



Northeast Energy Efficiency Partnerships

New York Smart Thermostat Market Characterization

Delivered to: New York State Energy Research and
Development Authority

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SEE Change Institute

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About NEEP

Mission

Accelerate energy efficiency as an essential part of demand-side solutions that enable a sustainable regional energy system

Approach

Overcome barriers and transform markets via ***Collaboration, Education and Enterprise***

Vision

Region embraces **next generation energy efficiency** as a core strategy to meet energy needs in a carbon-constrained world



One of six regional energy efficiency organizations (REEOs) funded by the US Department of Energy (US DOE) to link regions to US DOE guidance, products and programs

About SEE Change Institute

- See Change Institute blends social science with innovative design to address global issues through human solutions.
 - We bring together leading academics and practitioners to work on strategy, implementation, research, and evaluation of behavior-based energy programs.
 - Backed by theory, tested with data, and designed with care, we develop, implement, and evaluate programs to solve the issues that matter to us the most.

Summary of Contents

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- The Smart Thermostat Market
- New York Market: Smart Thermostat Baseline and Consumer Survey
- Barriers and Opportunities for Wider Smart Thermostat Adoption in New York
- Interventions, Recommendations, and Potential Impacts
- Conclusion

Introduction

- The goals of this characterization are to:
 - Assess customer knowledge, attitudes, and actions toward smart thermostats
 - Analyze various stakeholder perspectives on the industry and market potential
 - Estimate the current baseline of smart thermostat penetration in New York State
 - Determine the size and scope of the opportunity for NYSERDA to advance this market

Introduction Cont.

- The findings are intended to help NYSERDA identify opportunities and challenges in this market to determine appropriate interventions and ultimately, market transformation
- Much of the data presented is specific to New York, findings have implications for other markets throughout the United States and world
- This presentation is a companion to the full report which includes all citations and further explanations of findings

The Smart Thermostat Market

Market Confusion in Terminology

“Wi-Fi”



“connected”

“smart”

“learning”

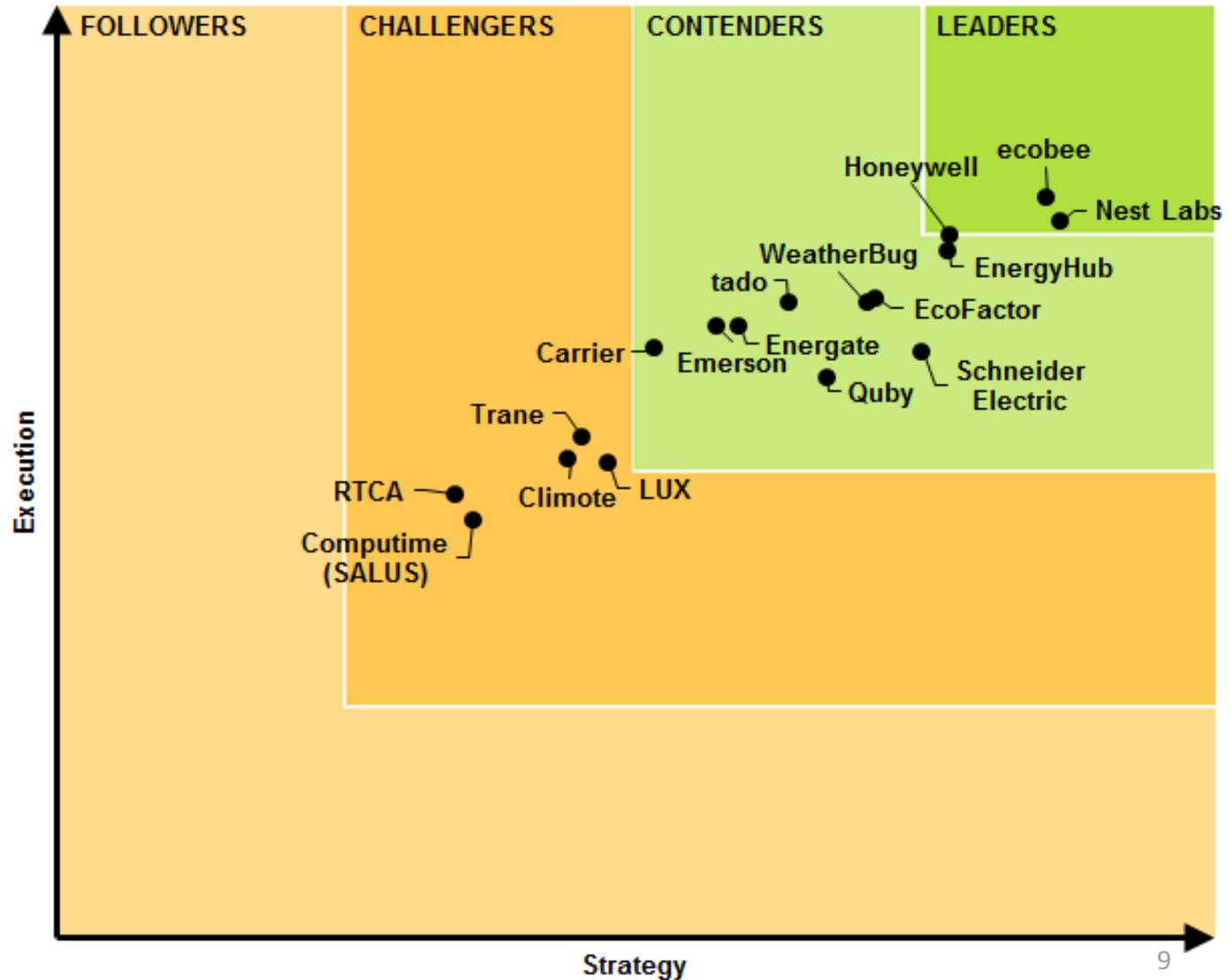
“programmable”

Technology overview

Terminology	Description
Programmable Thermostat	A thermostat connected to a home’s HVAC system that can be programmed by a user or technician to follow a schedule based on the lifestyle of the user.
Connected or Wi-Fi thermostat	A thermostat that is connected to the Internet and typically includes a user interface , such as a mobile app or online dashboard, for the user to remotely make changes. Connected or Wi-Fi thermostats do not necessarily have any advanced features , though any smart thermostat could also be considered a connected thermostat.
Smart or learning thermostat	A connected thermostat that employs advanced algorithms and/or sensors to improve user comfort, control, and energy use . This may include occupancy sensing, geofencing, or learning behavior.

