Smart T-Stats, Building Science, & the Connected Home

RESNET National Conference

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ICF

ecobee

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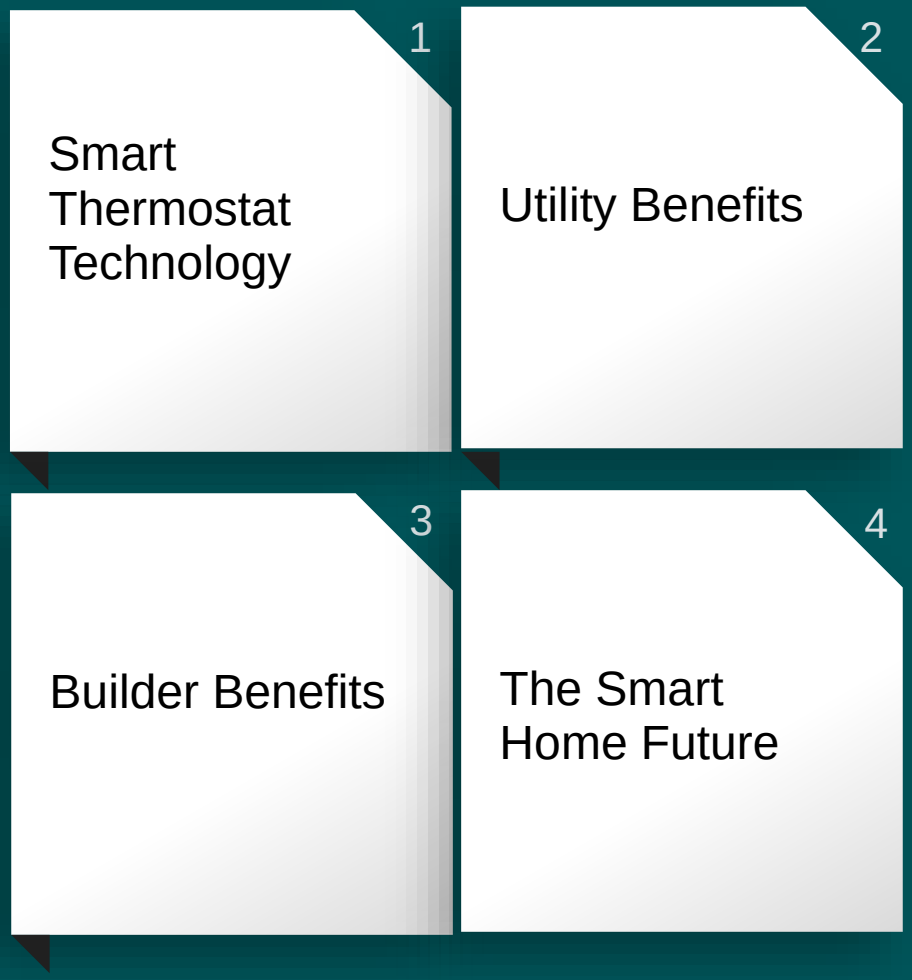
Introductions

Agenda


1
Smart Thermostat Technology
2
Utility Benefits
3
Builder Benefits
4
The Smart Home Future

1

Smart Thermostat Overview

Smart Thermostat Overview

75 Years of Progress

Smart Thermostat Overview

Programmable Thermostat

- Daily/Weekly Schedule
- Allows setbacks
- Historically not user friendly

Device Types

Smart Thermostat Overview

Programmable Communicating Thermostat (PCT)

- Programmable Thermostat with web access
- Access through computer, smart phone, or tablet
- Improved user interface
- Integrated DR or connected features

Device Types

Smart Thermostat Overview

Smart / Learning Thermostat

- PCTs that integrate additional algorithms and/or features (e.g., motion detectors, weather) that “learn” customers preferences
- Automatically make thousands of minor adjustments over the course of a year which can add up to noticeable savings without impacting comfort

Device Types

Smart Thermostat Overview

Optimization

- Cloud-based services to optimize communicating thermostats
- Often hardware agnostic
- Depends on consistent Wi-Fi connection

CONNECTED SAVINGS℠
BY WHISKERLABS

ECO FACTOR

EnergyHub™

Cloud Optimization

Thermostat Definitions

Tier	Title	Definition
Tier 1	Programmable Thermostat	Customer-programmed temperature set points schedule
Tier 2	Programmable Communicating Thermostat (PCT)	Tier 1 features, plus • Remote customer access to adjust set points • Remote utility control of set points for demand response (DR)
Tier 3	Analytics-Capable Thermostat (Smart Thermostat)	Tier 2 features, plus • Additional energy savings features through analytics • Enhanced customer engagement • Enhanced program planning and evaluation with robust customer-specific datasets

Source: Michigan Energy Measures Database (MEMD)

MEMD Definitions

ENERGY STAR® Specification

Device Requirements

- In the absence of connectivity, acts as basic thermostat
- Static temperature accuracy of ± 2˚ F
- Network standby power ≤ 3 W
- Time to standby ≤ 5 min

Product Requirements

- Users can set and maintain a schedule
- Feedback to occupants about energy impacts of their choices
- Provide users info related to their HVAC energy consumption
- Can collect data need for field savings metric calculation
- Includes basic Demand Response (DR) criteria

Field Savings*

Metric	Statistical measure	Performance Requirement
Annual % run time reduction, heating (HS)	Lower 95% confidence limit of weighted national average	≥ 8%
	20th percentile of weighted national average	≥ 4%
Annual % run time reduction, cooling (CS)	Lower 95% confidence limit of weighted national average	≥ 10%
	20th percentile of weighted national average	≥ 5%
Average resistance heat utilization for heat pump installations (RU)	National mean in 5°F outdoor temperature bins from 0 to 60°F	Reporting requirement

**Alternate path available*

2

Utility Benefits

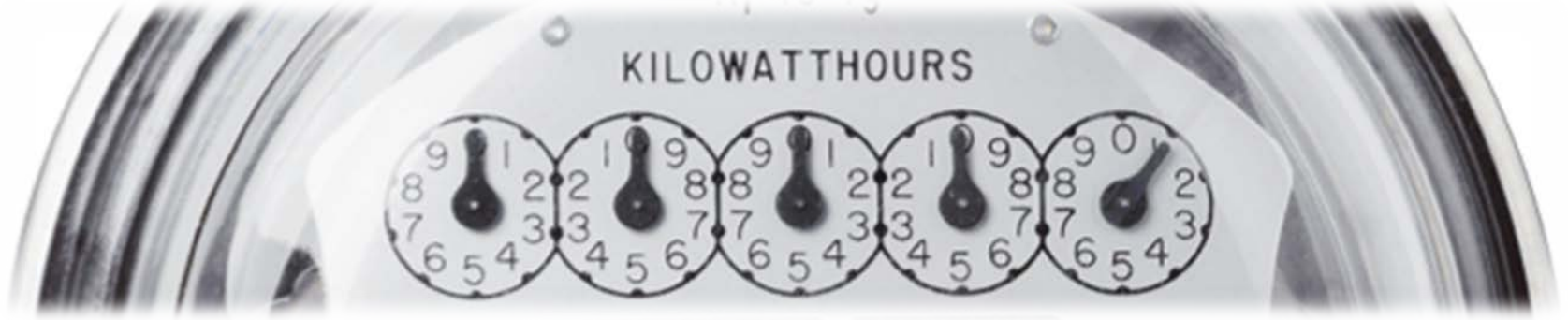
Energy Savings

	Electric Cooling Energy Savings (kWh/ft2)	Electric ER HeatingEnergy Savings (kWh/ft2)	Electric HP Heating Energy Savings (kWh/ft2)	Gas Heating Energy Savings (therms/ft2)
Deemed Savings	**0.287**	**0.81**	**0.289**	**0.035**
1,500 ft2 Home	430.5	1215	433.5	52.5
2,000 ft2 Home	574	1620	578	70
2,500 ft2 Home	717.5	2025	722.5	87.5
3,000 ft2 Home	861	2430	867	105
3,500 ft2 Home	1004.5	2835	1011.5	122.5

