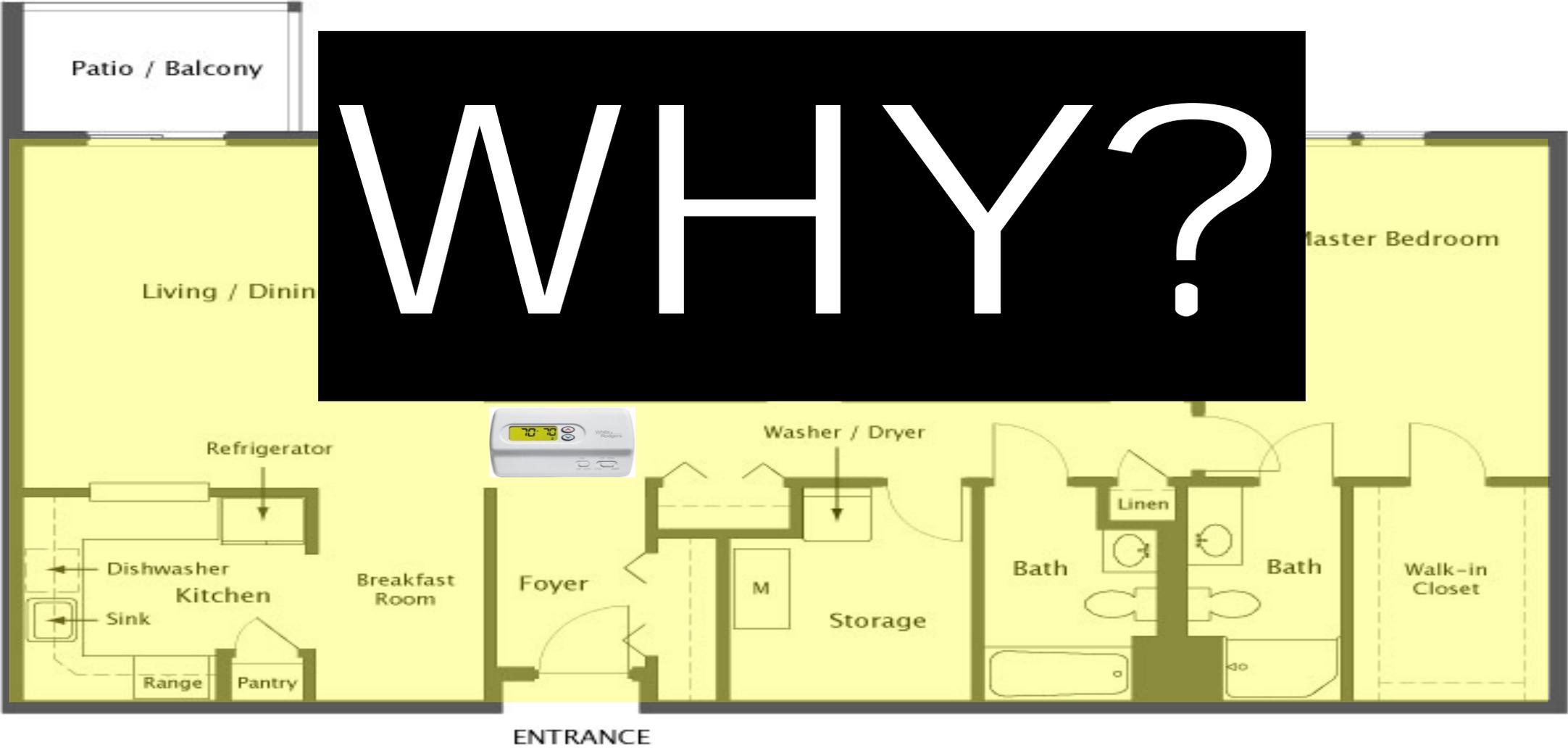
- Kevin DeMaster, Mitsubishi Electric
- Matt Carlson, Aquanta
- Jamie Peters, Nest

New Innovations in Energy Efficiency Technology and Smart Homes

Advanced Mini Split Heat Pumps



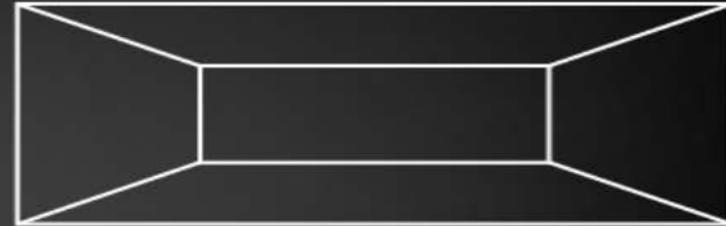
Challenge YOUR Thinking! - CONTROL



Challenge YOUR Thinking! – HEAT TRANSFER

Transferring Energy
More Efficiently

Air Duct
Air = 0.48 Btu/h per LB



Water Pipe
Water = 8.88 Btu/h per LB



Refrigerant Pipe
Refrigerant = 85.38 Btu/h per LB



Challenge YOUR Thinking! - COMFORT

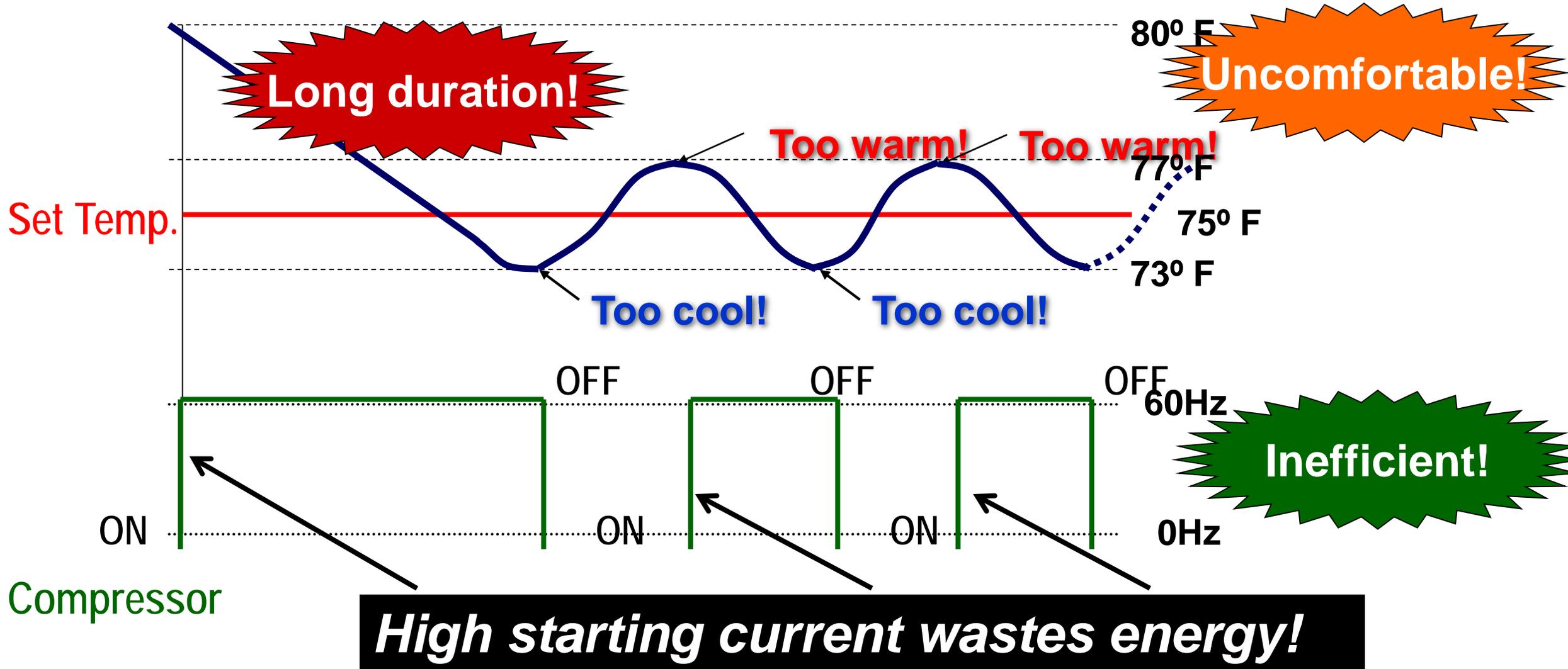


Challenge YOUR Thinking! - EFFICIENCY



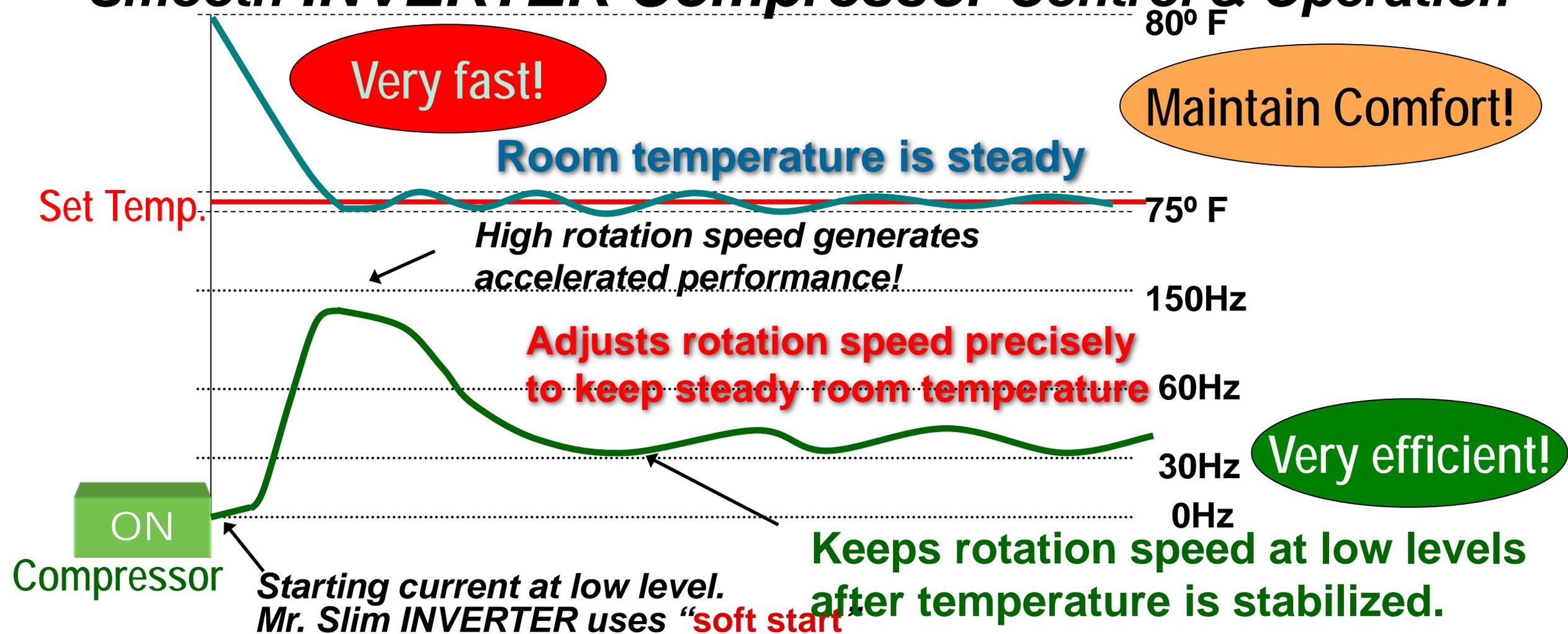
Start/Stop Driving (w/engine off) = Unitary Compressors

