# The Smart Energy Home: Driving Residential Building Decarbonization

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Northeast Energy Efficiency Partnerships (NEEP)
Public Webinar 3/20/2019

# Opening Scene

# Agenda & Logistics

- Welcome
- Background on Smart Energy Home Initiative
- New Report!
- Context Setting—the “Collective Vision”
- Policy Considerations of Note
- Common Barriers and Opportunities
- Strategies Moving Forward
- Conclusion and Q&A

- Logistics:
  - All lines will remain muted
  - Type in questions at any time, but will be reviewed at the end of webinar as time allows
  - Presentation is being recorded. Slides and recording will be posted online and sent out to registrants tomorrow

# Thank you for joining today! Who are you? Polls

# Who are we?
# Northeast Energy Efficiency Partnerships (NEEP)

*"Assist the Northeast and Mid-Atlantic region to reduce building sector energy consumption 3% per year and carbon emissions 40% by 2030 (relative to 2001)"*

## Mission

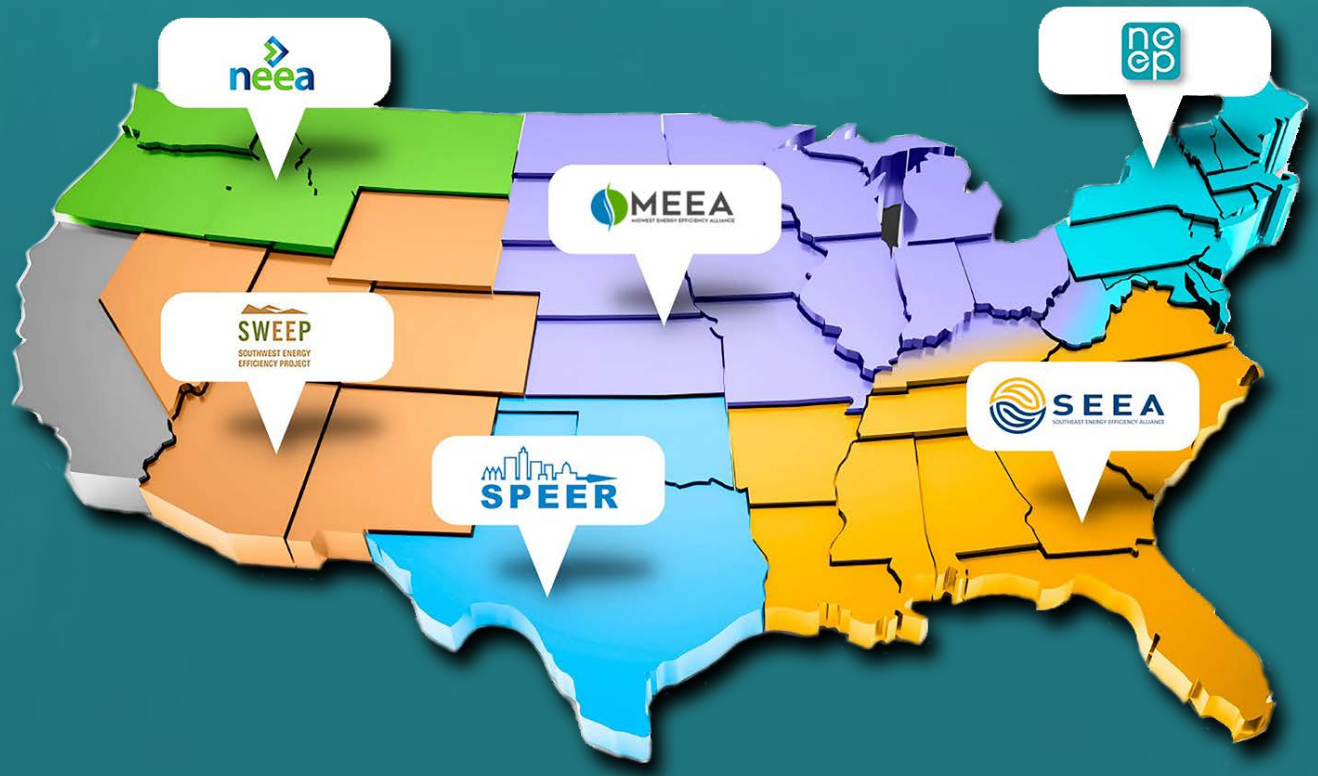
We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

## Vision

We envision the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play.

## Approach

Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge




**One of six REEOs funded in-part by U.S. DOE to support state and local efficiency policies and programs.**

# It's in the name! Couldn't be done without *partnerships*!
# Thank you to our Smart Energy Homes Initiative Supporters!