Arkansas TRM v5

National Landscape

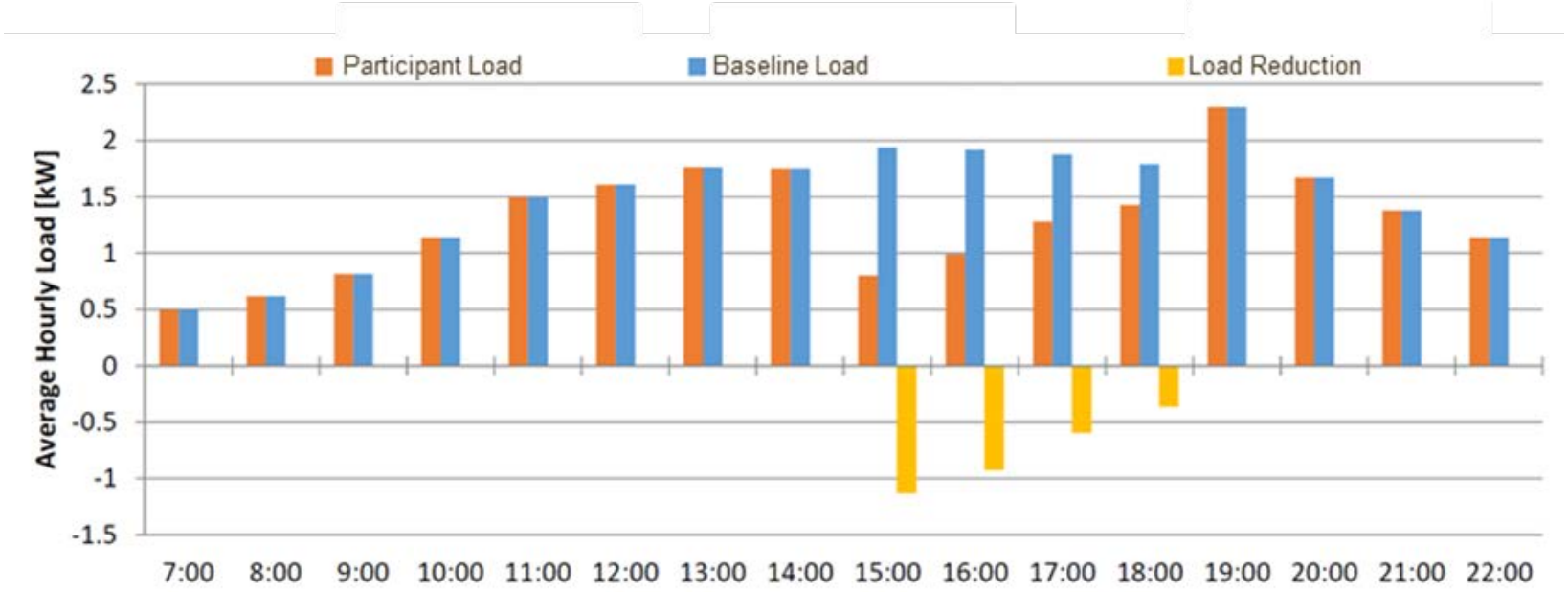
- Savings assumptions are listed in 10 TRMs
- Annual savings range from 104 kWh to 462 kWh
- Peak demand savings range from .126 kW to .438 kW
- Incremental measure costs range from $139 - $250
- Average rebates at $100



Energy Savings

Demand Response

- Smart Thermostats offer a unique opportunity to combine energy efficiency and demand response