Conventional ON/OFF Compressor



INVERTER Compressor Advantages

Smooth *INVERTER* Compressor Control & Operation



Technology Advancements Zoned Comfort Solutions™



NEW APRIL
Industry
Changing



MAKE COMFORT *Personal*™

Hot Humid Research- Displacement

U.S. DEPARTMENT OF ENERGY Energy Efficiency & Renewable Energy Technology Solutions for New and Existing Homes

Building America Case Study

Supplemental Ductless Mini-Split Heat Pump in the Hot-Humid Climate

Brevard and Volusia Counties, Florida

PROJECT INFORMATION

Project Name: Phased Deep Retrofit: Phase II
Location: Central Florida
Partners: Florida Power & Light, fpl.com
Building America Partnership for Improved Residential Construction, ba-pirc.org
Building Component: HVAC
Application: Retrofit, single-family
Year Tested: 2014-2015
Applicable Climate Zone: Hot-humid

PERFORMANCE DATA

Average home living area: 1,872 ft²
Central HVAC heating: Heat pump (2); resistance heat (4)
Median HVAC SEER: 13.0
Median duct leakage: Qn,out = 0.06
Cost of energy-efficiency measure (including labor): \$3,465
Projected energy savings: 37% cooling; 59% heating
Projected energy cost savings: \$280/year
Simple payback: 12 years

Building America
U.S. Department of Energy

Central heating, ventilating, and air-conditioning (HVAC) systems are commonplace in Florida but have leaky and heat gain-prone duct systems. Ductless mini-split heat pumps (MSHP) inherently have at least a 15% efficiency advantage over these standard systems.

The Building America Partnership for Improved Residential Construction BA-PIRC is a U.S. Department of Energy Building America team that studied the effects of MSHPs in six central Florida homes. Team members installed 1-ton MSHPs that were high-efficiency—25.5 Seasonal Energy Efficiency Ratio (SEER)—in the homes' main living areas. It was hoped that the ductless supplemental MSHPs might reduce space cooling and heating energy by shortening the runtime of less-efficient existing central systems that are subject to duct losses. However, how this would work out practically was highly speculative because this configuration required two different systems with potentially competing thermostats serving a single zone.

In most cases, the indoor unit was located as close as possible to the central return grille of the existing system to help with room-to-room distribution of MSHP air when both systems were functioning. In each house, the cooling set point of the MSHP was initially set 2°F or 4°F lower than that of the central system. There was no way to know in advance of the experiments how the systems would interact with two independent thermostats. To maximize comfort and efficiency in each home, BA-PIRC researchers worked with homeowners in the days and weeks following the MSHP installation to find the optimal thermostat set points for both systems.

Figure 1 graphically illustrates the energy savings achieved at one site after the MSHP was installed. Among the six test sites, median cooling energy use was reduced by 10.9 kilowatt-hours per day (kWh/day) (37%) and heating energy use was reduced by 13.2 kWh/day (59%). Assuming a current installation price of about \$3,500, the economics of this measure are potentially attractive; they include a suggested payback of 12 years and an 8.1% annual rate of return.

STUDY

- DOE Building America
- 6 Central Florida Homes
- 1 ton Systems 25.5 SEER
- Improve Inefficiency Equipment & Ductwork
- 2-4F Offset of Central System

RESULTS

- Cooling Energy Reduction - 37%
- Heating Energy Reduction - 59%



The indoor unit is located as close as possible to the central return grille of the existing system

Hot Humid Research- Whole Home

STUDY

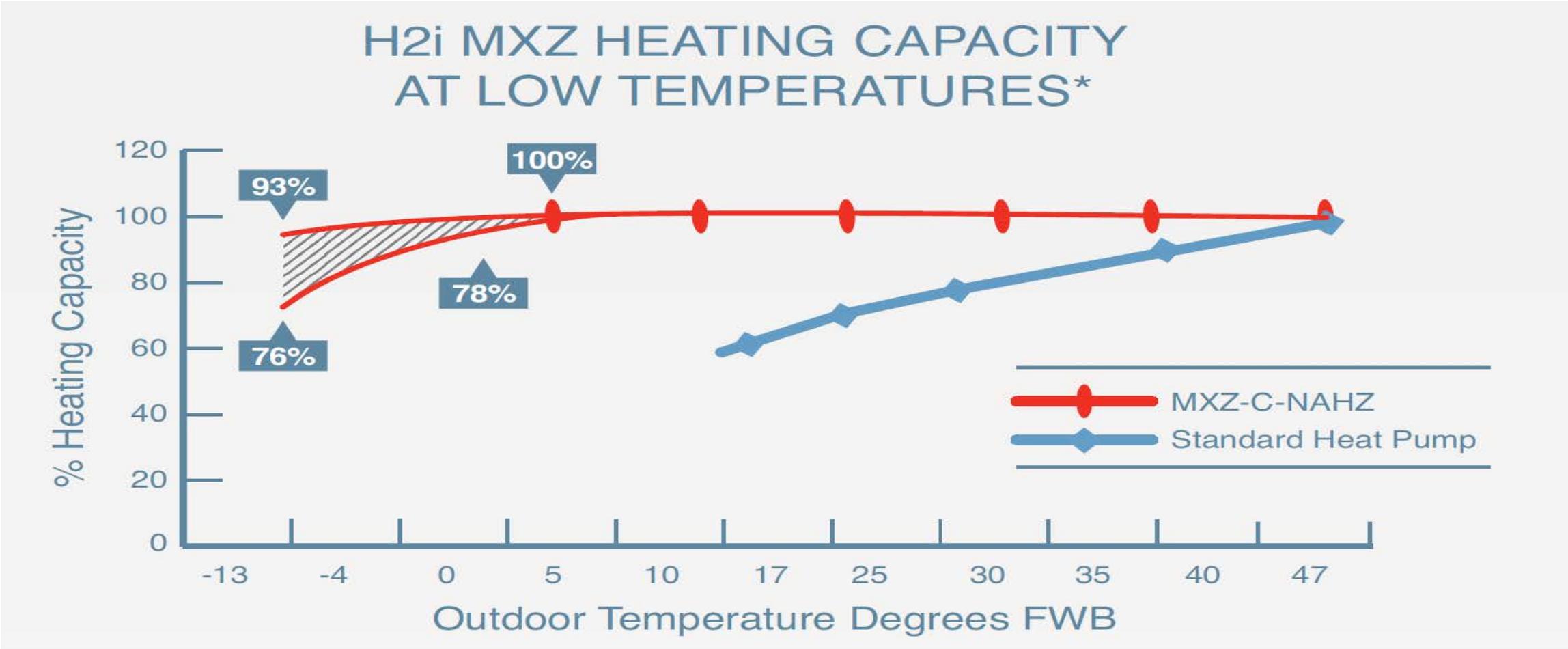
- Florida Solar Energy Center
- 53 Central Florida Homes – 3yr period
- Supplemental (Ductless, Ducted)
- Whole Home – Central Replacement

RESULTS

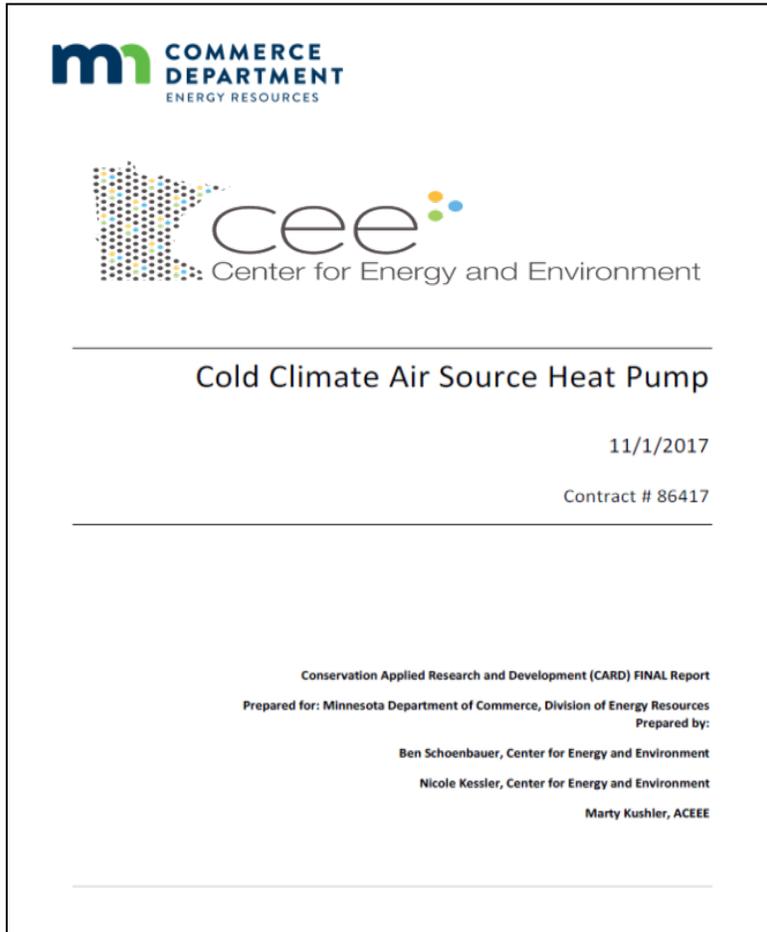
	Ductless	Ducted	Central Replacement
Cooling	33%	29%	29-37%
Heating	59%	76%	NA-76%
Summer Peak	16%	41%	11-41%
Winter Peak	56%	NA	NA