Brands and Products

Navigant's
Smart
Thermostat
Leaders from
Leaderboard
Report, 2016



Most Cited Smart Thermostats

ecobee

Est. 2008



Nest

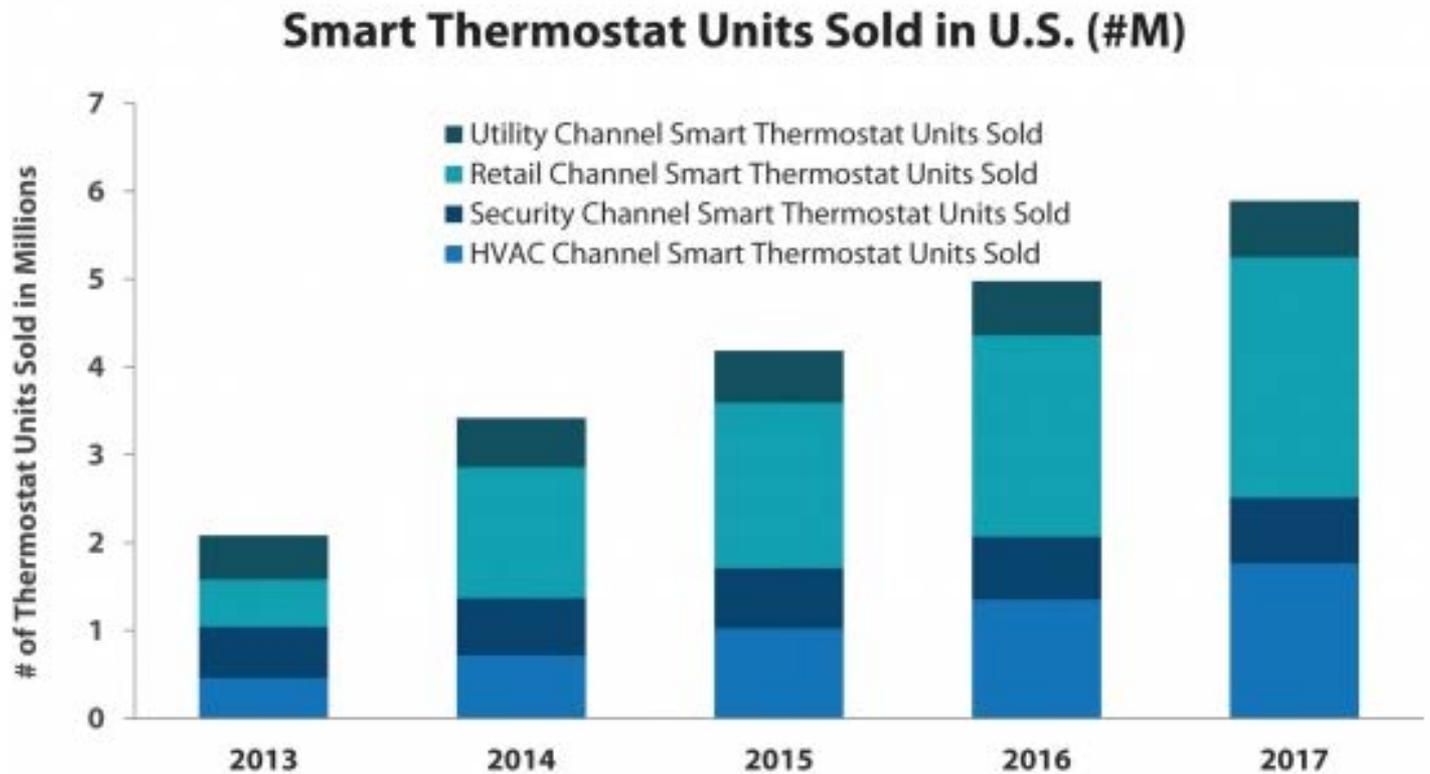
Est. 2011



National Smart Thermostat Market Size



Parks
Associates
2015 Smart
Thermostat
Units Sold
and
Projections



© 2015 Parks Associates

Size of Thermostat Market

- Smart thermostats are growing in proportion of the overall thermostat market
 - From 40% in 2015 to 50% in 2017 according to Parks Associates
- Entire thermostats market is growing
 - Fueled by early replacement of operational thermostats with smart thermostats
 - From 10 million in 2015 to 12 million in 2017 according to Parks Associates

Product Costs

Manufacturer	Model	Equipment Cost
Allure	EverSense	\$210.00
ecobee	ecobee3	\$249.00
ecobee	ecobee3 lite*	\$169.00*
Honeywell	Lyric Round	\$199.00
Honeywell	Lyric T5	\$149.99
Nest	Nest Learning	\$249.00
	Thermostat (3rd Gen)	
RCS	001-01773	\$164.29
Schneider Electric	Wiser Air	\$229.98
Venstar	Voyager	\$145.00

*Product not yet available

Size of Smart Thermostat Market

- Assuming a weighed average of \$210
 - Based on presumed popularity of more expensive Nest and ecobee
- Assuming from Parks Associates 5 million smart thermostats sold in the U.S. in 2016

$$\$210 \times 5M = \$1.05\text{Billion}$$

- Calculated **\$1.05 billion in sales** in 2016 in U.S.

ENERGY STAR® Connected Thermostat Specification



- Programmable thermostat program sunset in 2009
- Connected thermostat specification under development
 - *expected to be finalized in early 2017*
- Provides a common baseline, manufacturers to report data every 6 months to stay on the list
- Proposed savings thresholds are **8% for heating, 10% for cooling**
- Once final, NEEP Recommends NYSERDA only promote products that earn ENERGY STAR Certification



Potential Energy Savings from Smart Thermostats



- Fraunhofer Savings Potential of Smart Thermostats by Climate Zone for Very cold/cold and Mixed-humid

Climate Zones that occur in New York	Heating Savings		Cooling Savings	
	Percentage of total household energy use	MMBtu equivalent per household	Percentage of total household energy use	kWh per household
Very cold/cold	15%	9.1	20%	119
Mixed-humid	15%	5.7	20%	381

Ranges of Reported Savings from Smart Thermostats



- Fraunhofer:
 - 15% heating, 20% cooling
- NEEP 2015 (compiled from several evaluations):
 - 1-15% heating, 1-17% cooling
- ENERGY STAR's proposed levels in Draft 3 Specification
 - 8% heating, 10% cooling

New York Savings Potential from Smart Thermostats



- From EIA's 2009 RECS Data:
 - 53% of New York households used individual window/wall air conditioning units
 - another 20% have a central air conditioning system
 - air conditioning represents 1% of household energy use
 - natural gas provides space heating for 57% of New York households
 - fuel oil provides 29% of space heating
 - space heating makes up 56% of total energy use
- When all energy sources are combined, the average New York household consumes the equivalent of **103 mmBtu** per year

New York Savings Potential from Smart Thermostats Cont.



- Potential heating savings:
 - Using Fraunhofer’s 15% potential savings from heating, smart thermostats could offer up to 8.7 MMBtus per household per year average heating energy savings.
- Potential cooling savings:
 - Only 20% have central AC which is best candidate for smart thermostat control
 - Using Fraunhofer’s 20% potential savings from cooling, the cooling potential savings about 30 kWh/year per household

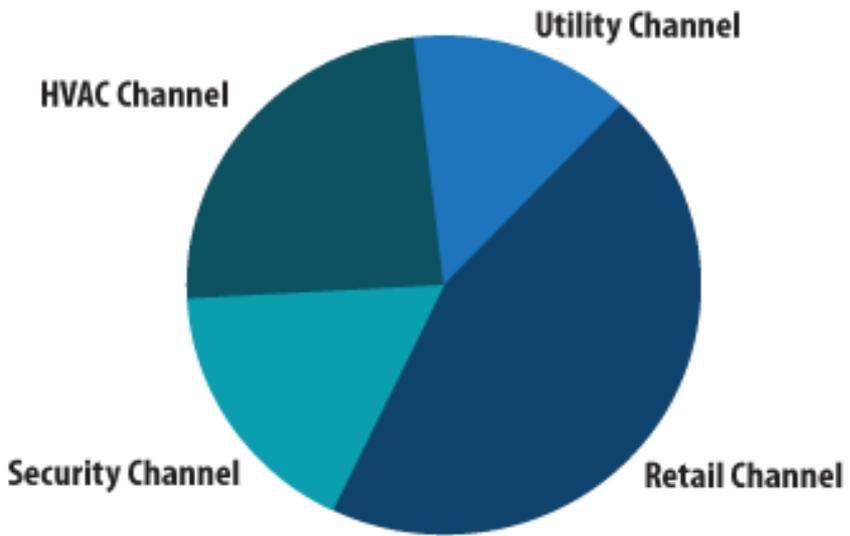
Market Actors

Market Actor	Description	Examples
Hardware Manufacturer	These companies produce smart thermostats. Some are relatively new companies focused on smart thermostats. Others are traditional thermostat manufacturers who have expanded their products.	New: Nest, ecobee, tado, Quby Traditional: Honeywell, Schneider Electric, Emerson, Carrier, Trane
Software Vendor	These companies partner with thermostat hardware manufacturers to provide the advance algorithms that move a product from connected to smart.	EnergyHub, EcoFactor, Weatherbug, Energate
E-tail	Online retailers and online manufacturer stores on their website for direct to customer online sales.	Amazon, newegg, manufacturer online stores
Brick and Mortar Retail	Retailers with a history of selling thermostats have an extension of their existing sales. Consumer electronics retailers have also entered this market	Lowe's, Home Depot, Best Buy, Target, Sears, Apple Store, independent retailers
HVAC Distribution Channels	Manufacturers with a traditional base in HVAC, smart thermostat are an addition to the suite of offerings through distributors and installers. Newer manufacturers have also sought out HVAC distribution and installation.	HVAC distributors, HVAC installers
Security and Telco Service Providers	Many security and telecommunications service providers have started offering smart thermostats as part of their bundle of offerings.	ADT, Alarm.com, Comcast, AT&T
Home Performance Contractors	Several manufacturers offer training and tools to aid in the sale and installation of their products for contractors. Few focus on this channel for sales	Home Performance Contractors