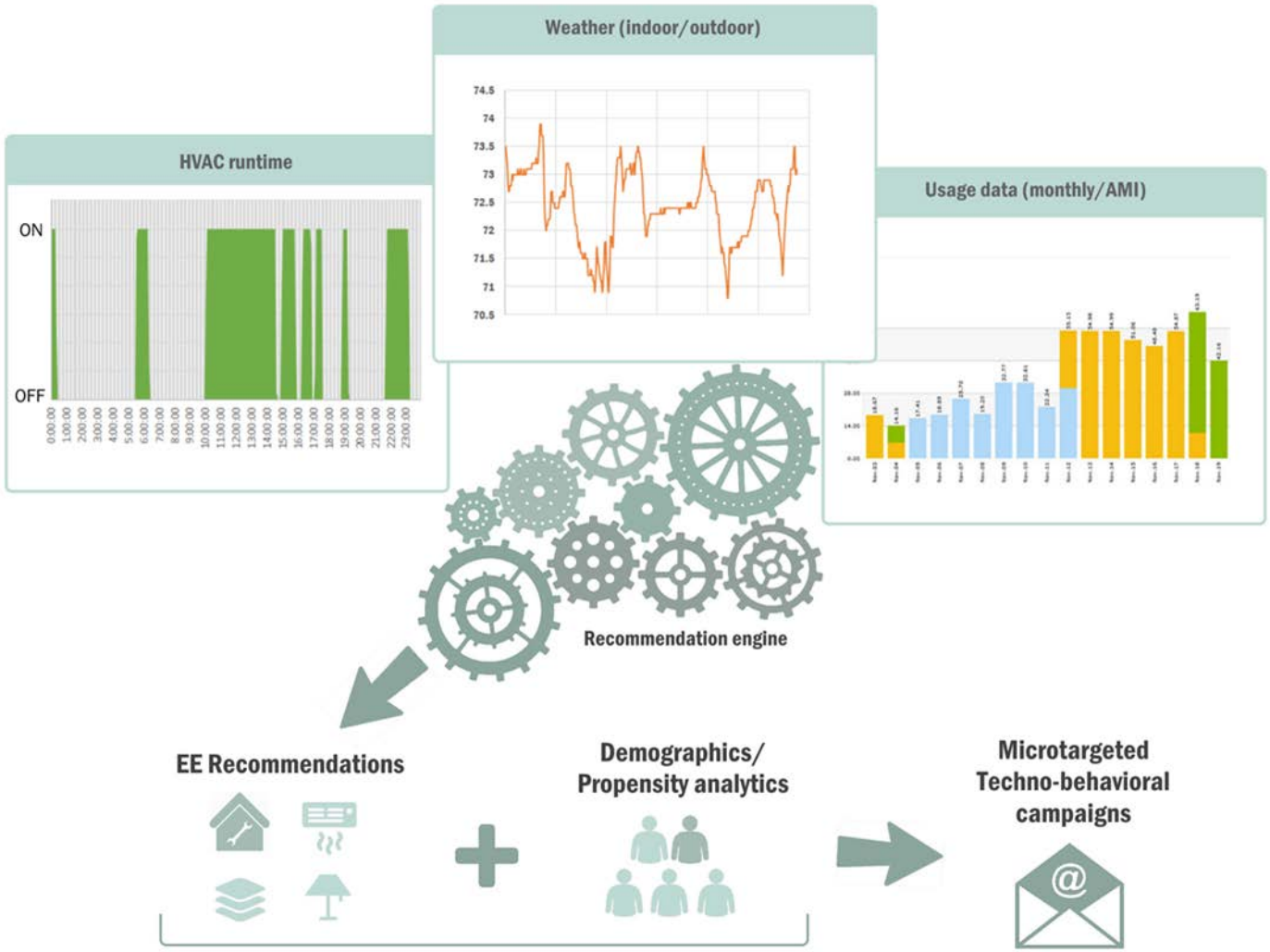
Demand Response

Demand Response

- 2-way communication rethinks the traditional DR approach

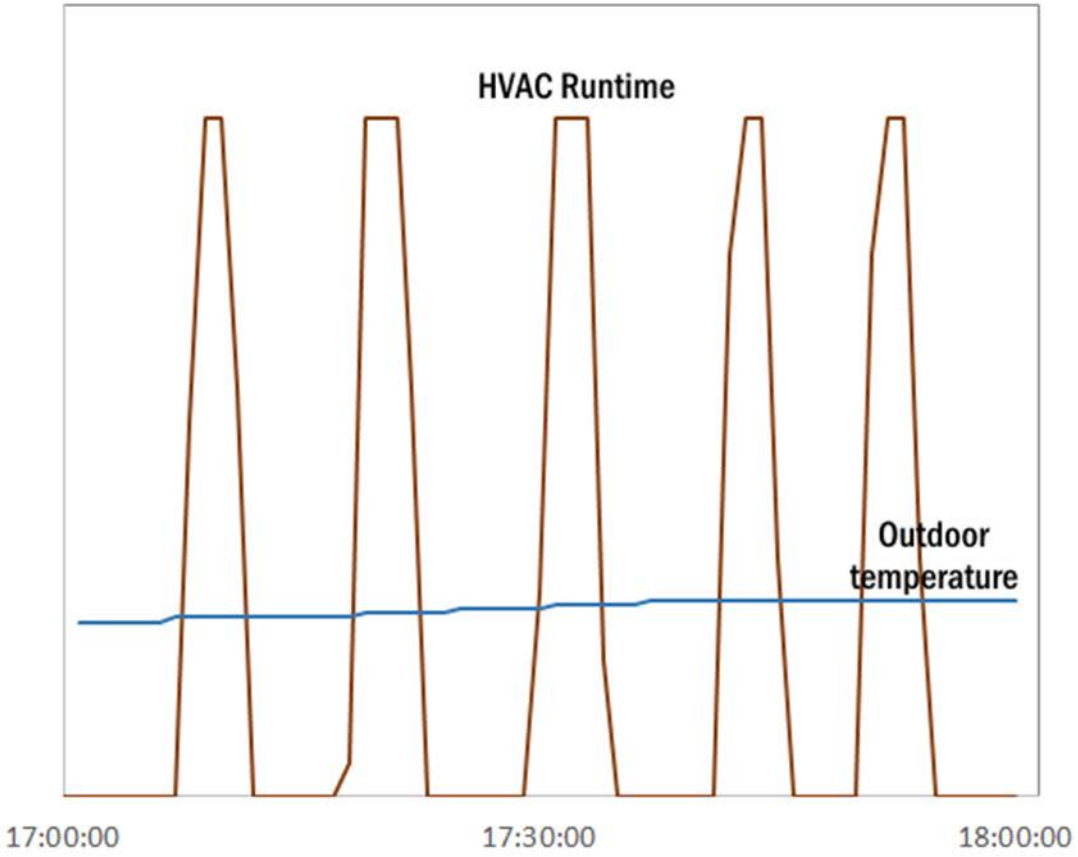
2-Way Communications

Data Driven Analytics



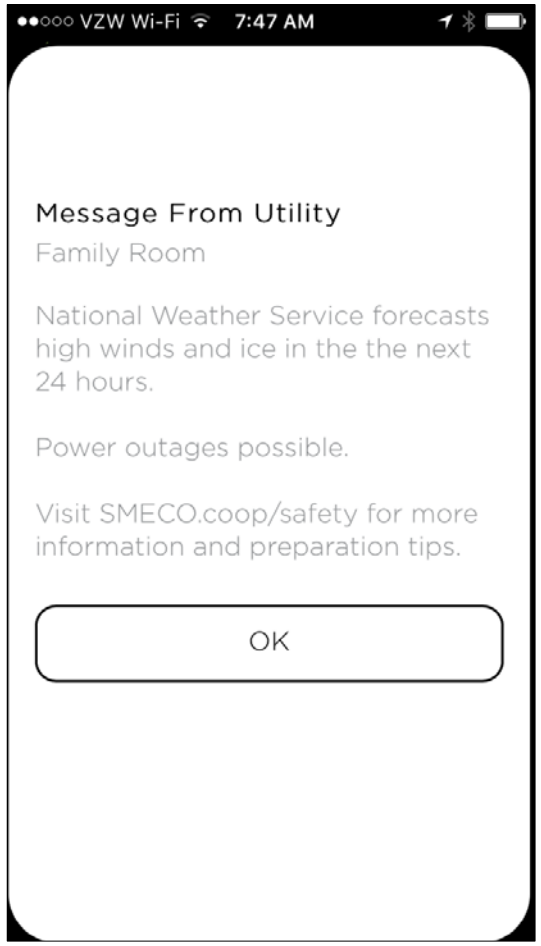
Beyond kWh

HVAC Monitoring



Data Analysis

Customer Engagement



Branded Communications

Customer Surveys

Please rate the importance of the following statements on why you applied for the pilot:

(Not Important / Somewhat Important / Neutral / Important / Very Important)

- I like to be the first to try new technology: 35% Important
- I want to control my thermostat via smart phone: 59% Very Important
- The thermostat will help me save energy: 76% Very Important
- The thermostat will improve my home's comfort: 49% Very Important

SMECO Pilot Applicants

Customer Surveys

Have you noticed any changes in comfort after the thermostat has been installed?

- Yes, my home is more comfortable: 47.24%
- No, my home is less comfortable: 6.30 %
- I didn’t notice a difference: 46.46%

Comfort

Customer Surveys

The use of thermostat notifications for energy efficiency opportunities is:

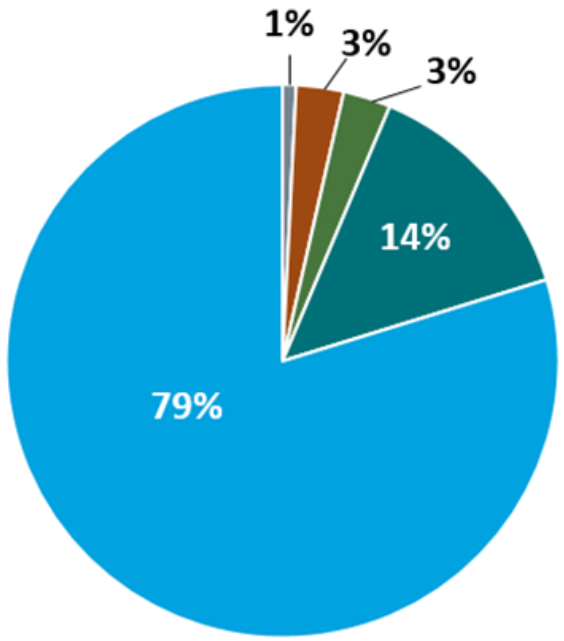
- Informative: 78%
- Intrusive: 8%
- Convenient: 58%
- Timely: 22%

Would thermostats be a good method of communication for emergency event notifications such as power outages or severe weather potential?

- Yes: 91%
- No: 9%

Messaging

Customer Surveys



- Very Satisfied
- Somewhat Satisfied
- Neither Satisfied or Dissatisfied
- Somewhat Dissatisfied
- Not at All Satisfied

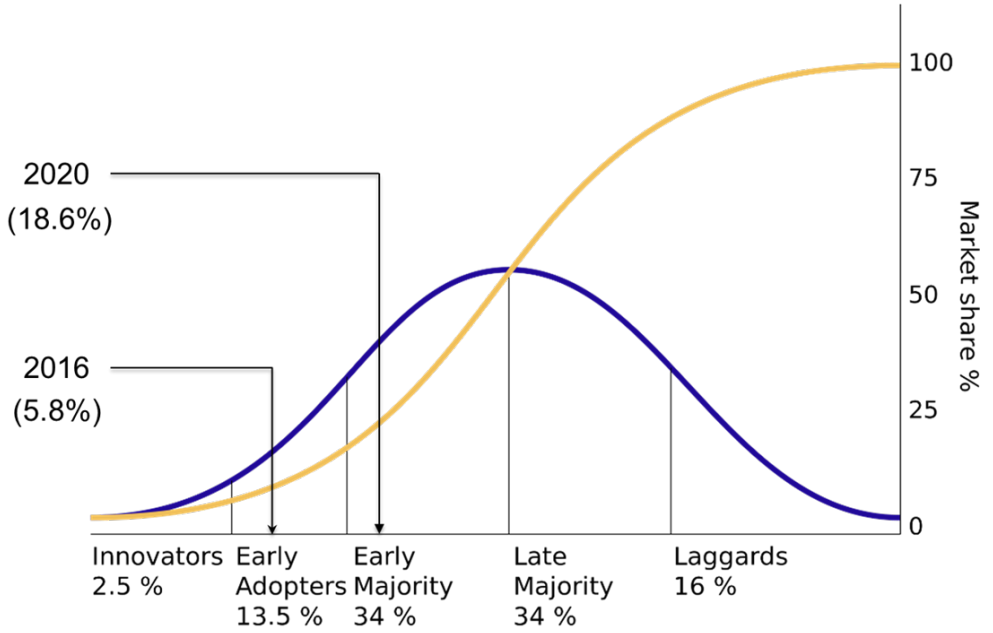
Smart T-Stat Feature	% Used
Used custom schedule for energy savings	86%
Used “Home” / “Away” sensors	65%
Controlled the T-stat with phone	85%
Used “Vacation” mode	27%
Configured advanced settings for deeper savings	45%

Overall Satisfaction

3

Builder Benefits

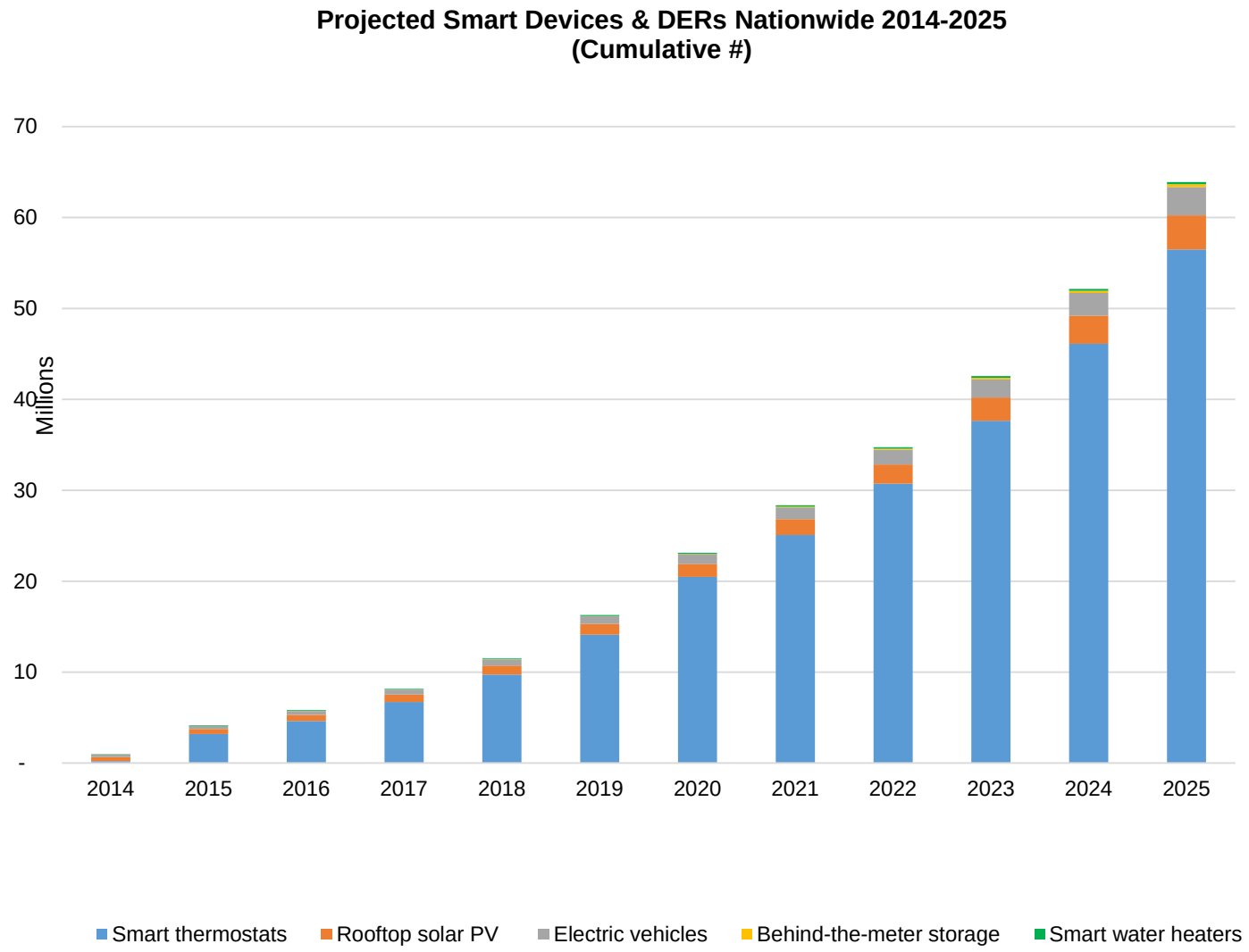
Are Customers Ready?