Cold Climate - Heating



Cold Climate Heat Pump Research



- 6 Minnesota Homes
- Compared Heat Pumps w/propane backup
- Ductless HP displacement strategy
- Validated Cold Climate Technology

CEE Cold Climate Summary Highlights

- The **ductless systems had higher efficiencies** below 0°F because the heat pump could run down to -13F OAT.
- Average COP 1.3-1.7
- Ductless even heating @ -19 °F



Table 7. Savings from ccASHPs over baseline furnace at each site

Site	Heating Design Load, Btu/hour	Site Energy Reduction	Cost Reduction	Propane Reduction	Savings, \$/year
S_1_ducted	34,341	37%	28%	56%	\$469
S_2_ducted	28,339	47%	34%	73%	\$524
S_3_ducted	24,734	49%	40%	67%	\$764
S_4_ducted	24,306	50%	31%	60%	\$377
S_6_ductless	11,950*	52%	52%	NA	\$610
S_8_ductless	8,400*	54%	54%	NA	\$349

2018 CEE Whole Home Ducted Cold Climate Verification



- Duplex – New Construction
- Retrofit 1500 sq. ft. home

Results ccASHP	
Annual Heating Load	518 therms/yr
Annual Energy Used	249 therms/yr
Annual COP	2.08
Elec Used (all)	7301 kWh
boost only	217 kWh
Cost	\$657.06 \$/yr
Est HP Load Frac	98.5%
All Elec HP > ER	
Site NRG savings	7866 kWh 51.9%
Cost Savings	\$707.96 \$/yr 51.9%



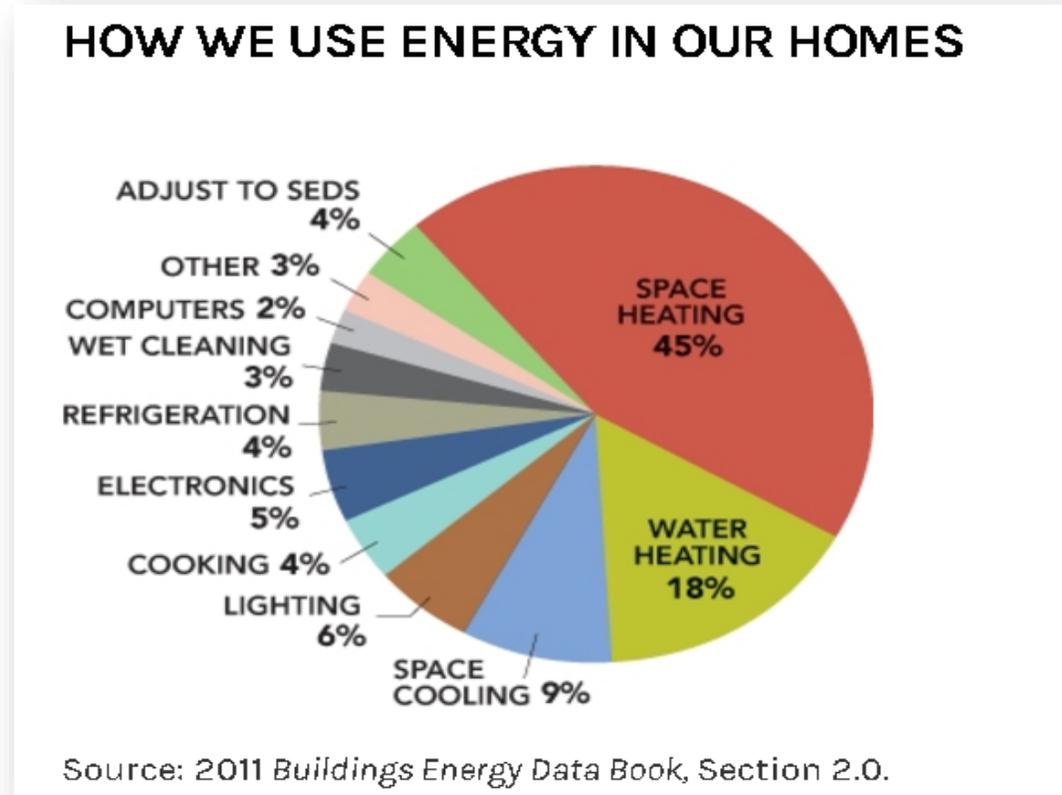
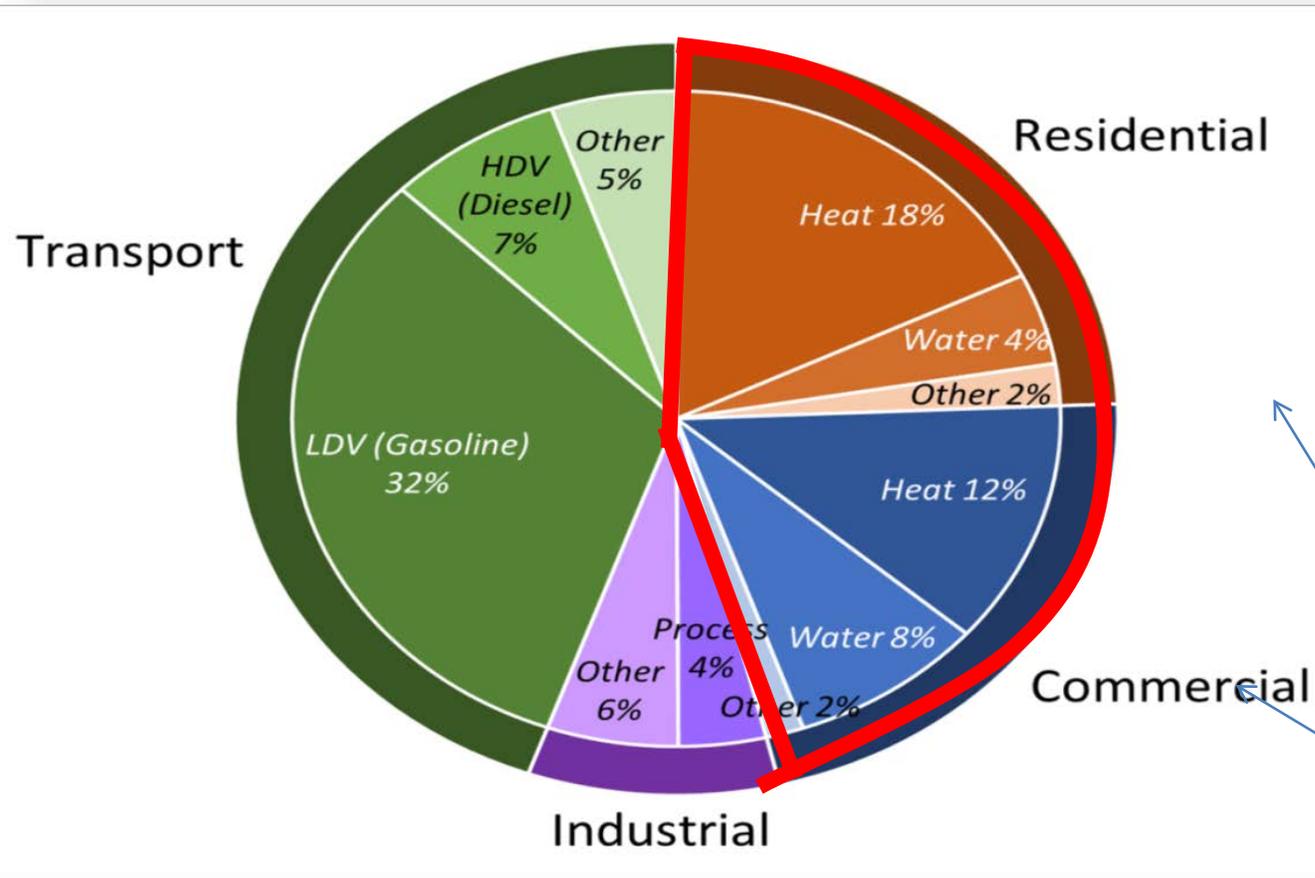
Results ccASHP	
Annual Heating Load	623 therms/yr
Annual Energy Used	346 therms/yr
Annual COP	1.80
Elec Used (all)	10139 kWh
boost only	872 kWh
Cost	\$912.47 \$/yr
Est HP Load Frac	95.5%
All Elec HP > ER	
Site NRG savings	8128 kWh 44.5%
Cost Savings	\$731.52 \$/yr 44.5%

Grid is Getting Greener



Strategic Electrification

Fossil Fuel use [ex: New York and New England]