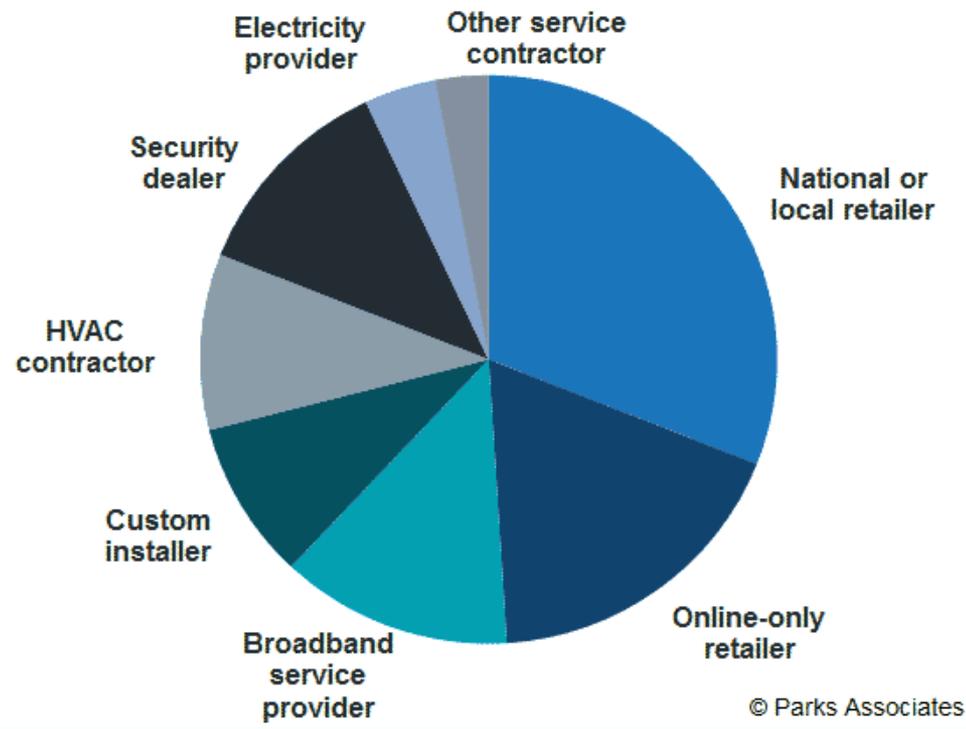


Smart Thermostat Product Journey

Share of Smart Thermostats Sold in U.S. in 2015



Smart Thermostat Sales Channels Device Owners in U.S. Broadband Households

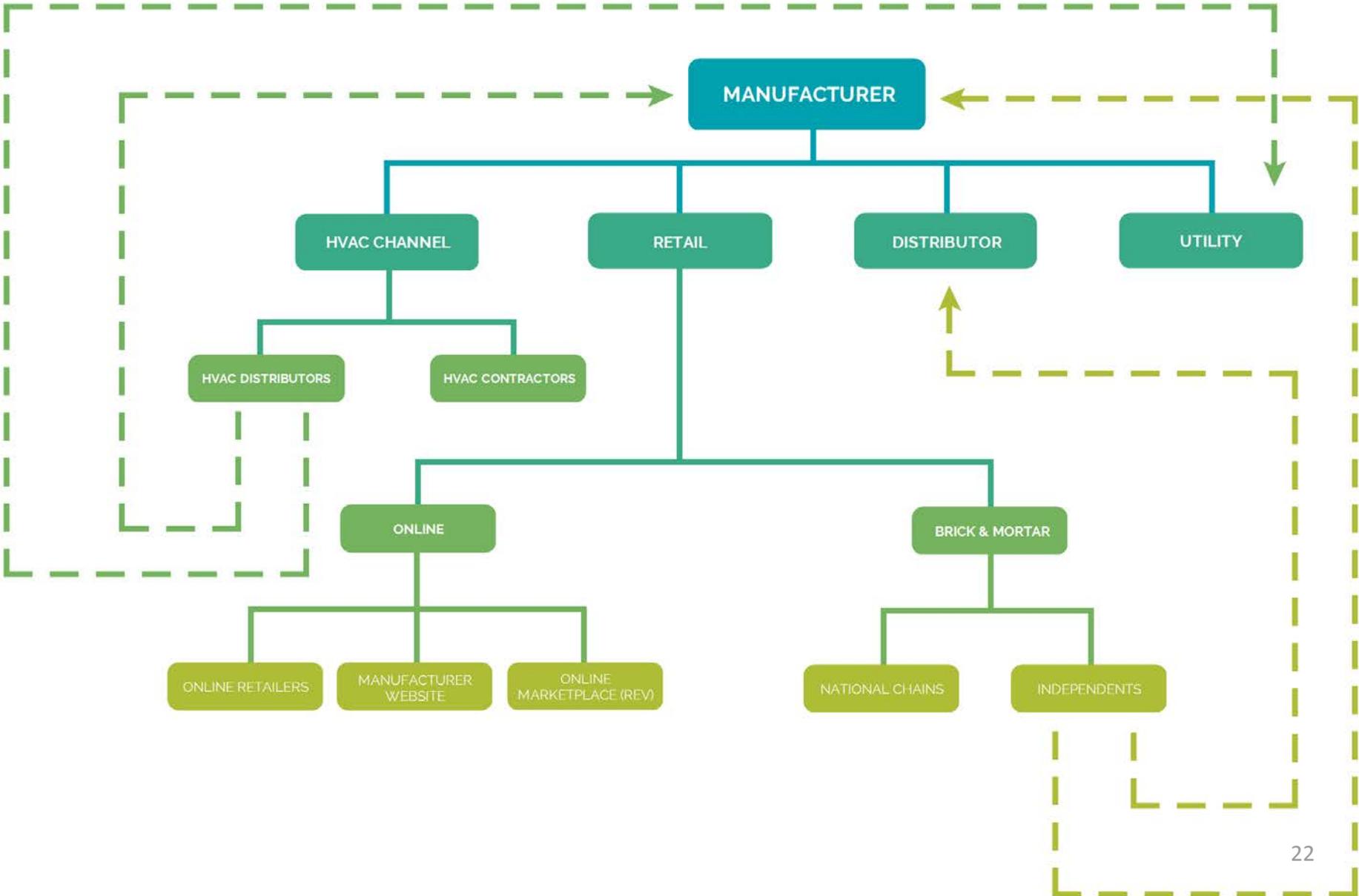


© Parks Associates

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From Parks Associates, 2015 and 2016

Sales Channels for Smart Thermostats



Industry Actor Interviews and Key Findings



Utilities



Industry Orgs



Tech Companies



Government



Researchers



Retailers

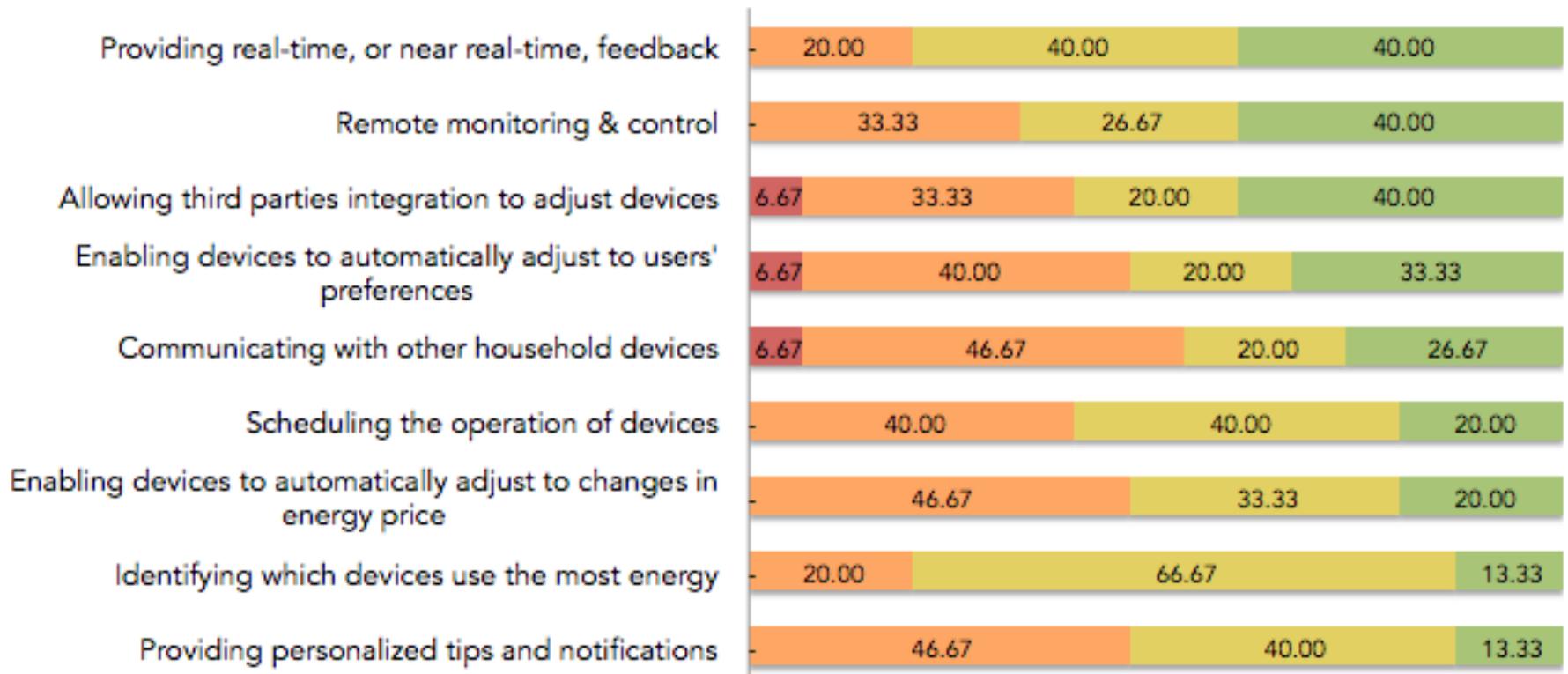
- SEE Change conducted semi-structured interviews with 32 key HEMS players from six stakeholder groups
- An additional 15 HEMS industry stakeholder responded to an online survey with similar questions
- Findings used to inform analysis