Source: Statisica

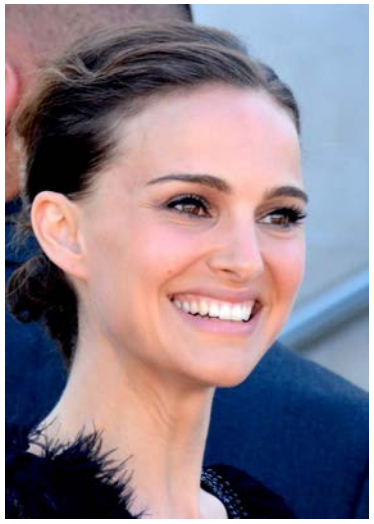
Diffusion of Innovation Theory

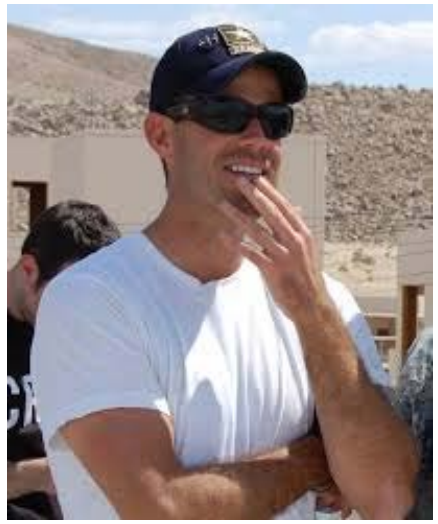
Are Customers Ready?



Rapid Growth

Do you know the difference?





Connected vs Smart

Energy Savings

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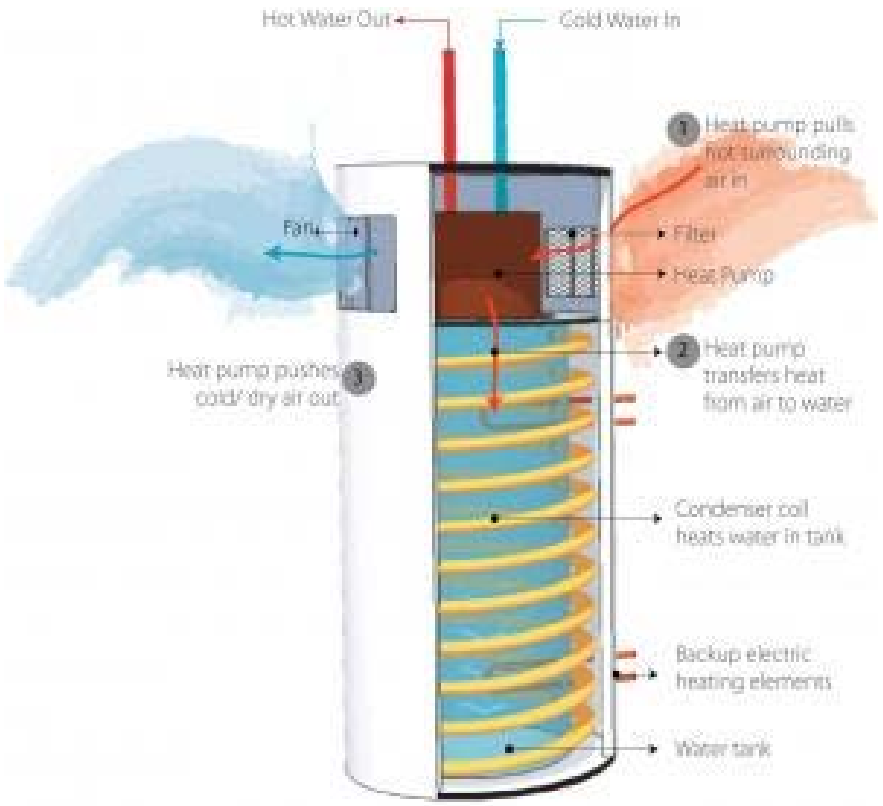
Arkansas TRM v5

Potential HERS Impacts

House Type	Sq. ft.	Heating/Cooling Type	Construction Standard	Original HERS	Modified HERS	Potential HERS Impact
Townhome	1,000	Heat Pump	2015 IECC	80	76	-4
Townhome	1,000	Gas Furnace/AC	2015 IECC	80	75	-5
Townhome	1,000	Heat Pump	EStar v3.1	64	60	-4
Townhome	1,000	Gas Furnace/AC	EStar v3.1	61	less than 58	-3
Single Family	1,500	Heat Pump	2015 IECC	80	74	-6
Single Family	1,500	Gas Furnace/AC	2015 IECC	80	72	-8
Single Family	1,500	Heat Pump	EStar v3.1	64	59	-5
Single Family	1,500	Gas Furnace/AC	EStar v3.1	61	less than 57	-4
Single Family	2,000	Heat Pump	2015 IECC	80	73	-7
Single Family	2,000	Gas Furnace/AC	2015 IECC	80	69	-11
Single Family	2,000	Heat Pump	EStar v3.1	64	57	-7
Single Family	2,000	Gas Furnace/AC	EStar v3.1	61	less that 55	-6
Single Family	3,000	Heat Pump	2015 IECC	80	less than 69	-11
Single Family	3,000	Gas Furnace/AC	2015 IECC	80	65	-15
Single Family	3,000	Heat Pump	EStar v3.1	64	less than 55	-9
Single Family	3,000	Gas Furnace/AC	EStar v3.1	61	less than 54	-7

Energy Savings

4 – 7 HERS Index Points



Source: Building America Solution Center

- $800-$1500 upgrade cost from standard DHW
- Requires additional plumbing (condensate drain)
- Some customer concern over noise/temperature offset