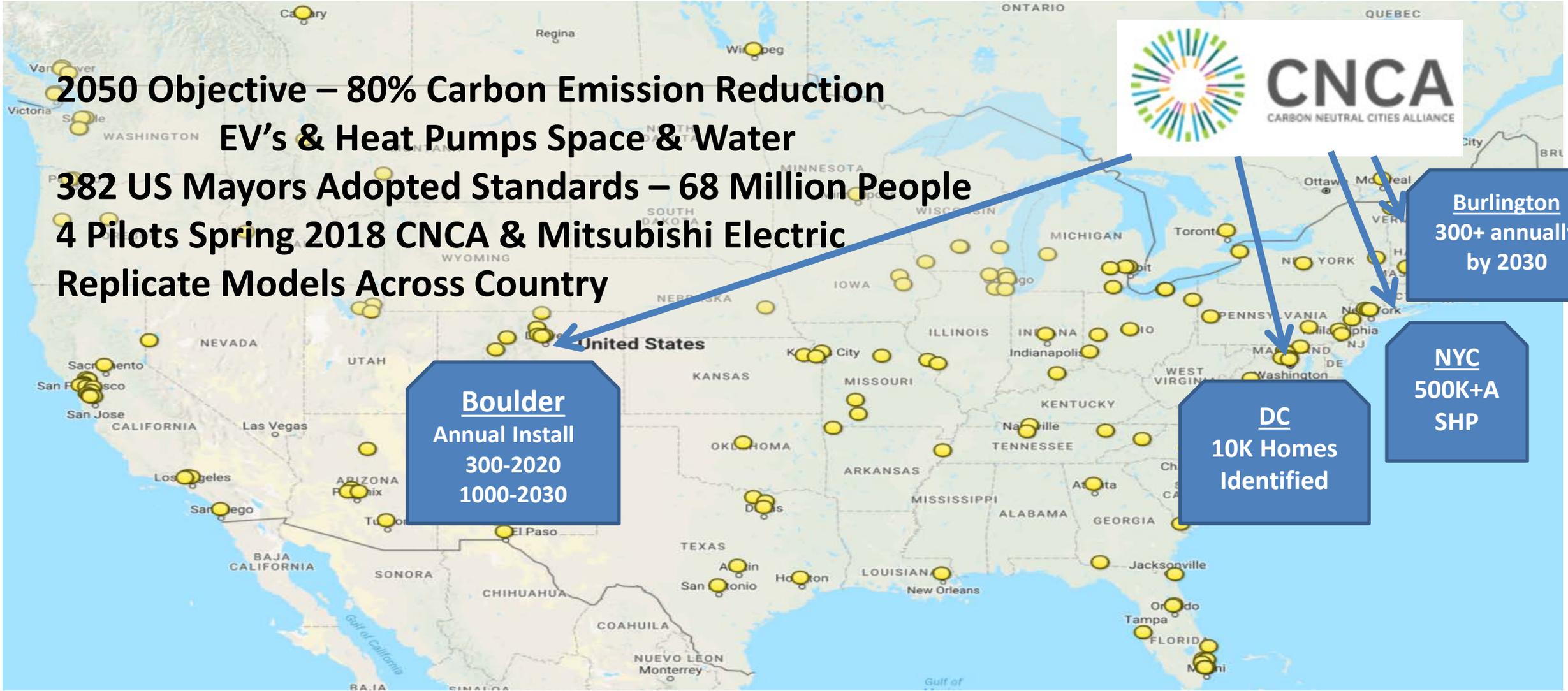


46% of Fossil Residential & Commercial Space and Water Heating

www.synapse-energy.com | ©2017 Synapse Energy Economics Inc. All rights reserved.

4.2 Quadrillion BTUs per year of direct fossil fuel use

Cities Gaining Momentum Post Paris Agreement



Contact Info

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Grid-Integrated Water Heater Control for the 21st Century



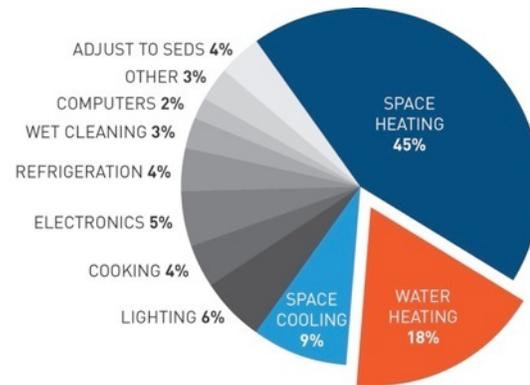
Aquanta Inc.
1775 Tysons Blvd, 5th Fl
Tysons, VA 22102
www.aquanta.io

Bringing the Water Heater Installed Base Into the 21st Century

① Customer Value



② EE/ Cost Savings

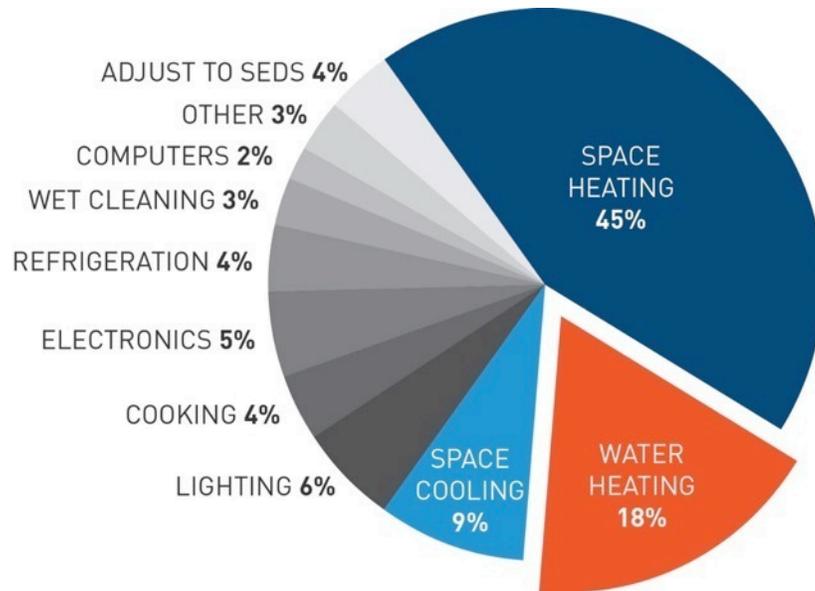


③ Grid Integration



Water Heating Energy: An Untapped Opportunity

A BIGGER SLICE THAN MOST THINK

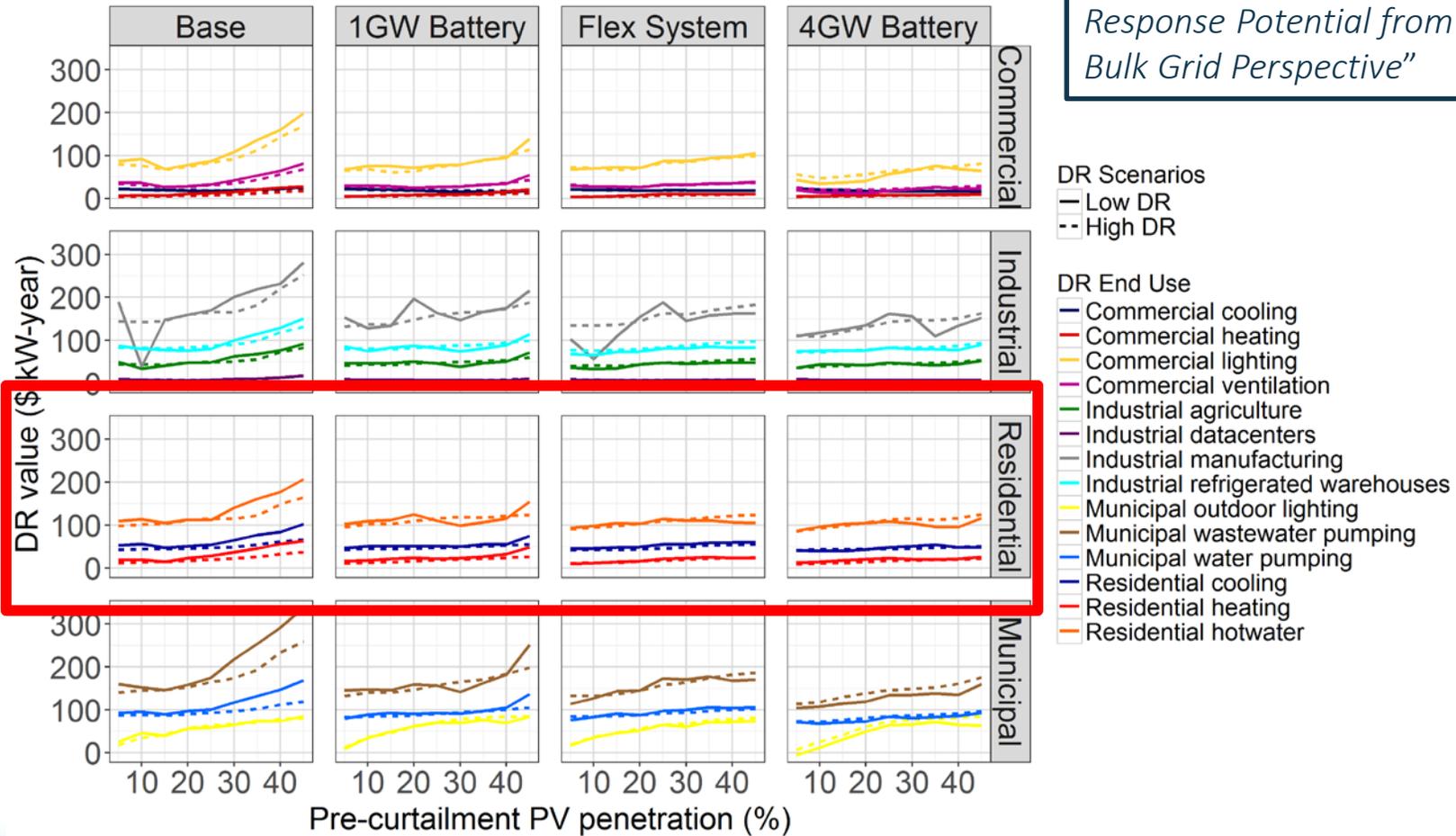


MACRO OPPORTUNITY

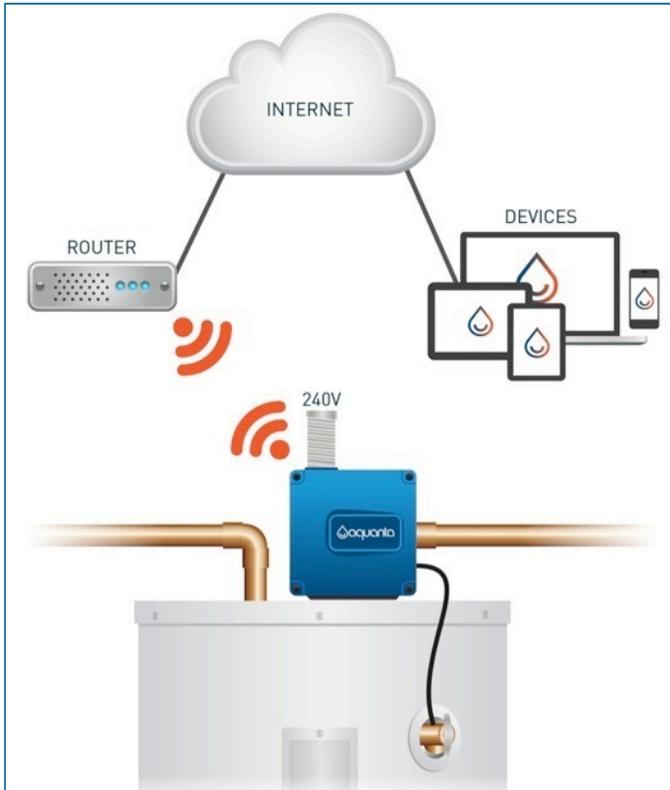
- ▶ 125mm+ Residential WH Installed Base in NA
- ▶ Annual Residential WH Impact
 - \$32B energy spending
 - 2.9 Quads energy used
 - 150mm metric tons CO₂
- ▶ 20-50% of Energy Input Wasted
- ▶ \$3.6B/Yr Utility Grid Integration Opportunity