Foundations:

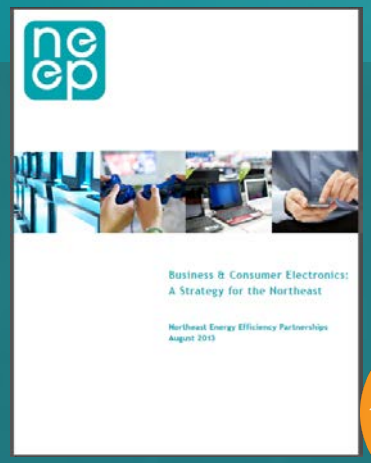
States:

Allies:

E4 THE FUTURE
ENERGY FOUNDATION
MERCK FAMILY FUND
Protecting the Natural Environment.
Strengthening the Urban Community.
Johnson Controls
PowerTakeOff
American Efficient
WECC
ALLIANCE TO SAVE ENERGY
Using less. Doing more.
NMR Group, Inc.
EZ GREEN HOME
EPRI
ELECTRIC POWER RESEARCH INSTITUTE
FRANKLIN ENERGY
seventhwave
WHISKERLABS
Panasonic
Ingersoll Rand
Inspiring Progress
LG
Life's Good
E4 THE FUTURE
PERFORMANCE SYSTEMS DEVELOPMENT
Synapse
Energy Economics, Inc.
ecobee
e1
EFFICIENCY ONE
WEST VIRGINIA OFFICE OF ENERGY
CascadeEnergy
The Edison Foundation
INSTITUTE for ELECTRIC INNOVATION
CADMUS
abode
energy management
CONNECTICUT ENERGY ENVIRONMENT
ers
energy & resource solutions
nest
FUJITSU
NEW YORK STATE OF OPPORTUNITY.
NYSERDA
Sponsored
bidgely
sagewell
Opinion Dynamics
DAIKIN
MITSUBISHI ELECTRIC
COOLING & HEATING
ENERGY SOLUTIONS
CABA
Continental Automated Buildings Association
NAIMA
KEEA
KEYSTONE ENERGY EFFICIENCY ALLIANCE
Life Is On
Schneider Electric
Thermostat Recycling CORPORATION
efi
ACEEE
American Council for an Energy-Efficient Economy
CLEAResult
EMC
Electric Market Correction
Home Performance Coalition

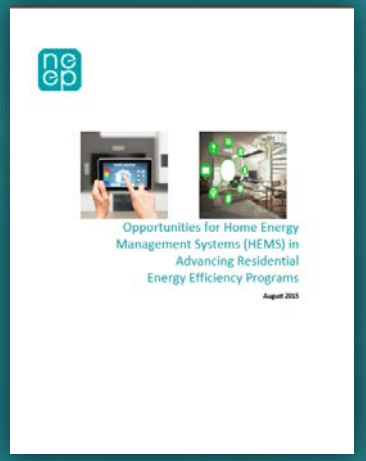
# Background on Smart Energy Home Initiative

# NEEP's background in the Smart Energy Home



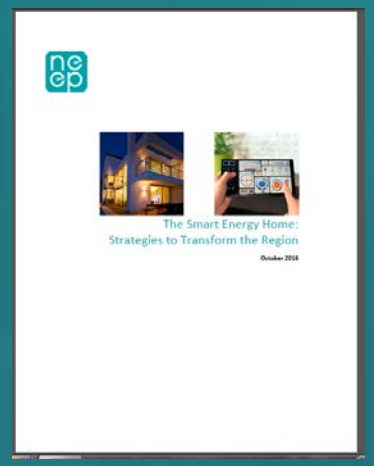

2013

2014




Product List

2015




2016

Briefs and Trainings:

- Claiming Savings from Smart Thermostats: Guidance Document,
- The Smart Energy Home and Cross-Promotional Opportunities in Energy Efficiency,
- The Smart Home Interface: A Tool for Comprehensive Residential Energy Efficiency
- The Contractors Guide to the Smart Home

2017


The Smart Energy Home: Driving Residential Building Decarbonization

2018

2019

# 2019 NEEP Smart Energy Homes Initiative


- Full project brief here
- Initiative Mission:
  - *Enabling residential decarbonization by transforming homes to be efficient and flexible grid assets.*
- Long Term Market Transformation Goals:
  - 2022: Virtually all smart products are DER-ready and can work as part of an integrated Smart Energy Home system.
  - 2030:
    - 50% of Northeast homes are “energy smart” (i.e., have at least two “energy smart” systems - HVAC, water heating, plug loads/appliances).
    - 30% of existing homes and buildings are benchmarked and retrofitted to reduce carbon emissions 50%.
- Look out for this year:
  - Home Energy Management Systems Working Group
  - Driving Decarbonization webinar series

# New Report!

# It’s here!!


- Available from
  - https://neep.org/smart-energy-home-driving-residential-decarbonization
  - Thank you to our reviewers and contributors!!