HPWH

4 – 7 HERS Index Points

- $900-$1200 upgrade cost from 14 Seer to 18 Seer AC

Upgraded HVAC

4 – 7 HERS Index Points

Source: Building America Solution Center

- $800-$2000 additional cost
- Often requires re-design

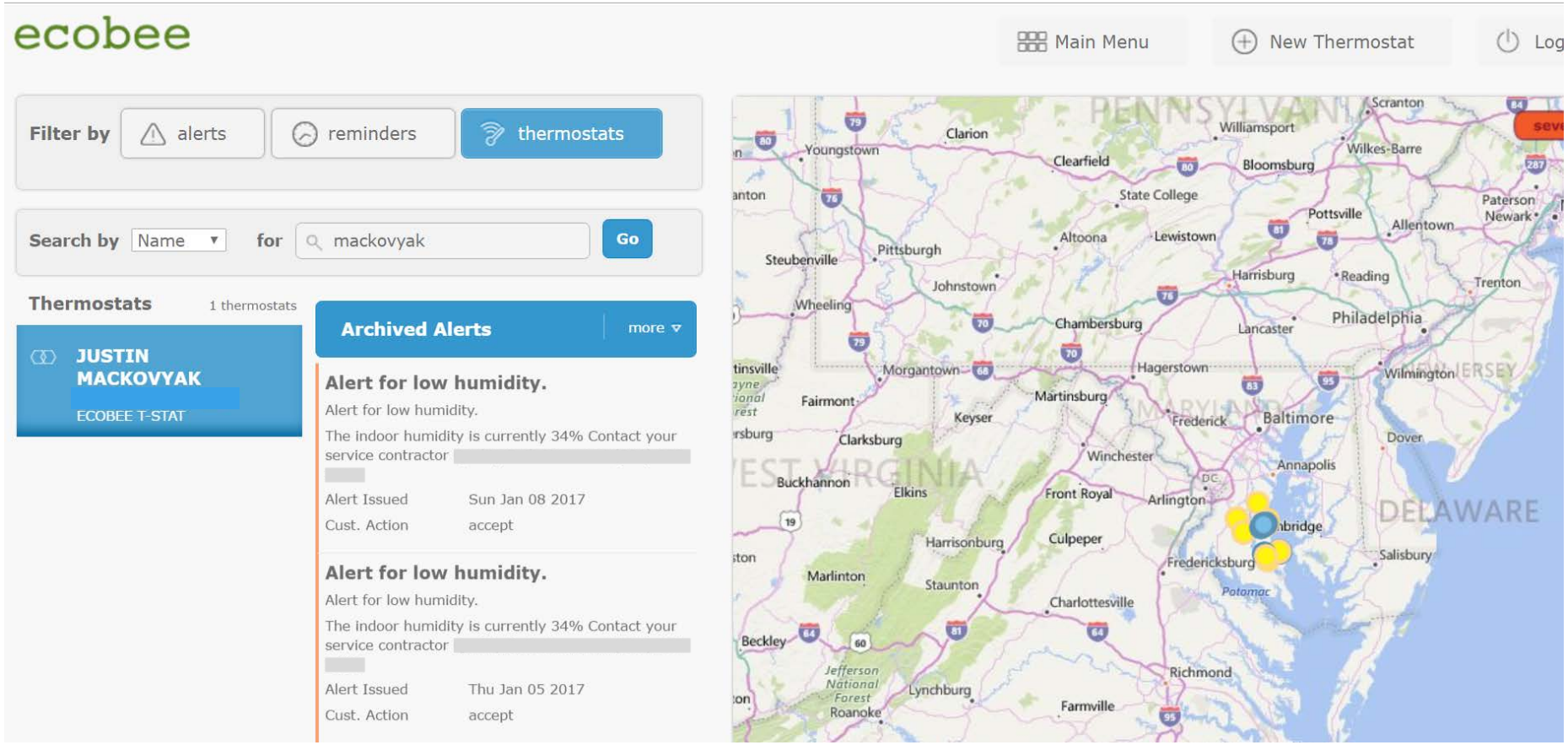
Ducts in Conditioned Space

What should be 4 – 7 HERS Index Points….

- $169-$249 additional cost
- Immediate differentiator from used homes
- Entry point into smart home technology

Smart Thermostat

HVAC Monitoring



HVAC Monitoring

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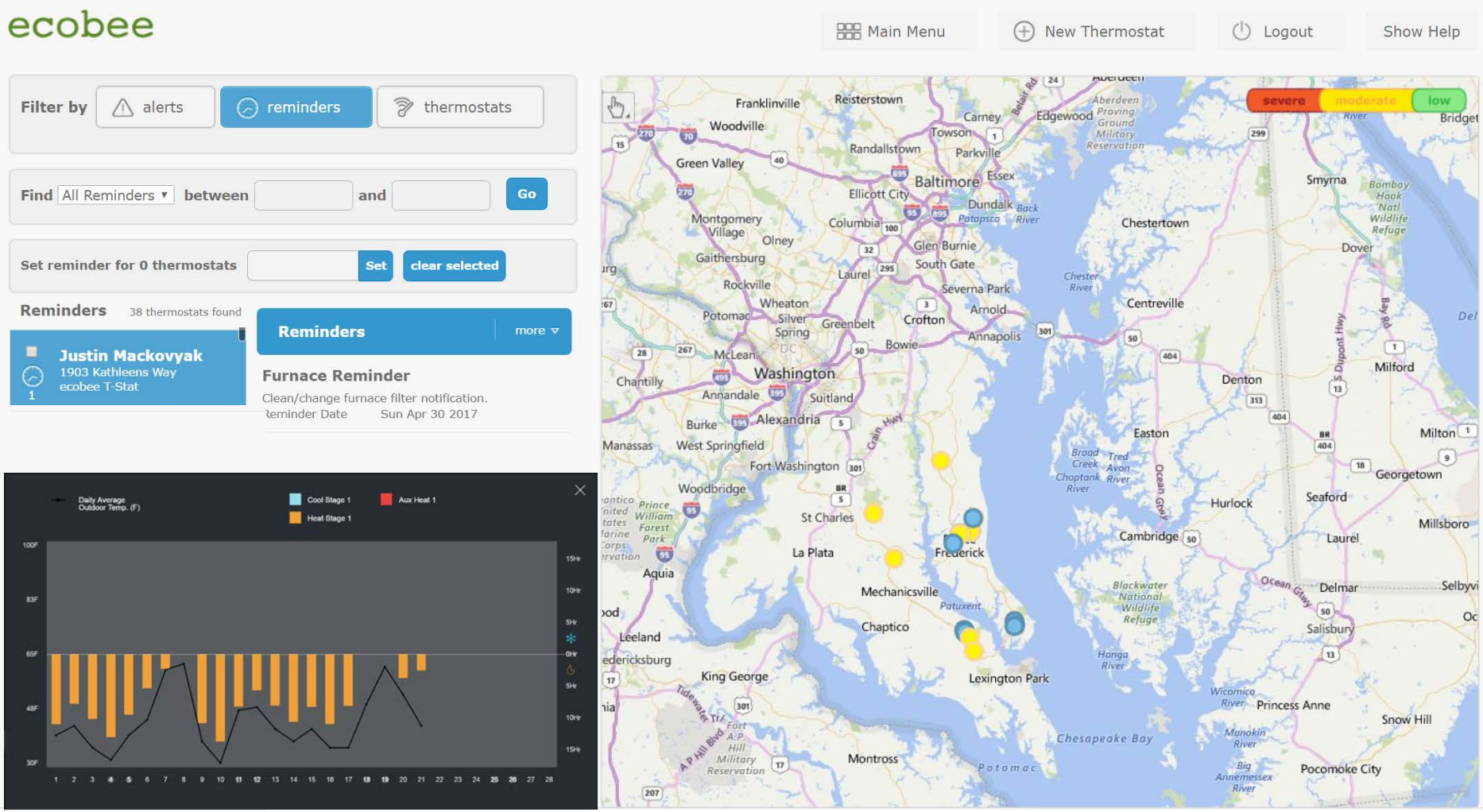
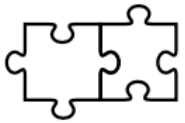


HVAC Monitoring

Key Benefits for builders

1. Enhanced Energy Savings for Homeowners

- Smart thermostats deliver between 13-23% energy savings over standard programmable thermostat
- Smart thermostats can enhance energy saving technology in new homes (high efficiency HVAC, System Monitoring, etc.)



2. Reaching your target buyer

- Millennials are now the largest in the workforce[1]
- 4 in10 Millennials have identify being interested in smart home products and that number is growing[2]
- Biggest barrier to adoption includes navigating the infant connected home space
- Builders have the opportunity to add greater value to the buyer and an important role in helping them navigate the connected home space, which can be a key point of difference vs their competition

3. Utility alignment

- Utilities across NA are investing to drive adoption of smart thermostat technology
- Rebate programs in many regions creates strong incentive for builders and homeowner to install
- Increased focus on energy savings and Demand Response programs is going to increase requirement for smart thermostats

1. "Millennials Now Largest Generation in the U.S. Workforce", Time – May 11, 2015
2. NPD- June 23, 2015

Recap

Food for thought…

- Energy Efficiency saw its peak in the new construction industry occur in 2012, highest market penetration over 40% of homes nationally.
- No national downturn in housing since that time.
- HERS Rating and the associated efficiency improvements above code cost $1,000 per house.
- Smart Homes cost $500 and dropping.
- Energy efficiency hasn’t produced the differentiation from marketing purposes.
- Easier to teach sales reps to control home from iPad