Grid-Interactive Water Heating: Leading Enabler of Renewables

NREL 2017: “Demand Response Potential from the Bulk Grid Perspective”



Aquanta Water Heater Controller



- ▶ **Networked, Smart Home Enabled**
 - Cloud-cloud integration w/ other platforms
- ▶ **Advanced Analytic Capabilities**
 - “Learning” algorithm
 - Enable and enhance Smart Grid
- ▶ **Easy, (Near-)Universal Retrofit**
 - < 15 min install; DIY-friendly
- ▶ **Electric and Gas WH Versions**
 - Compatible w/ 65-80% of US WH installed base

Aquanta Water Heater Controller



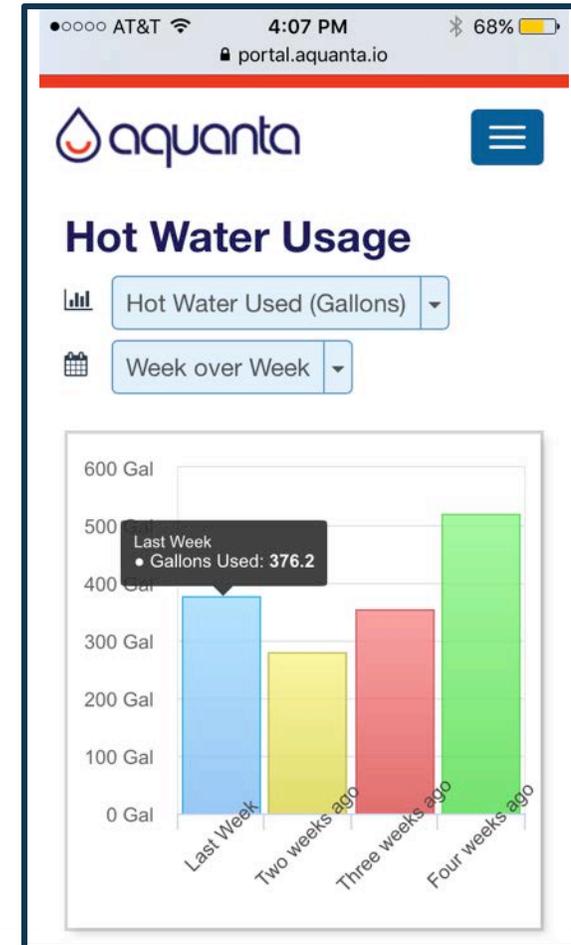
1. Customer Value

- ▶ **Convenience**
 - Remote WH monitoring & control
 - Manual temp/time scheduling
- ▶ **Comfort**
 - Auto-learning (“Aquanta Intelligence”)
 - Hot Water Available %
- ▶ **Control**
 - Leak detection/maintenance alerts
 - Smart home integration



2. Energy Efficiency

- ▶ *Intelligent/Auto Control*
 - Reduced standby losses
 - Lower tank temperatures
 - Reduced heat cycling
 - Reduce of overheating (setpoint control)
- ▶ *Manual Control*
 - Timer feature
 - Away/Vacation setting
- ▶ *Behavioral*
 - Usage feedback & savings suggestions
 - Peer comparisons

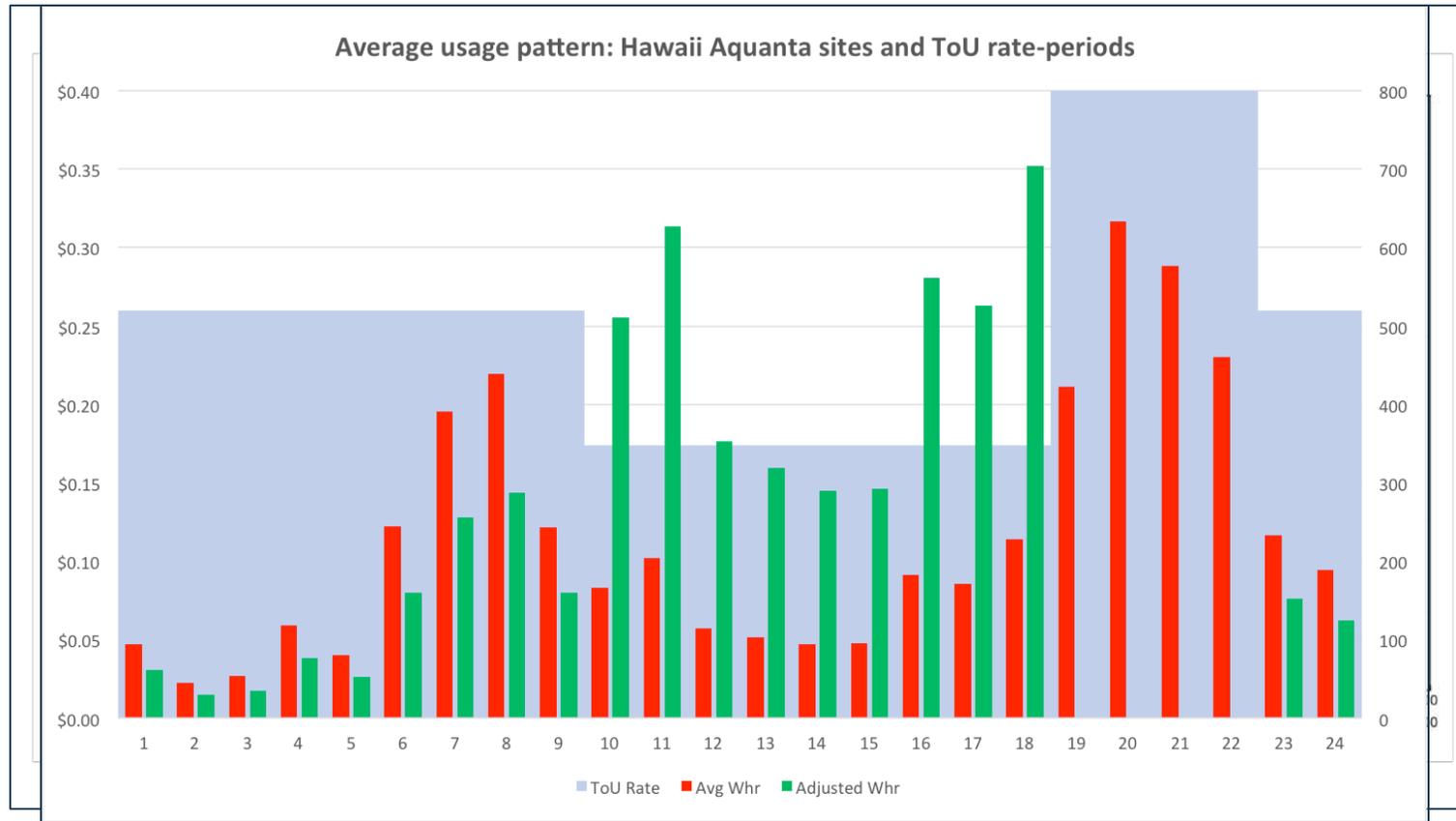


3. Grid Integration



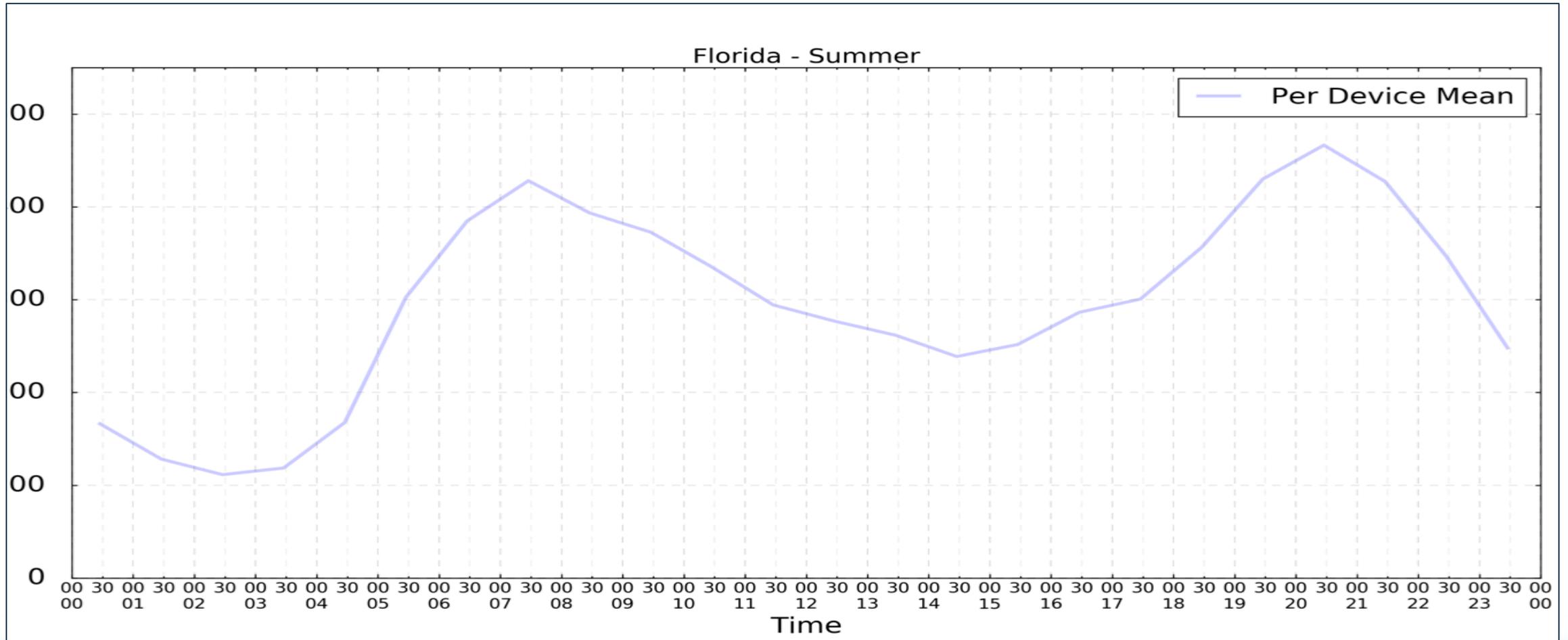
- ▶ DR/capacity markets
- ▶ Enable TOU/variable pricing
- ▶ Storage/WH as battery
- ▶ Renewables integration
- ▶ Mitigate demand charges
- ▶ Whole home energy management