Stakeholder Survey Responses on Important Features for HEMS Adoption



Please rate the importance of the following features for wide-spread adoption of connected home technology

■ Not important
 ■ Somewhat important
 ■ Important
 ■ Very important

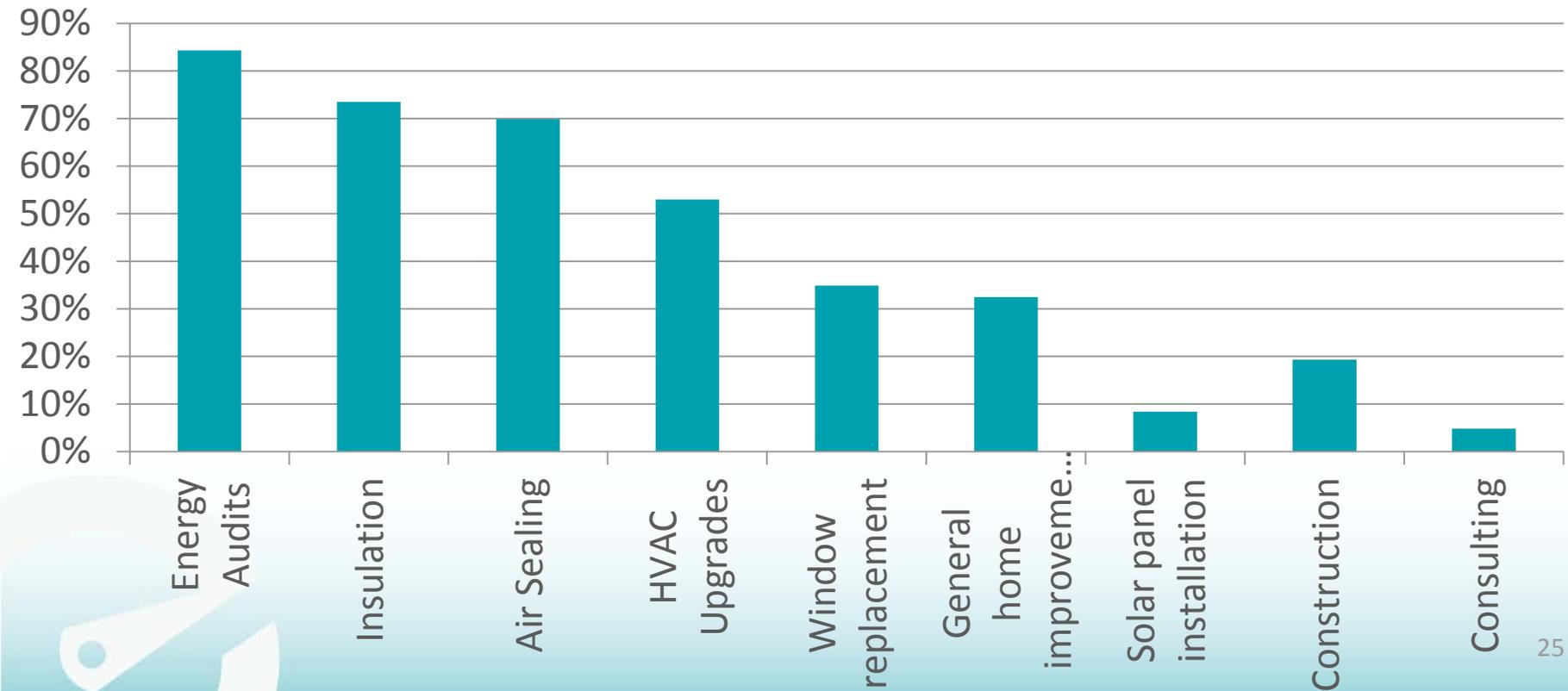


New York Contractor Survey and Key Findings



- Home performance contractors identified as major channel
- Survey: 83 respondents throughout NY

Please indicate what work your company performs in the residential space.

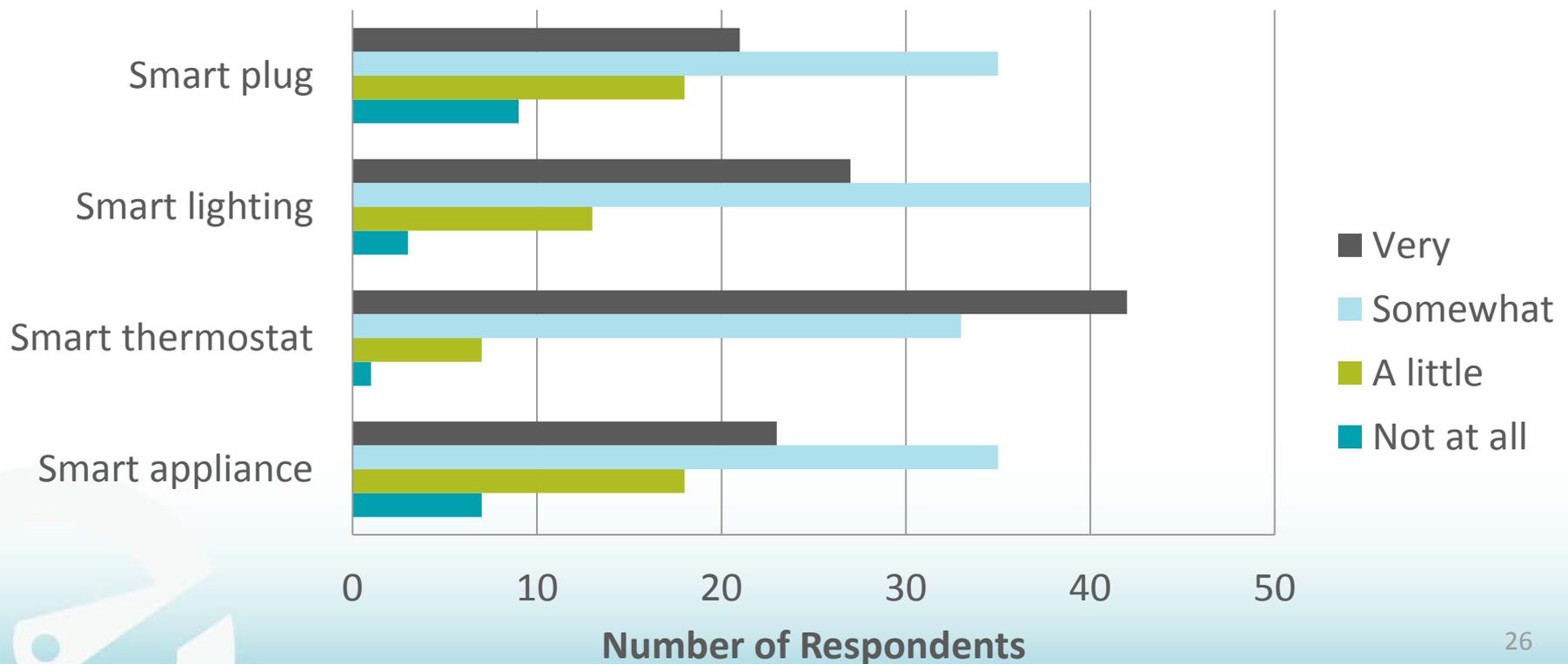


Contractor Smart Home Awareness



- Only 1 contractor not aware of “smart home”

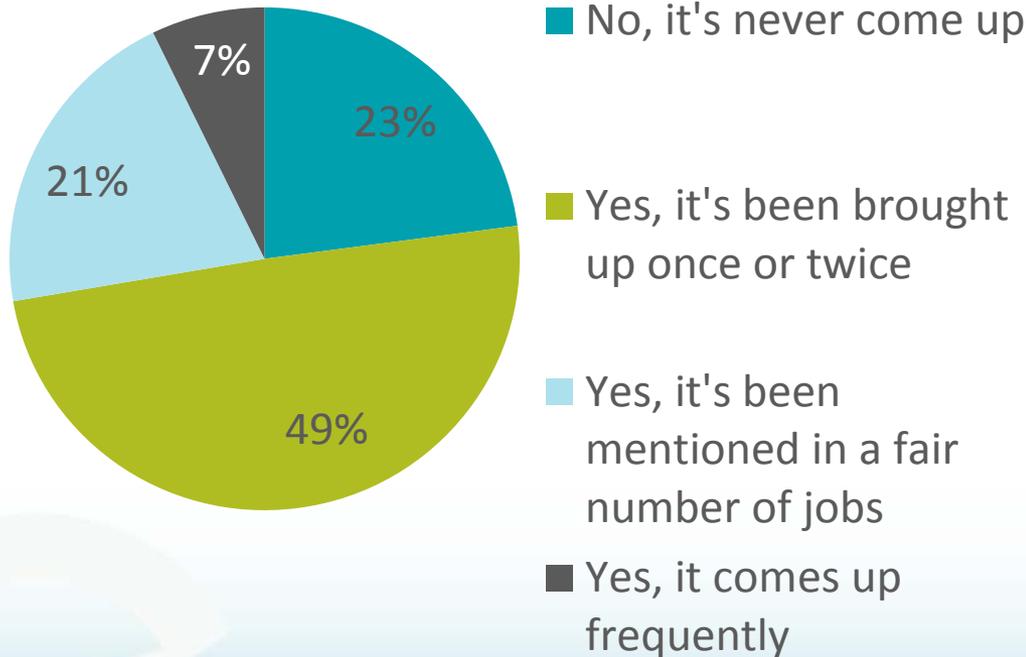
How familiar are you with each of the following smart home technologies?