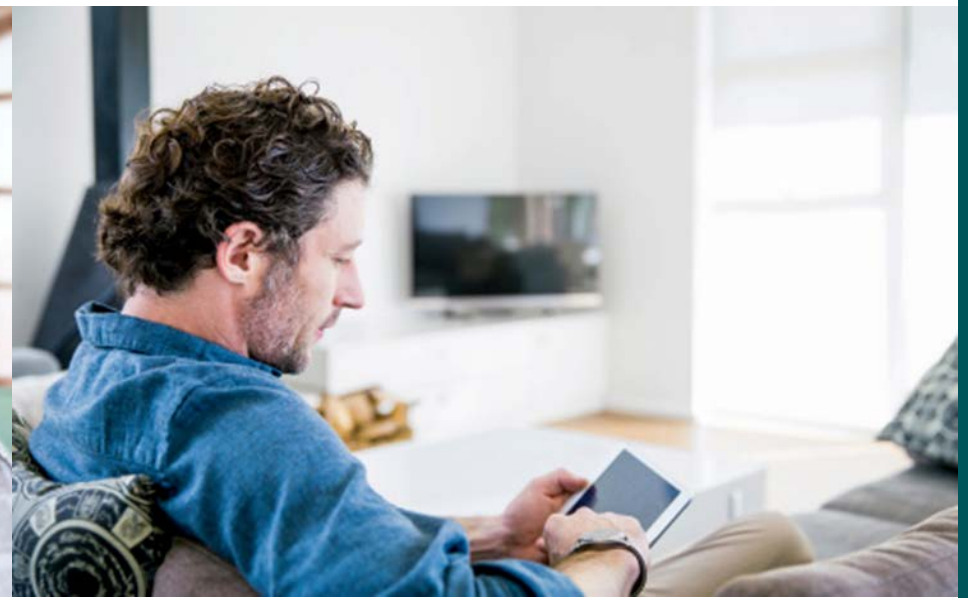
Weak Signals in the Market

5

Smart Home

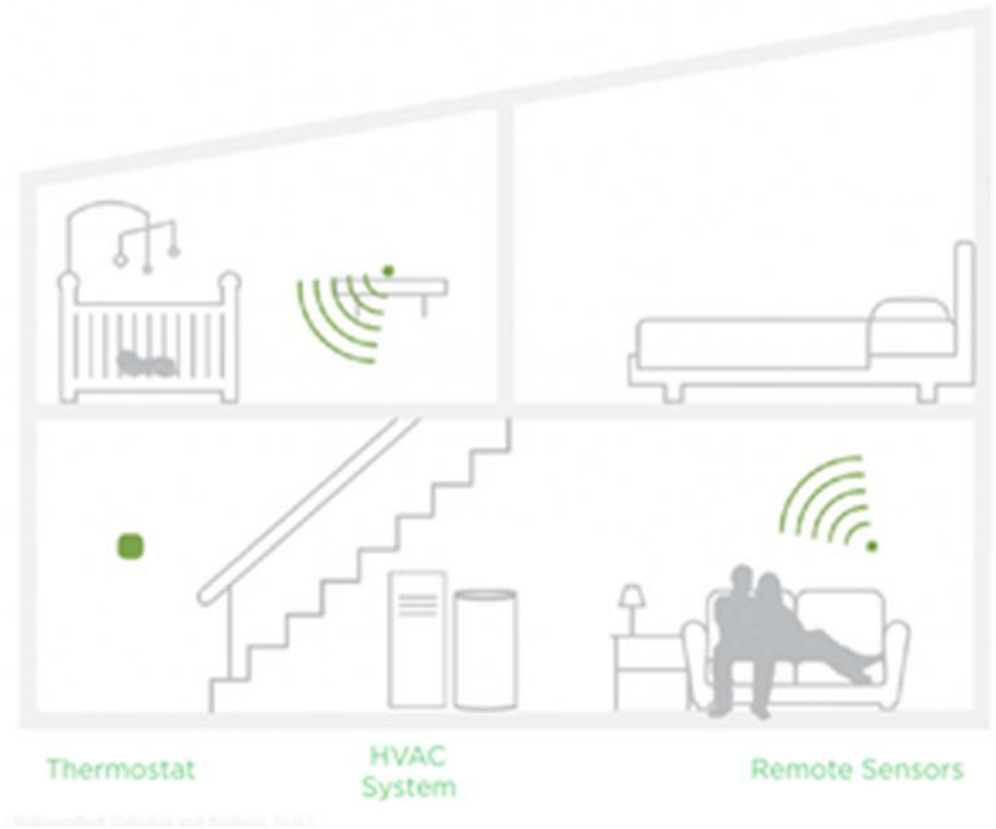
What do they want?