Case Study: TOU in Hawaii

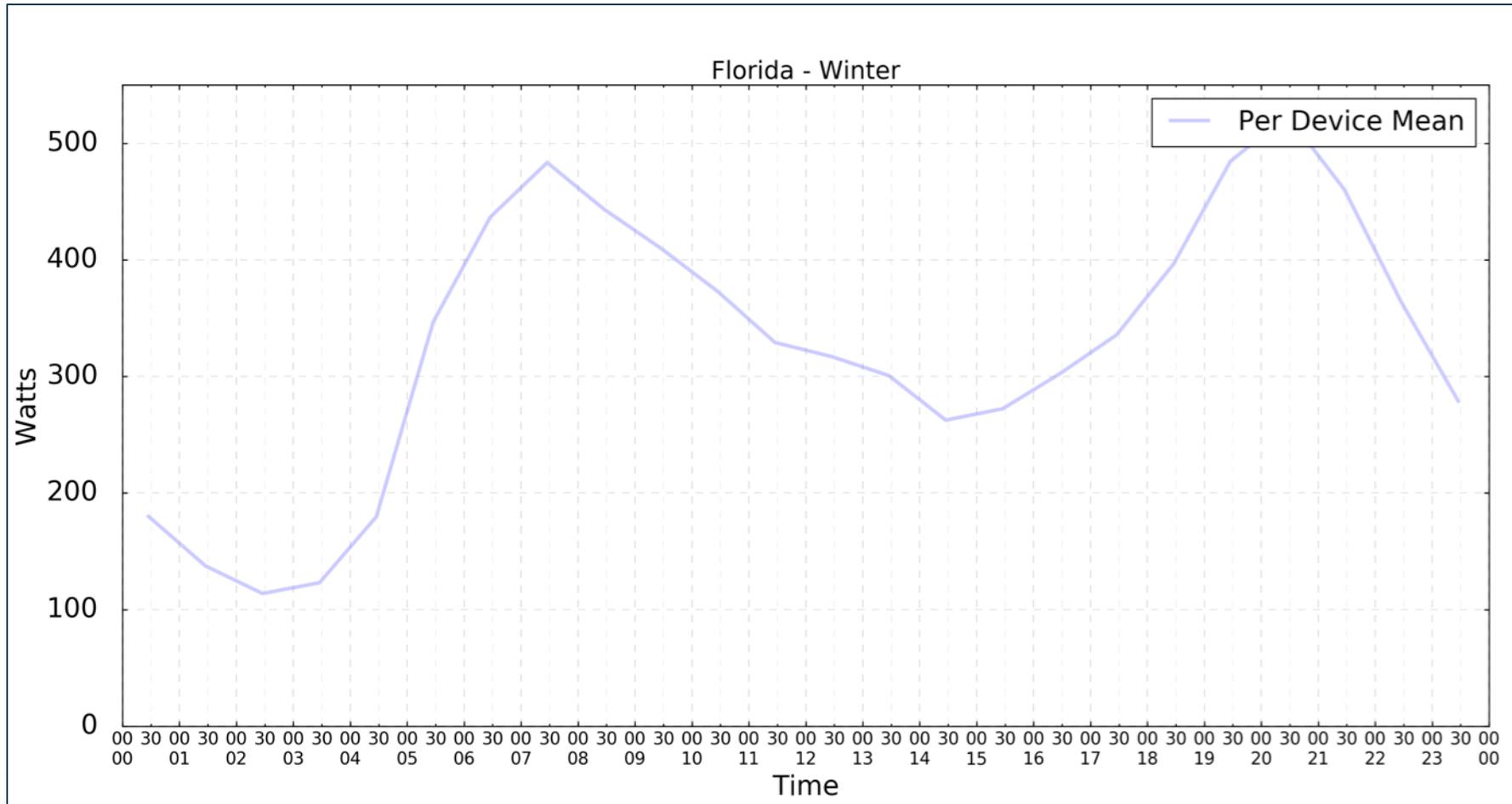


Total Annual Cost without ToU Shifting	\$ 593.56
Total Annual Cost WITH ToU Shifting	\$ 397.93
Annual Savings WITH ToU Shifting	\$ 195.62

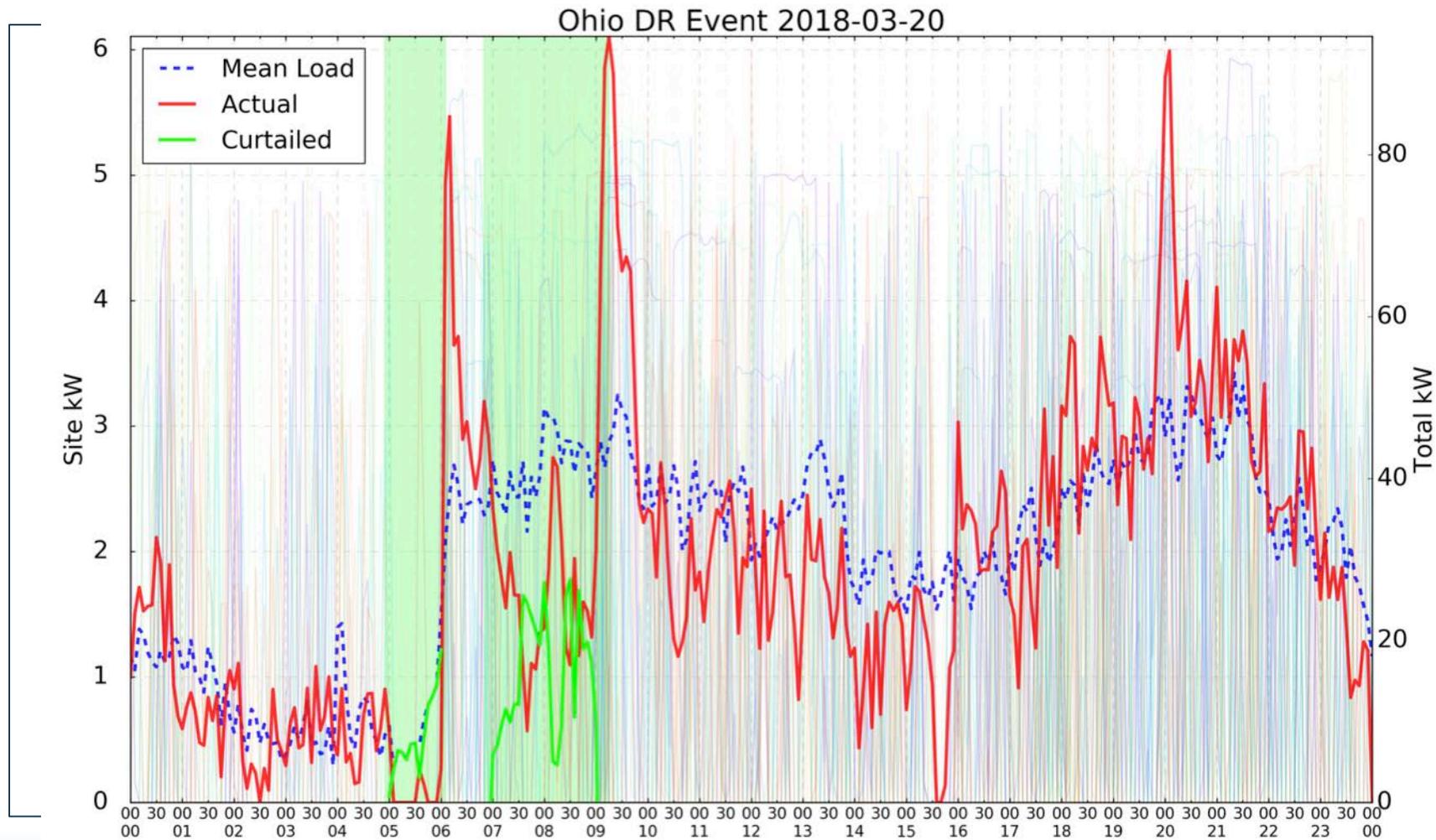
Case Study: WH Load in FL: Summer



Case Study: WH Load in FL: Winter



Case Study: DR in Ohio



More Use Case Opportunities

- ▶ Gas DR
- ▶ Water Heater Monitoring/Predictive Maintenance
- ▶ Integrated Home Energy Management
- ▶ Residential PV/Water Heater/Battery Integration & Coordination
- ▶ Thermostat/Water Heater Coordination



Thank You!

Matt Carlson
CEO
matt@aquanta.io



2018 Better Buildings Summit

Jamie Peters, Google
Customer Success - Energy Partnerships

August 23, 2018

Google

You **Tube**

nest[®]



Google Home

Pixel



ANDROID



waze

**Connected home programs go
mainstream**

Since introducing the Nest Learning Thermostat in 2011

Nest thermostats have saved 22 billion kWh

“

To create a home that
takes care of the
people inside it and the
world around it.

”



Nest Thermostat E

E for Everyone; E for Easy; E for Energy Savings



- AutoSchedule
- Home/Away Assist (plus optional geo-fencing)
- Eco Mode
- Nest Leaf (behavioral feedback)
- Airwave
- Heat Pump Balance
- True Radiant
- Energy History
- Sunblock

Smart thermostats: no longer for higher incomes only



ComEd MARKETPLACE Account Products Buyer's Guides Support Cart

Help bring energy efficiency to those who need it most

nest Power Project [LEARN HOW](#)

FEATURED ENERGY-SAVING PRODUCTS

Product	Price	Rebate
3RD GEN NEST LEARNING THERMOSTAT - STAINLESS STEEL	\$149	After a \$100 Instant Rebate
NEST THERMOSTAT E	\$69	After a \$100 Instant Rebate
ECO624 WIFI THERMOSTAT W/ BUILT-IN ALICE VOICE SERVICE	\$149	After a \$100 Instant Rebate

Buy Today, Nest Donates 10%

Columbia Gas of Ohio A Nicor Company

Saving matters. And so does helping those in need.