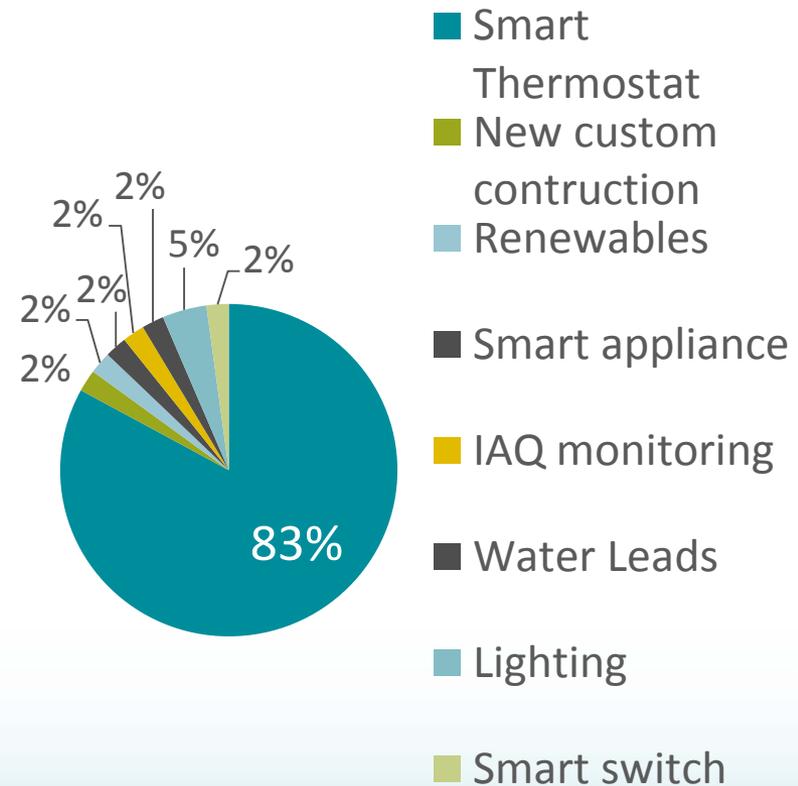
Are Customers Asking About it?

- Somewhat...

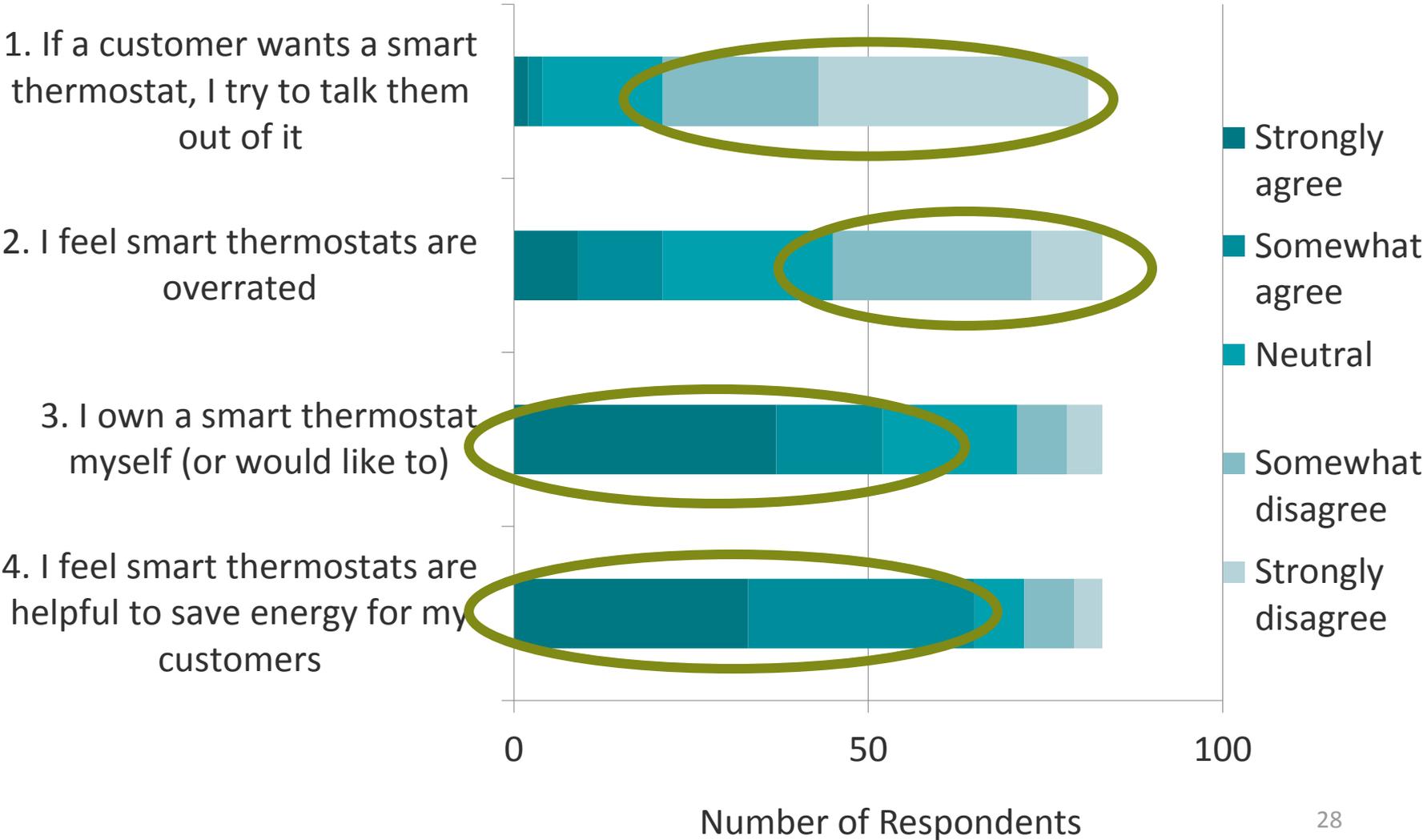
Do your customers ask you about smart home technologies?



If yes, which ones



Contractor Opinions of Smart Thermostats



Contractor Survey Conclusion

- Relatively high awareness and some experience with smart thermostats
- Some skepticism, but not overwhelming
- Value proposition for incorporating smart thermostat promotion into their work is not yet clear
- Potential for intervention on all components

NY Market: Smart Thermostat Baseline and Consumer Survey*

*See survey instruments, available as companion documents to this report, posted on NYSERDA's website.