- Comfort
- Convenience
- Savings



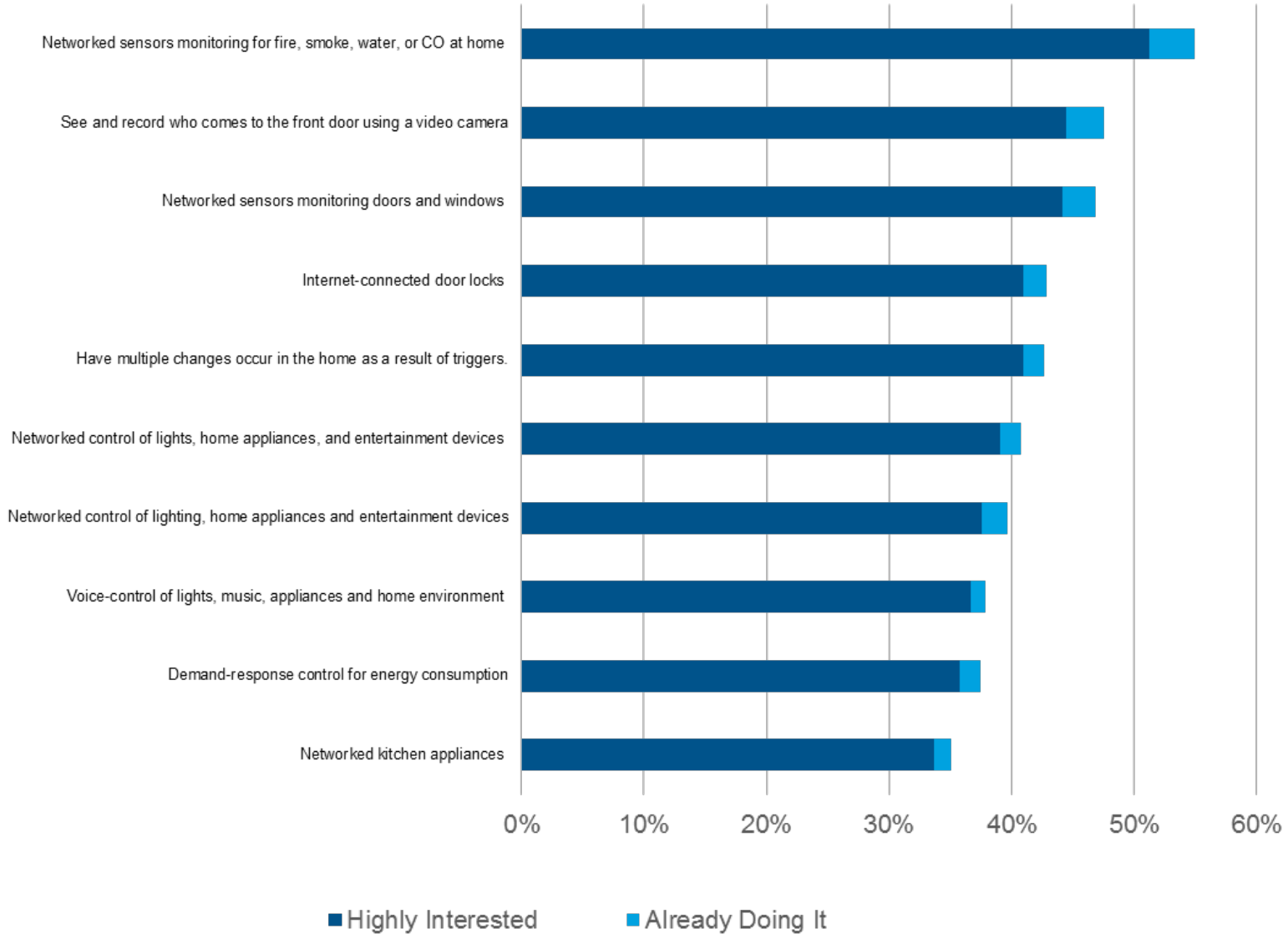
Our Customers

How it looks today …



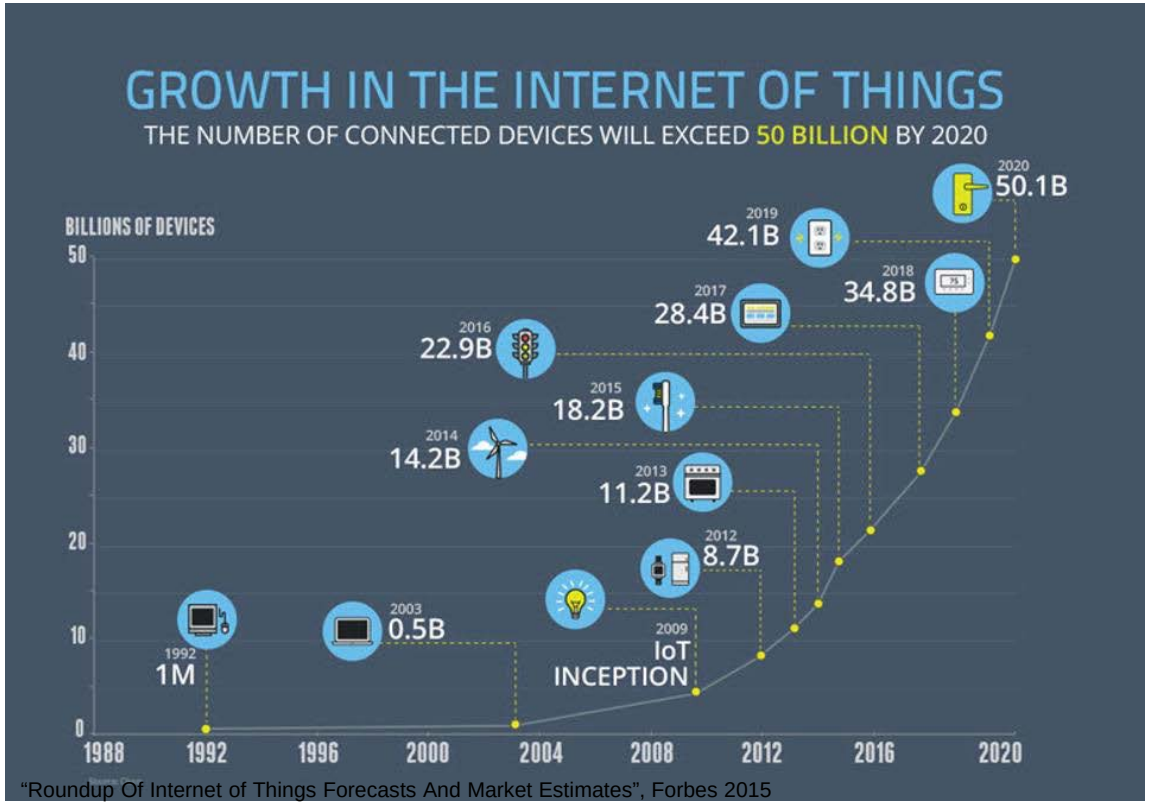
The Connected Home

Smart Home Automation and Control Applications



What are Customer's telling us …

Smart Thermostats - IoT Movement – Connected Home They are ALL related …



"Roundup Of Internet of Things Forecasts And Market Estimates", Forbes 2015

- Current estimates have IoT adoption between 30-50 billion units by 2020
- This represents approx. $6 Trillion in spending over the next 5 years
- Every category of products is likely to be effected
- Space is still young and consumers need help to navigate which is a collective opportunity for all of us … great curated, customer experiences …

What is the media telling us …

Smart/Connected Home

- NAHB research shows that smart home technology including heating/cooling, lighting, appliance control and voice are likely will be common place within a decade.
- 70% of consumers surveyed identified as using at least one form of smart technology today and would like to see more in their next home purchase.
- Builders who can integrate and help consumers navigate this technology will differentiate themselves.
- Security and energy will be the most important to consumers followed closely by entertainment.

What are Industry Assoc's telling us ….

What does a smart home entail?


Amazon Echo Dot


Google Nest


Lyric Thermo


EcoBee Thermo


Honeywell Thermo


Aeotec Siren


Heavy Duty Switch


WeMo Outlet


Aeon Labs Outlet


Aeotec MultiSensor


Glass Break


Aeotec Recessed Door


Aeotec Contact


GE Switch


Kwickset Lock


Yale Lock


Samsung Cam


D-Link Camera


Baby Cam


Remote Controls

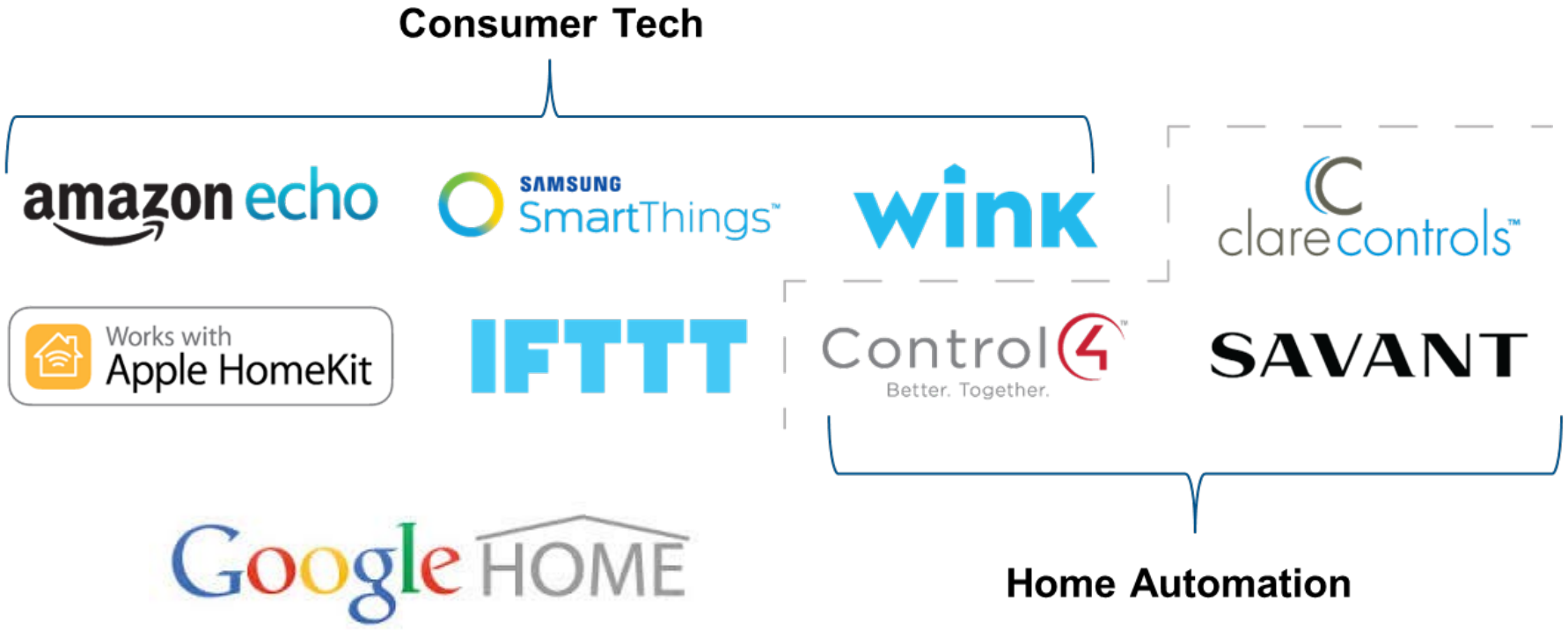

GE Pool Pump

Numerous Connected Devices

What is needed …

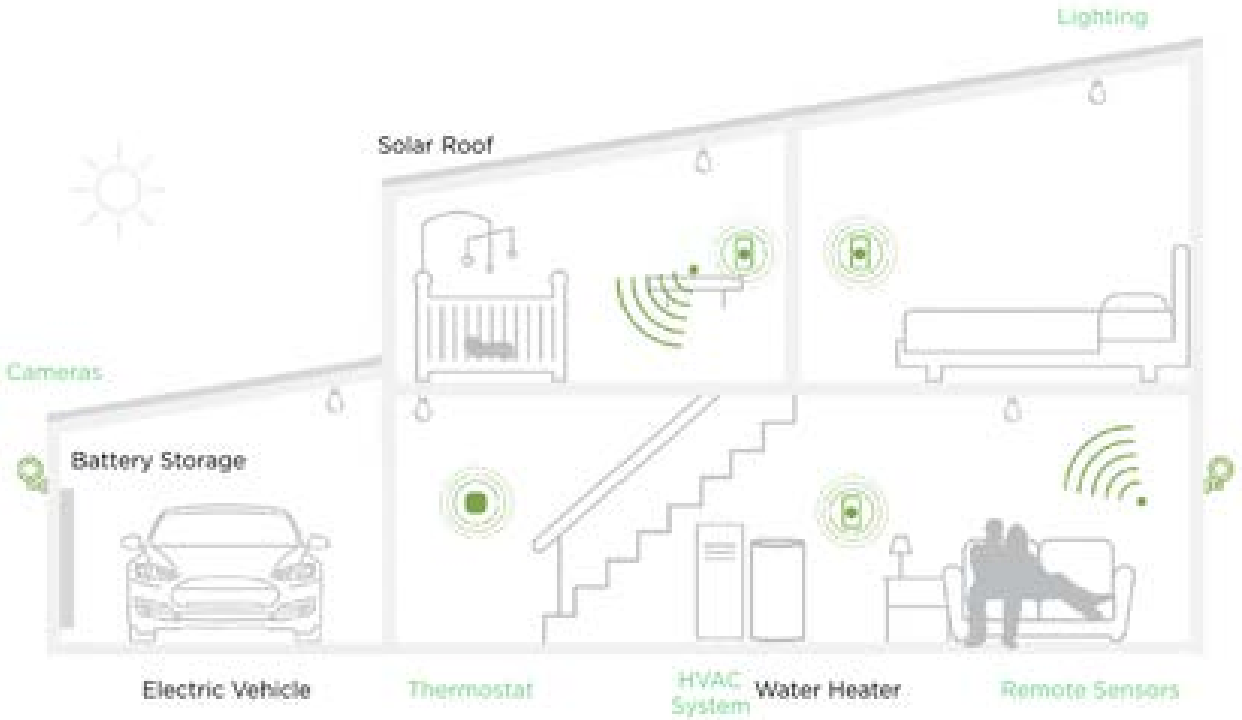
Open Integration

- Open API's allow consumers and builders to mix/match smart technologies but control through single hub.