Now through April 30, get a \$90 instant rebate on the Nest Thermostat E and Nest Learning Thermostat. And when you and others across the country purchase a Nest Thermostat this month, Nest will donate 10 percent of the proceeds (up to \$500,000) to go to organizations working across the U.S. to bring energy efficiency to those who need it most.

[Shop now >](#)

SMUD Energy Store ENERGY EFFICIENT PRODUCTS HOME IMPROVEMENT PROJECTS

connected Home Lighting Water Saving Outdoor Living Advanced Power Strips Portable Power

NEST POWER PROJECT

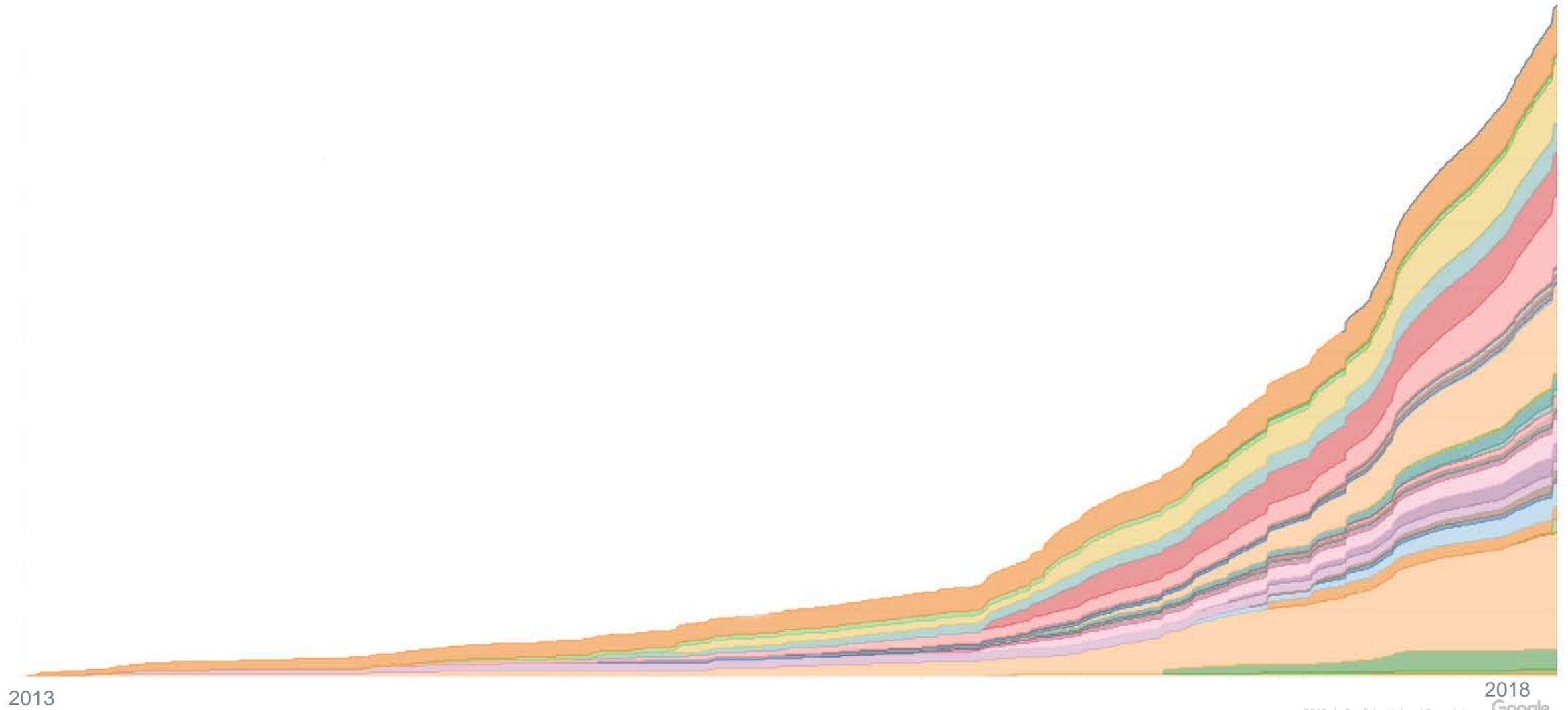
Save energy, give efficiency

Brought to you by the nest Power Project

In honor of Earth Day, Nest is launching a five-year campaign dedicated to lifting the energy burden across America. The burden of high energy costs is often carried by those least able to afford it. And, because low-income families are more likely to live in inefficient homes, they often pay more for energy than other households do.

- In some parts of the U.S., families spend close to 30% of their income on home energy bills.
- Nearly one in four Americans is eligible for federal and state home energy assistance programs.*
- These households in need of energy assistance programs include 22 million children.†

Smart thermostat-enabled demand response



2013

Imagine.... 70% of customers **opting-in** for more EE



- Personalized schedule tuneups each Winter and Summer season
- Drives **3-5%** incremental heating and cooling savings
- Peak Aware version adds **16-20%** avg kW load shift during summer peak periods

Energy services at scale

SoCalGas: Winter Seasonal Savings

79K+

ComEd: Summer Seasonal Savings

59K+

Smart thermostats: a great fit for Direct Install programs

Now serving single family, multi-family, SMB, manufactured housing, market rate, low/moderate Income...



35k+ Nest Thermostats
2016-19
>Includes SMB



18k Nest Thermostats
2018



50k+ Nest Thermostats
2018

>Includes MF, manufactured housing



150k Smart Thermostats
2017-18



Energy
Efficiency
Alberta

40k Smart Thermostats
2017-18

And now launching:

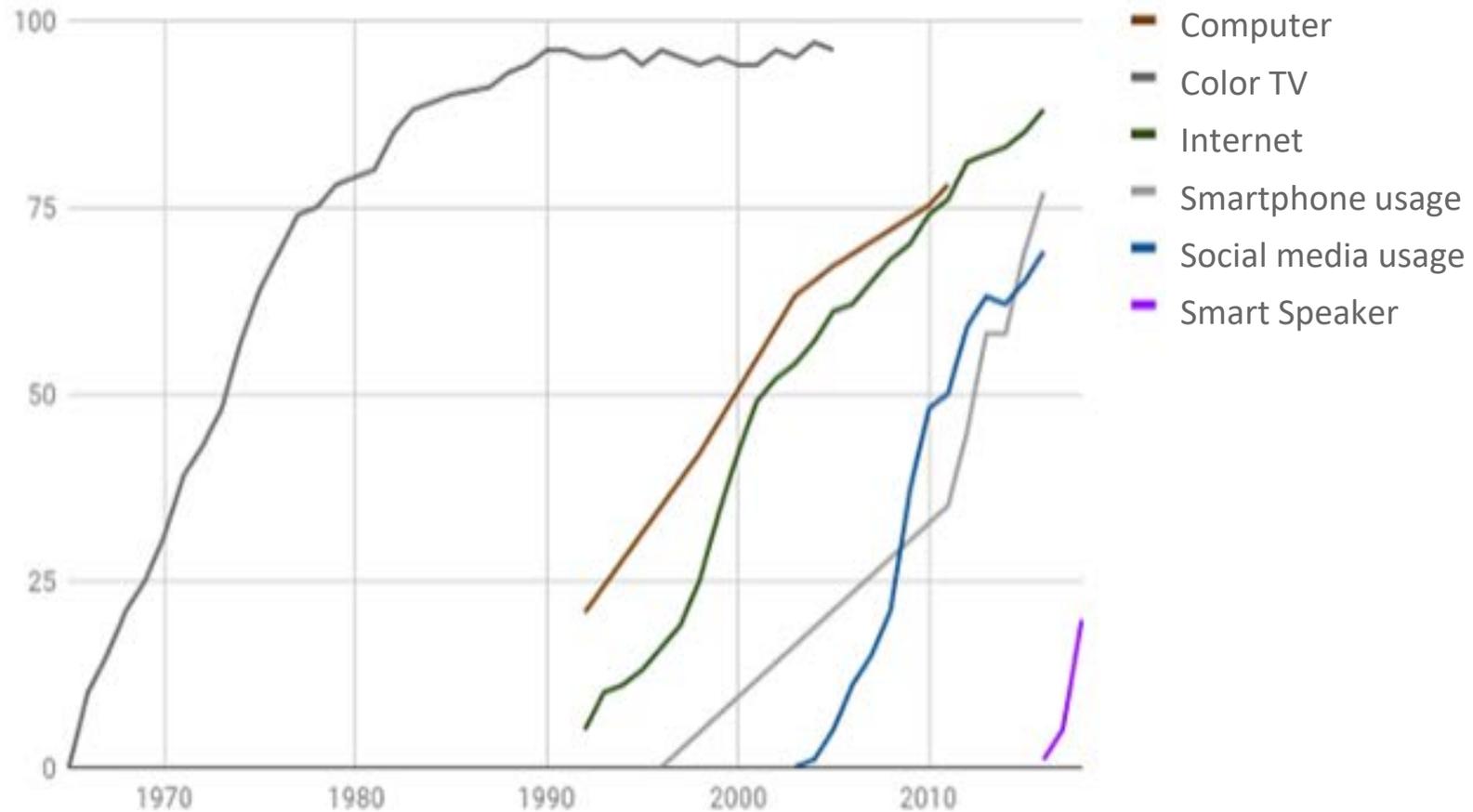


Next up.... Voice



Smart speaker market growth

Technology Adoption by Household in the U.S.