NY Smart Thermostat Penetration Baseline

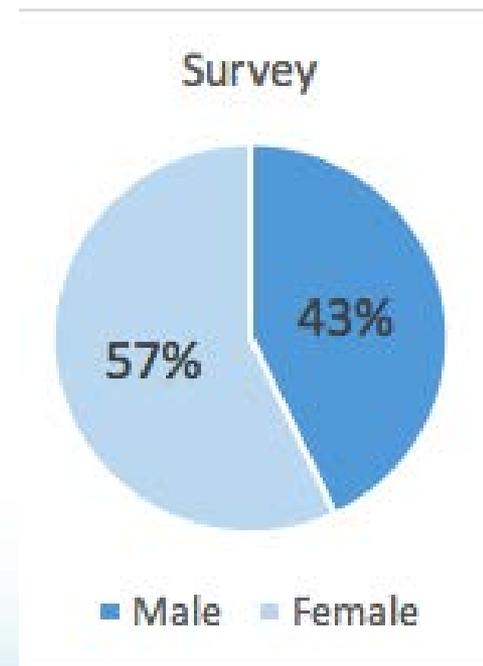
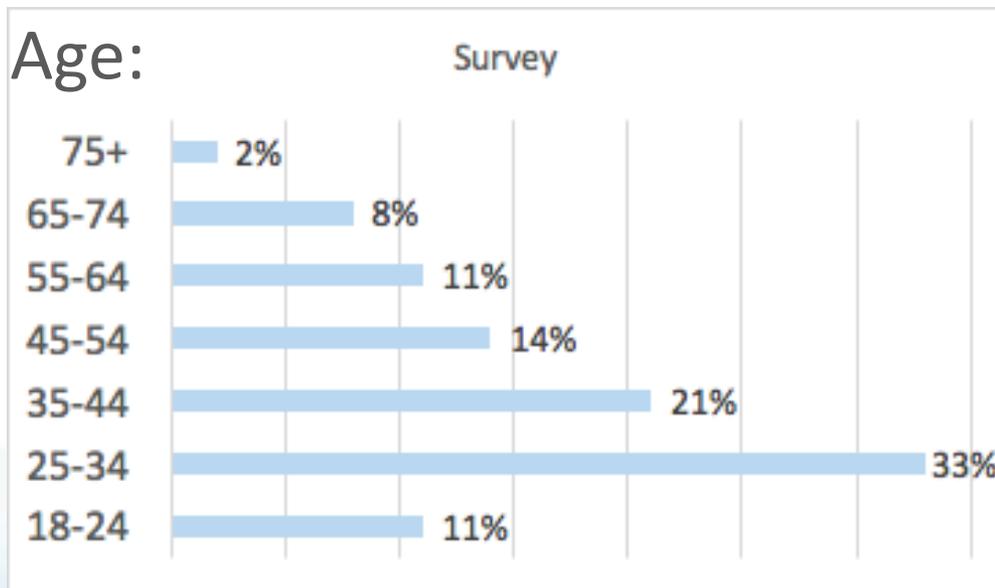


- Reviewed available national data
- NY Resident survey of 538
- Long Island subset of 118
- Results of similar survey in CA
- **NEEP recommends a 13 to 17% range as the baseline for New York penetration of smart thermostats**
 - **with the preponderance of evidence pointing to the 14%-15% penetration**

Source	Rate
Parks Associates Extrapolated to NY	12.4%
Sylvania Socket Survey	13%
NY Resident Survey Low	8.9%
NY Resident Survey High	17%
PSEG-LI Subset of NY Residential Survey	15.3%
PG&E Survey	14%

NY Customer Survey Analysis

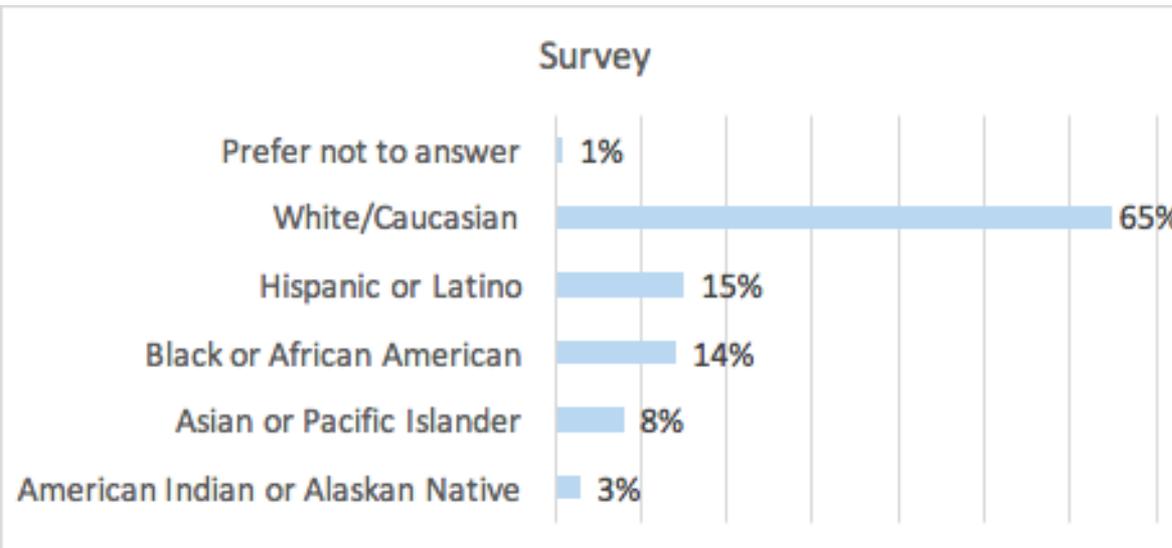
- Participants: 538 New Yorkers
 - 35% from NYC
 - 10% from Buffalo, Rochester, Yonkers, and Syracuse
 - 55% from rest of state



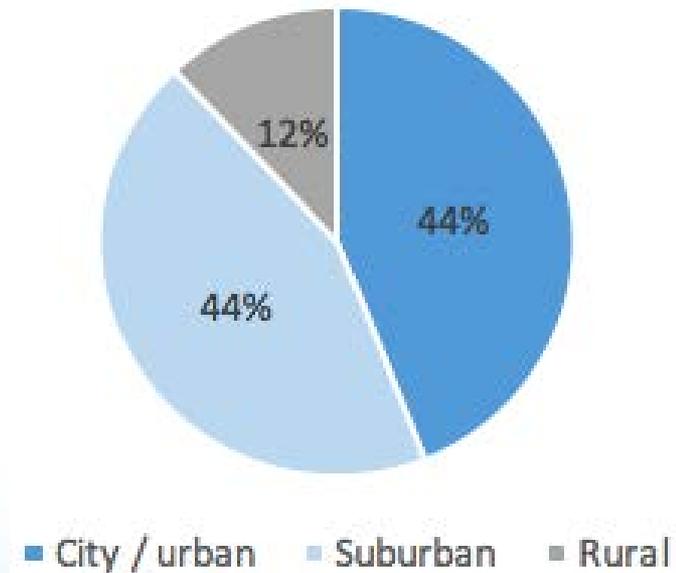
NY Customer Survey Analysis Cont.

- Large range of incomes:
 - 30% <\$50,000
 - 36% \$50,000-\$100,000
 - 19% \$100,000-\$175,000
 - 8% >\$175,000

Race/Ethnicity



Self-identified community



Survey Question Structure and Content

- Smart home technology awareness:
 - How aware are survey respondents of smart home technologies and the smart home market?
- Smart home technology attitudes:
 - How do survey respondents feel about smart home technology, in general and in their own personal use and ownership?
- Smart home technology actions:
 - Do survey respondents own smart technology? How would (or do) respondents like to interact with and use their smart technology?

Results: Awareness

- Relatively high level of awareness of the notion of a “smart home”
 - Nearly 90% of respondents were at least a little familiar with “smart homes”
 - 62% of respondents said that they were either “very” or “somewhat” familiar with “smart homes”
 - >50% respondents were either “somewhat” or “very” familiar with smart appliances, smart lights, and smart thermostats
 - 40% of respondents were not at all familiar with smart plugs
 - People were significantly more aware of smart thermostats relative to smart plugs and smart appliances ($p < 0.01$).

Where did you learn about smart home products?	
Media	63%
Store	36%
Word of mouth	36%
Service provider	18%
Not sure	13%
Other	2% <ul style="list-style-type: none"> • Work (4) • Internet (3) • Advertising (2) • Engineering magazines (1)

Purchase Location for Smart Devices

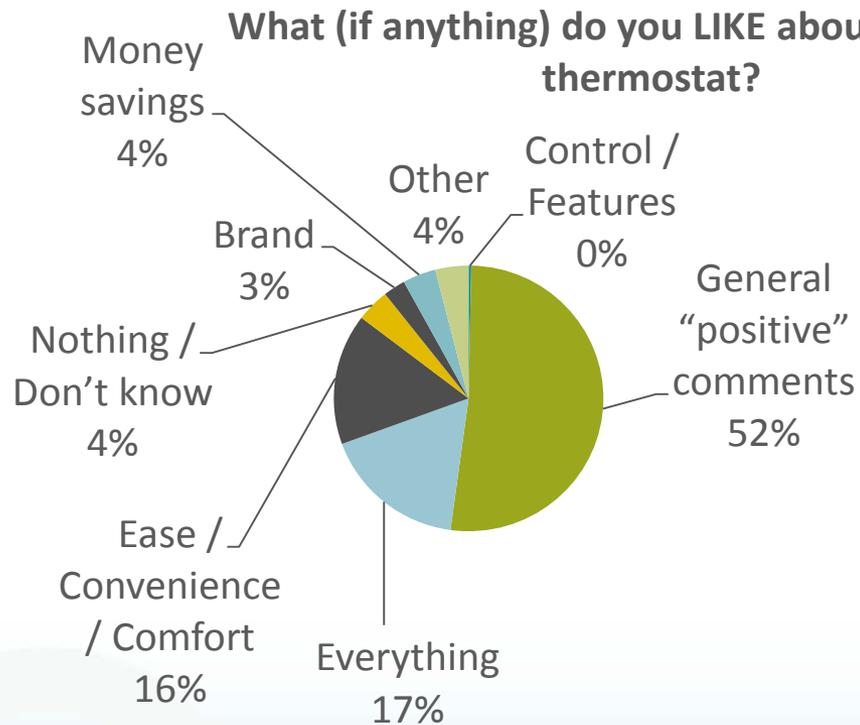
- For those who owned at least one smart devices, they got them from:

	Smart appliances	Smart lights	Smart plugs	Smart thermostat
Store	14%	4%	10%	10%
Online	12%	11%	10%	12%
Gift	5%	14%	4%	3%
Borrowed	<1%	2%	2%	1%
Came with my home	2%	2%	2%	2%
None of these, not sure	<1%	0%	<1%	1%
Other	0%	0%	0%	2% Installed with HVAC Installed by ConEd

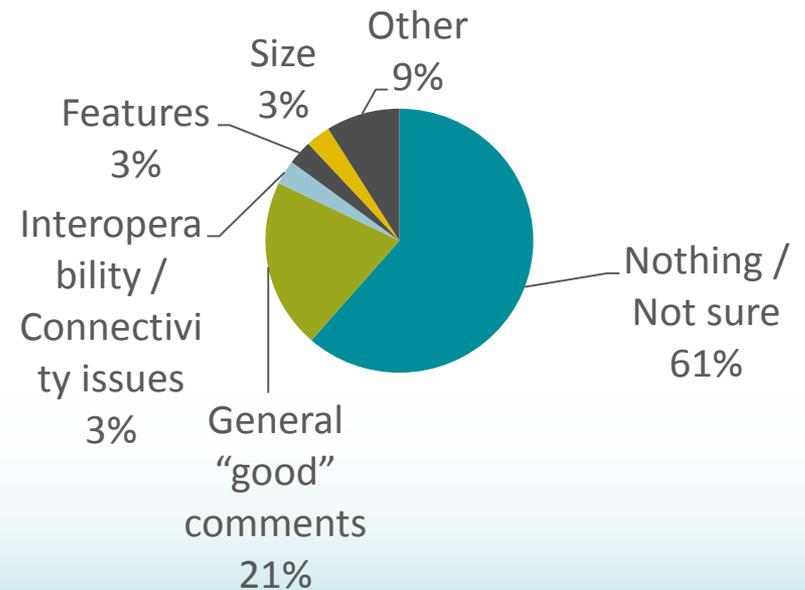
Smart thermostat Owners: Feedback



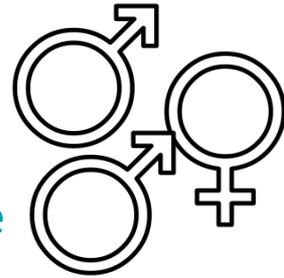
- Overwhelmingly positive



What (if anything) do you DISLIKE about your smart thermostat?



Smart Thermostats and Demographics



- Smart Thermostat Owners:
 - Men were twice as likely as women to own
 - Younger people, wealthier people, and Caucasians were all more likely to own
 - People in urban as opposed to rural or suburban locales were more likely to own
- In stand alone homes:
 - renters were disproportionately less likely to own
 - home owners disproportionately more likely to own
- Apartment dwellers (renters or homeowners):
 - significantly less likely to own smart thermostats
- Smart thermostat owners did not differ from non-owners in terms of how long they expect to stay in their homes
 - counterintuitively, found a marginally significant correlation ($p = 0.06$) that people who own smart thermostats actually expect to stay a shorter time in their home.

Smart Thermostat Owner Actions and Attitudes



- Smart thermostat **owners** did not perceive more smart home benefits than those without smart thermostats
 - No significant difference in the appeal of comfort-related benefits for owners or non-owners
 - Owners found all other smart products more appealing
 - Owners were more likely to own other smart devices
 - Owners are significantly more likely to also own solar panels and/or electric vehicles
 - 51% of smart thermostat owners also owned solar panels.
- Smart thermostat owners have significantly weaker personal norms, and significantly stronger social norms about conservation
 - Perhaps owners employ “moral licensing,”
 - the action of owning one type of “green” technology makes someone think that their neighbors are trying to conserve and that their community expect them to conserve
 - Owner weaker personal norms suggests owners do not personally feel responsible for conserving energy, as if they feel they have sufficiently “done their part” for conservation
 - This effect was found to be independent of gender, ethnicity, age, and income

Miscellaneous Findings and Questions

- A preliminary area for further exploration was the urban/suburban/rural ownership divide
 - Hypothesized that urban households may own more smart thermostats due to a higher exposure to media, but found urban, suburban, and rural households do not significantly differ in terms of learning about smart technology from media
 - All reported a high level of learning about smart technology from the media.
- When controlled for personal and social norms:
 - Found that most of the urban dominance of owning smart thermostats over the suburbs disappeared; the difference between urban and rural homes persisted but was drastically reduced
 - Suggests attitudes towards energy use, particularly, personal and social norms regarding conservation, explain the urban/suburban/rural divide of smart thermostat ownership.
 - People in urban areas were found to hold weaker personal and stronger social norms for conservation, both of which were associated with greater smart thermostat ownership.

Barriers and Opportunities for Wider Smart Thermostat Adoption in New York

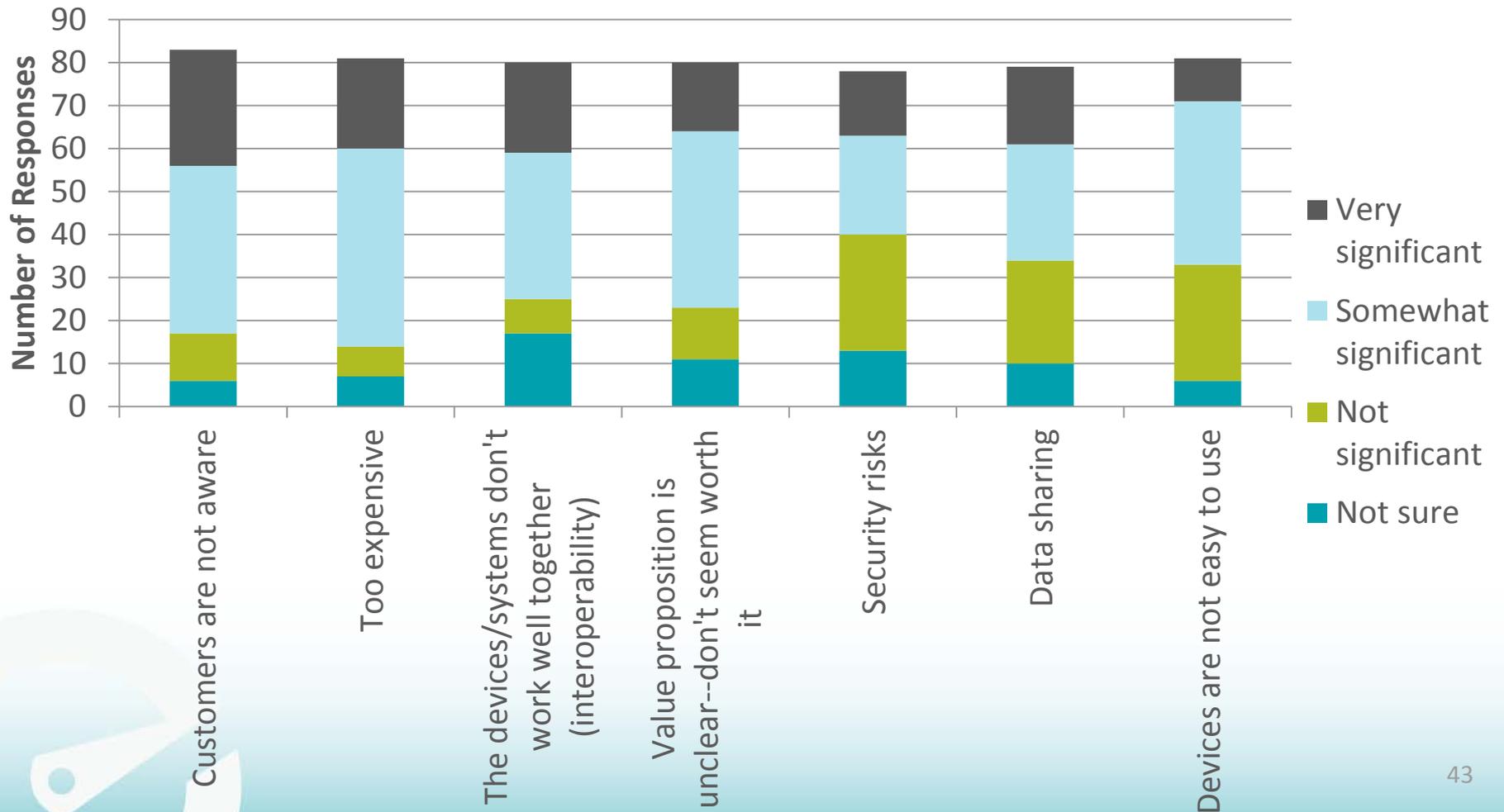
Barriers to Widespread Adoption

“Difficult setup, poor interoperability, difficulty in support, lack of strong value proposition to consumers, and lack of ability to control and deploy the systems by the service provider”

-Stakeholder interview

Barriers Ranking for Contractors

Please rate the significance of the following barriers to smart home adoption.