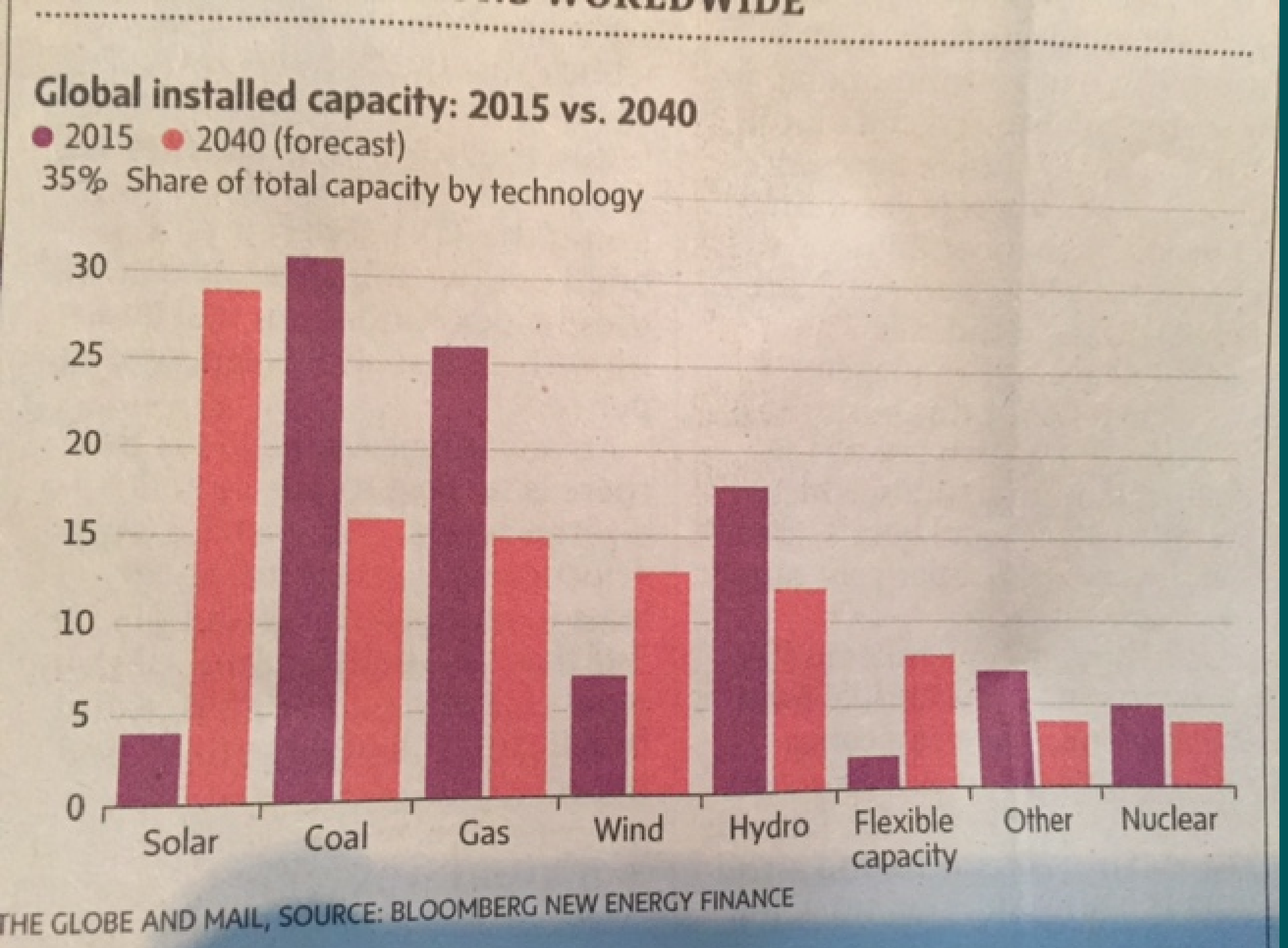


Choose your platform…

How it will look tomorrow …



The Connected Home



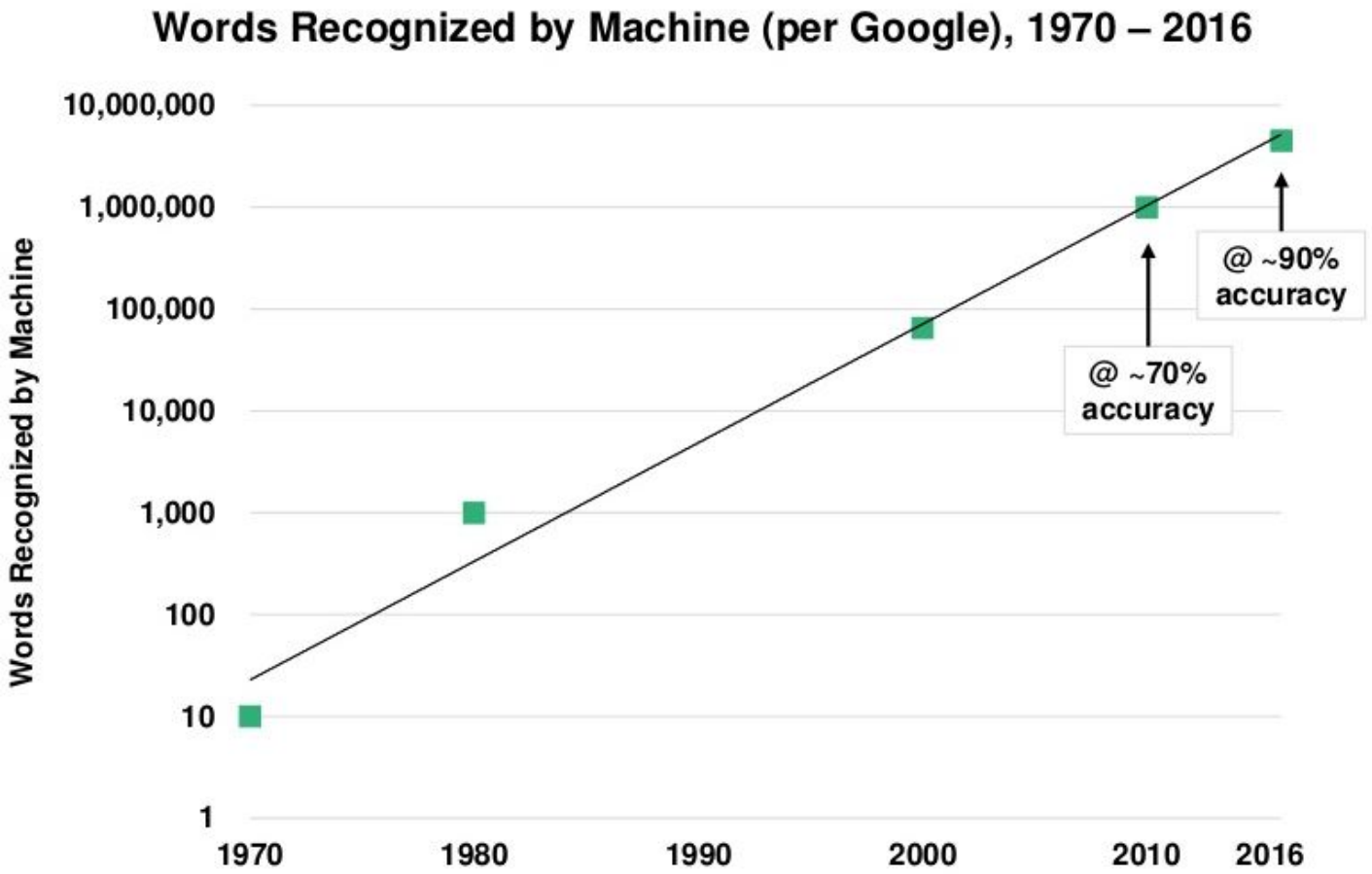
Quick deviation … Solar

Voice…

- **It’s Fast**
  - Humans can speak 150 words per minute vs. typing 40 words per minute
- **It’s Easy**
  - Just speak … removed the smart phone
- **It’s Context Aware**
  - Ability to understand a wide context of questions base on prior questions/interactions/ location/other semantics

What is here and now?

Natural Language Understand (NLU) has become highly accurate



NLU

Voice is not a fringe technology

- Amazon, the leader in voice, is estimate to have 11 million Echo devices since 2014
- Current estimates have voice technology under it’s Alexa platform delivering $11-12 billion in revenue (ecommerce + device sales) by 2020
- Google made a splash at the end of 2016 with the introduction of Google Home, leading many hailing the start to the “voice arms race”
- All major tech companies including Apple, Microsoft, and Facebook are investing in voice

Voice Adoption

Great Customer Experience…

This is what we all need to deliver

Smart Home Value

Customer Benefits

- Integrated Experience (Entertainment, Security, Convenience)
- Advanced Controls
- Enhanced Comfort
- Energy Management

Builder Benefits

- Growing market interest
- Additional revenue generation opportunities
- Utility support

Utility Benefits

- Energy Savings through Automation/Optimization
- Demand Response beyond HVAC
- Enhanced customer engagement

Key Benefits

Model approach for Smart Home integration

1. **Plan smart technology before breaking ground**
   - Plan technology around your target customer
   - Talk to your utility
   - Wire where necessary, wireless where possible

2. **Create a basic package**
   - You wouldn’t buy a car today that doesn’t have Bluetooth or a backup camera so why would you buy a home without basic smart technology?
   - A minimum package will soon be an expectation of the future buyer

3. **Give consumers opportunity to upgrade and customize**
   - Don’t lock consumers into one brand of technology
   - Leverage the power of API’s
   - Give consumers upgrade options to fit their needs, they’ll pay for them

Where to start

Questions