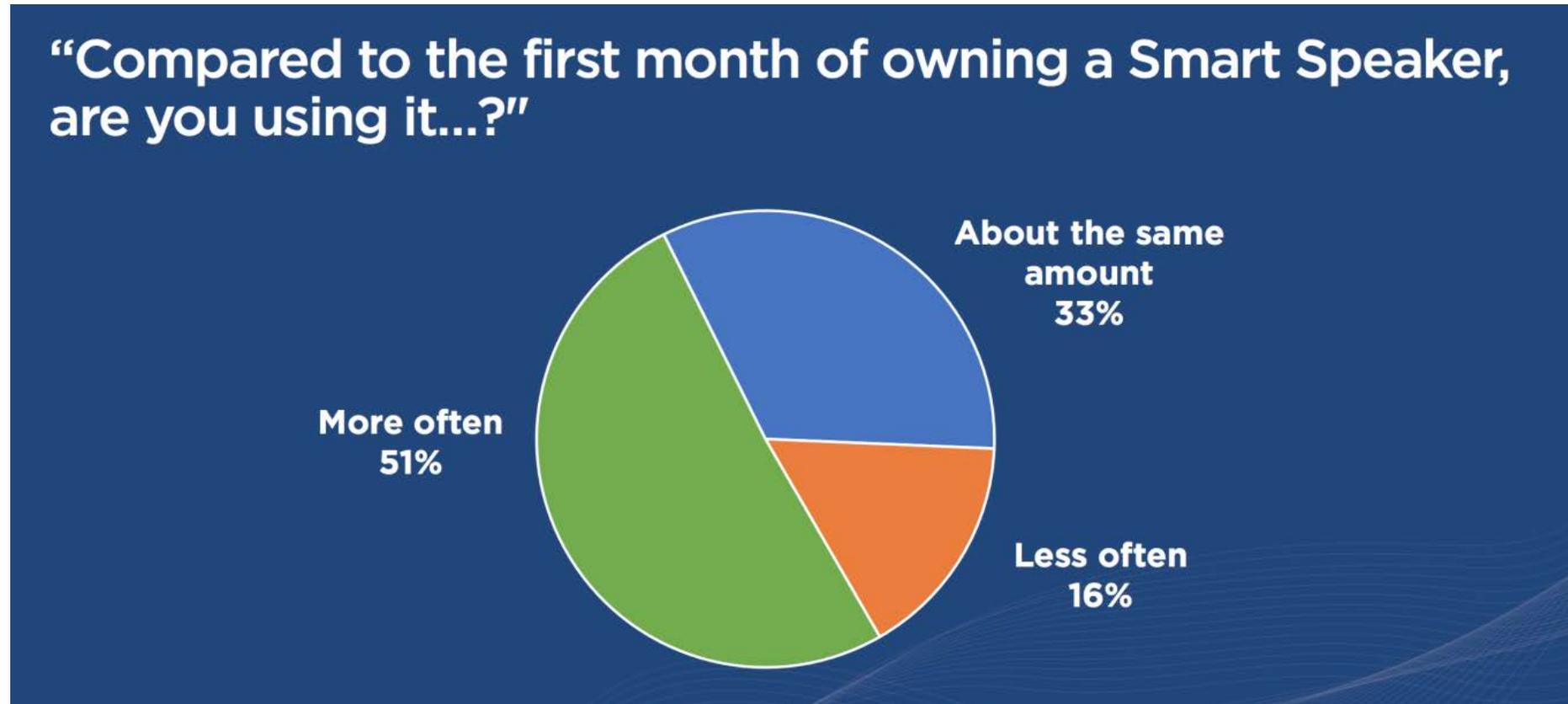


High usage



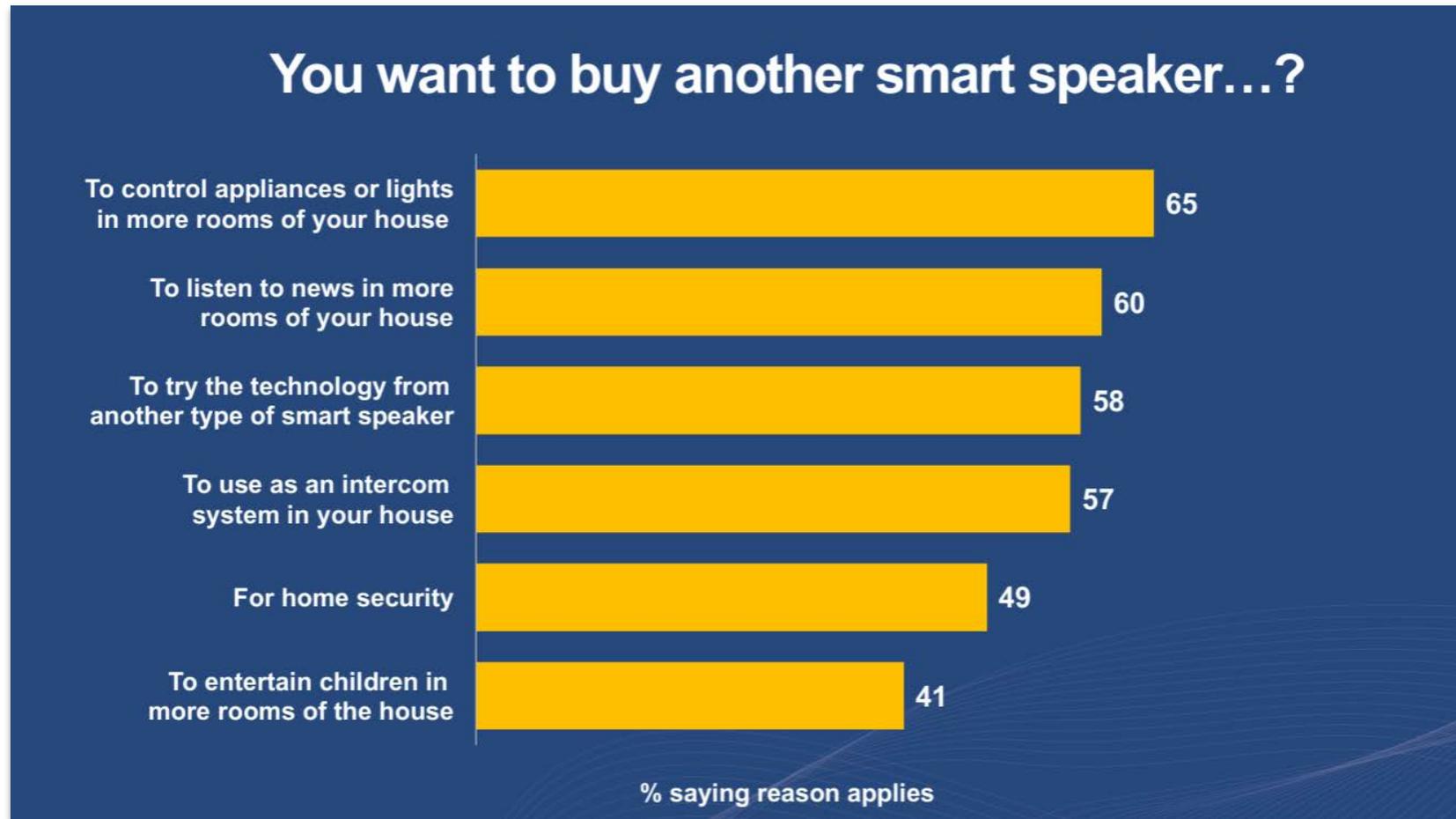
72% of people who own a voice-activated speaker say that their devices are often used as part of their **daily routine**.

Sustained usage



Source: NPR & Edison Research Institute, The Smart Audio Report, 2017

Additional growth driven by home control & monitoring



Source: NPR & Edison Research Institute, The Smart Audio Report, 2018

Unifying the Connected Home

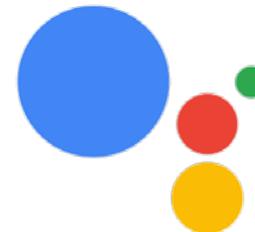
Nearly **60%** of Google Home or Amazon Echo owners have at **least one other smart product**, such as connected lighting, thermostats, security systems, and more.

Source: Consumer Research Intelligence Partners, Jan 2018

Smart displays are next



Google Assistant



Some energy partners are already getting started



Reliant Speak and Save

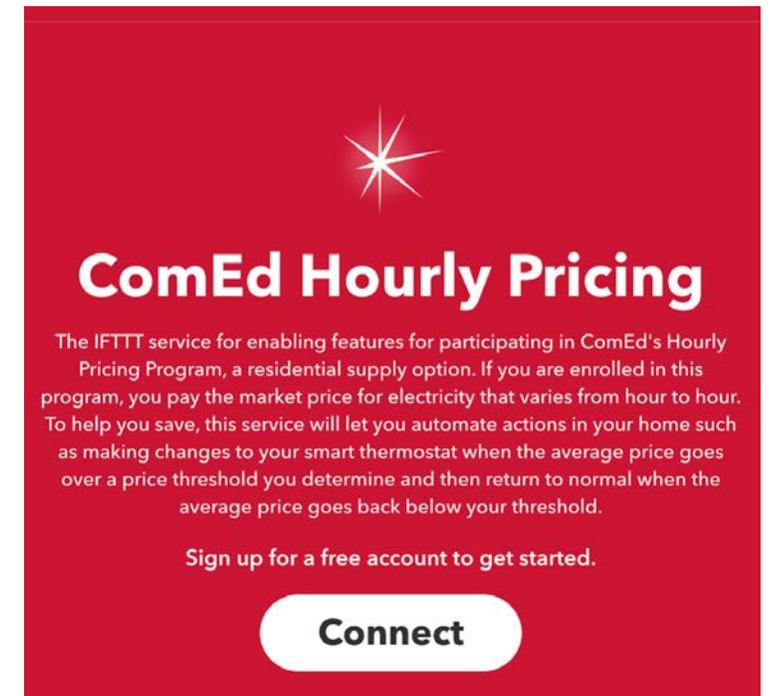
Sign up with Reliant and get a Google Home and a Nest Thermostat E

Use Google Assistant to check your usage, check your balance or pay you bill



BGE Google Assistant

Use Google Assistant to report an outage (mobile), check on your ETR, check your balance due



ComEd IFTTT

Use IFTTT recipe to enable energy saving actions IF certain thresholds are met

A new platform for EE & customer engagement

“Hey Google, talk to ComEd”



“Ok, let’s get ComEd”



“Hello, how may I assist you today? You can Check Outage Status, Report an Outage, or Check Account Balance...”

Thank you

Jamie Peters

Customer Success - Energy Partnerships

Google

jamieters@google.com