Analyzed Barriers

- Demonstrated Savings:
 - Range of savings demonstrated from pilot efforts
- High Cost:
 - Difficult sell to consumers who don't see full value
 - Price prohibitive for a large segment of the population
- Consumer Interest & Engagement in Energy Savings:
 - While popular relative to the rest of the HEMS ecosystem, most consumers are not engaging with smart devices from a primarily energy savings perspective
 - Adoption alone may not be enough to drive energy savings; consumers need further engagement with their smart thermostats to yield significant savings
- Data Sharing:
 - Utilities and program administrators are concerned about liability and data validation
 - Industry is concerned about reputation and customer protection

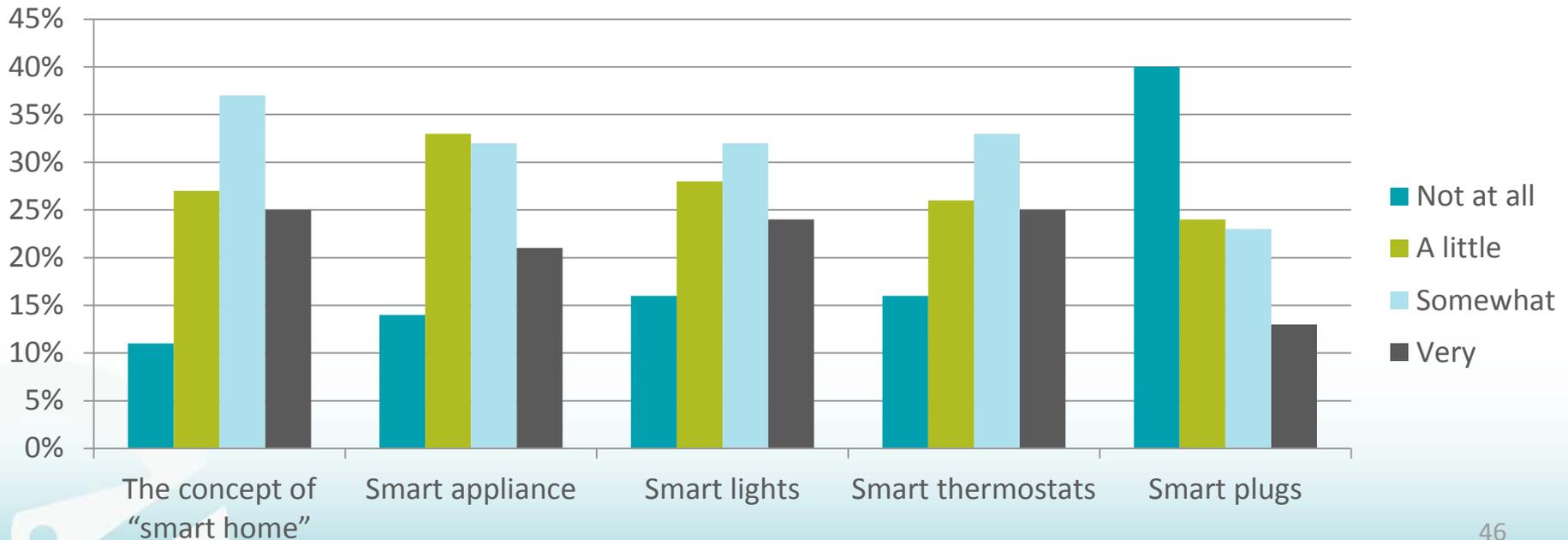
Analyzed Barriers Cont.

- Interoperability
 - customer confusion from multiple platforms, apps, and brands, which may be challenging for persistence. Some popular platforms are emerging to work with multiple systems and help improve this.
 - For smart thermostats, companies continue to build partnerships with other platforms; the challenge of interoperability seems to be diminishing
- Singular Focus on Products not Systems:
 - Concerns arose about a “singular focus” on one smart home product offering, in most cases the smart thermostat, and the potential for this siloed perspective to affect engagement with the energy management *systems*
 - Perhaps shifting program administrators role to be “unbiased advisor and integrator...where customers can shop for a plumber, shop for solar, get an EV charging station installed, or get a connected home set up...a holistic solution to needs that customers would have in their homes”

Analyzed Barriers (Cont.)

- Customer awareness:
 - While customers are more aware of smart thermostats than they are of other smart home products, general awareness is quite low
 - Results from NY customer survey:

How familiar are you with the following?



Opportunities

- Smart Thermostats can serve as Gateway product to the smart home:
 - Smart thermostats could act as a gateway product to catalyze consumer awareness and adoption of products across the larger smart home ecosystem
- Demand Side Management:
 - Because of the control functionalities smart thermostats provide for both consumers and third parties, there is significant demand response potential
- New Opportunities for Measurement and Verification:
 - Smart thermostats have the potential to provide new ways of measuring and verifying the actual savings data of households
 - Analysis of the data stream is an opportunity to understand the actual control behavior of the smart thermostat

Interventions, Recommendations, and Potential Impact

Interventions and Recommendations



- Consumer Education and awareness:
 - This report found gaps in consumer education and awareness of smart thermostats.
 - According to industry stakeholders, the desire to align educational efforts exists
 - Opportunities to capitalize on the various sources of awareness for smart home technologies, particularly media
- Home Performance Network as Smart Thermostat Ambassadors:
 - Opportunity to partner and push home performance contractors to bring smart thermostat technology to customers
 - Contractor education is necessary first step to ensure that they understand the benefits of smart thermostats and are willing to support them
 - Through contractor outreach and training, smart thermostat could become another tool, along with air sealing, insulation, windows, and more, in the home performance upgrade package

Interventions and Recommendations Cont.

- Efficiency Program activity:
 - In addition to the other recommendations listed here, **rebates and incentives** were the most commonly cited pathway for engaging customers
 - **Bring-Your-Own-Thermostat** programs, were a popular recommendation among surveyed stakeholders, as it combines customer choice with access to utility programs
 - BYOT minimizes some of the risk of product selection before the **ENERGY STAR** Connected Thermostat specification is complete, however once that specification is final, promoting products that meet the ENERGY STAR recognition is recommended.
- Bundling and Partnerships:
 - Opportunity to **bundle** products and services together to ease customers into the market while educating and engaging them in a broader range of energy management products
 - Potential to design behavior based incentives, or “**gamification**,” to regularly engage customers with their energy usage as well as drive more sustainable behavioral changes
 - Because many smart home players are new to the efficiency space, there are opportunities to create unique partnerships to inform and drive the market, especially with less-traditional stakeholders such as the **home security** and **telecommunications providers**, who are not as focusing on the energy benefits of smart thermostats, but are a significant player in the market

Interventions and Recommendations (Cont.)

- Targeting consumers:
 - The customer survey found strong correlations on ownership of smart thermostats, particularly that urbanites and men were much more likely to own a smart thermostat than suburbanites or women
 - Armed with that information, smart thermostat education and promotion should evolve beyond blanket marketing
- Evaluation of Smart Thermostats:
 - ENERGY STAR's work is promising in terms of addressing measurement, verification, and standardization obstacles
 - NYSERDA has the opportunity, through a market transformation lens, to bring new methods for evaluation of smart thermostat savings to the fore, as outlined in NEEP's 2016 Smart Energy Home Report
 - This could have impacts for both how New York claims savings, as well as implications for the entire country's evaluation framework

Tracking Success

- Key data sources to track:
 - Sales, measured through manufacturer or retailer provided data when available, (or shipping data through ENERGY STAR once Connected Thermostats specification is final)
 - Penetration, measured through on-site evaluations, provided from retailers, customer surveys
 - Resident awareness, tracked through surveys, media hits, social media
 - Contractor awareness, tracked through surveys, inclusion in conference agendas, media

Conclusion

Concluding Thoughts

- Penetration of smart thermostats in New York between 13% and 17%
 - over 80% of New York homes do not have a smart thermostat
- Energy savings potential for both heating and increasingly for cooling in across NY is incredible
 - Potential savings of over 217 million kWh for cooling
 - 63 Million mmBtus equivalent for heating
- Many opportunity for intervention
 - target consumers, partner with contractors, build partnerships, education, engaging consumers
- Report findings can be extrapolated beyond New York



QUESTIONS?

THANK YOU!

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