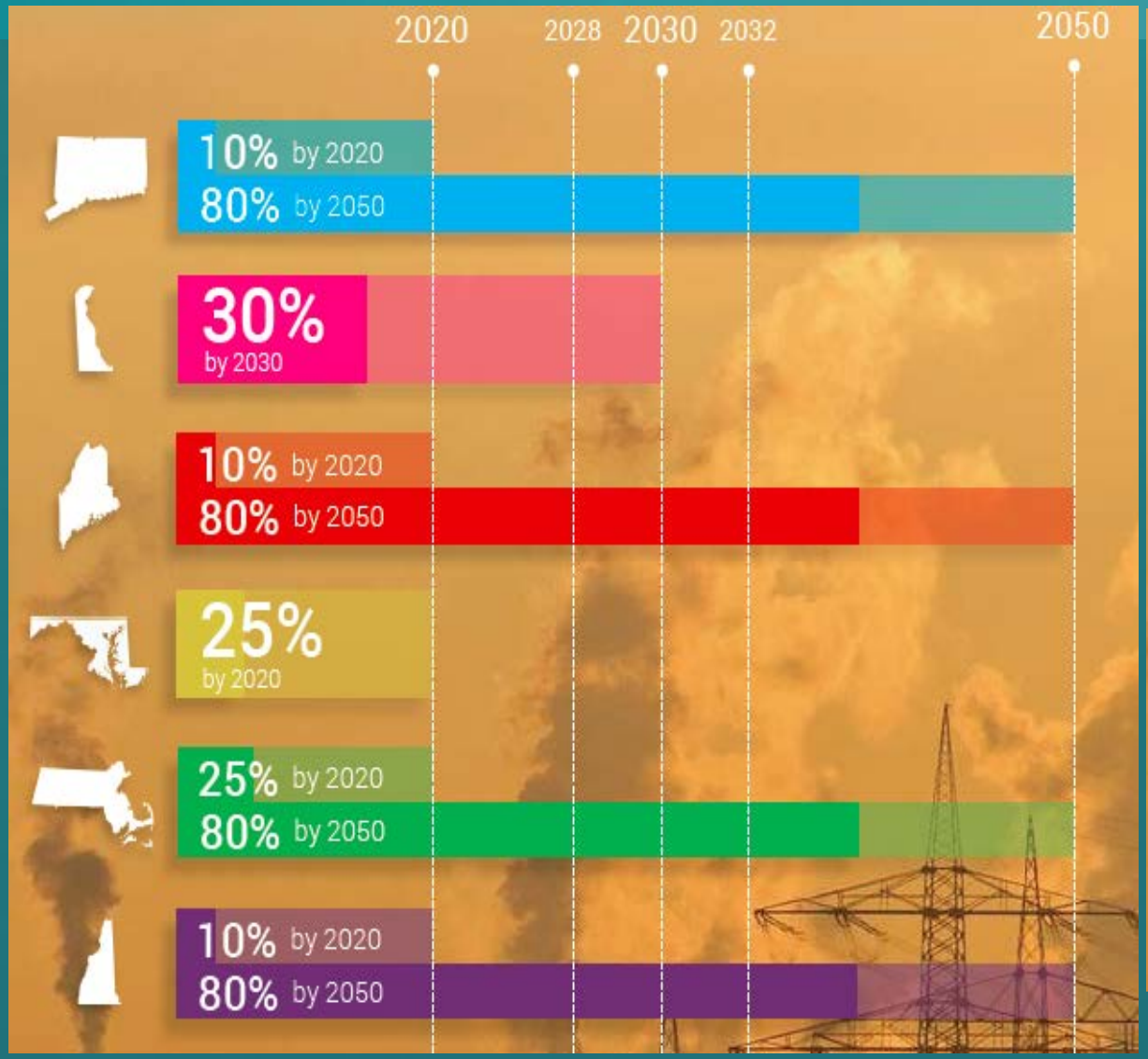
- NEEP Staff
- Harsh Engineer
- ACEEE
- Cadmus
- CLEAResult
- Con Edison
- CT DEEP
- Daikin
- E Source
- Ecobee
- Efficiency Vermont
- Embertec
- Energy Futures Group
- Eversource
- Franklin Energy
- Fraunhofer
- Fujitsu
- Home Performance Coalition
- ICF
- LG
- Lockheed Martin Energy
- MEEA
- National Grid
- NREL
- NRDC
- NH PUC
- NYSERDA
- Optimal Energy
- Pacific Gas and Electric
- Panasonic
- Performance Systems Development
- United Illuminating
- U.S. DOE
- U.S. EPA
- WattTime
- WECC (now Slipstream)
- Xergy Consulting.

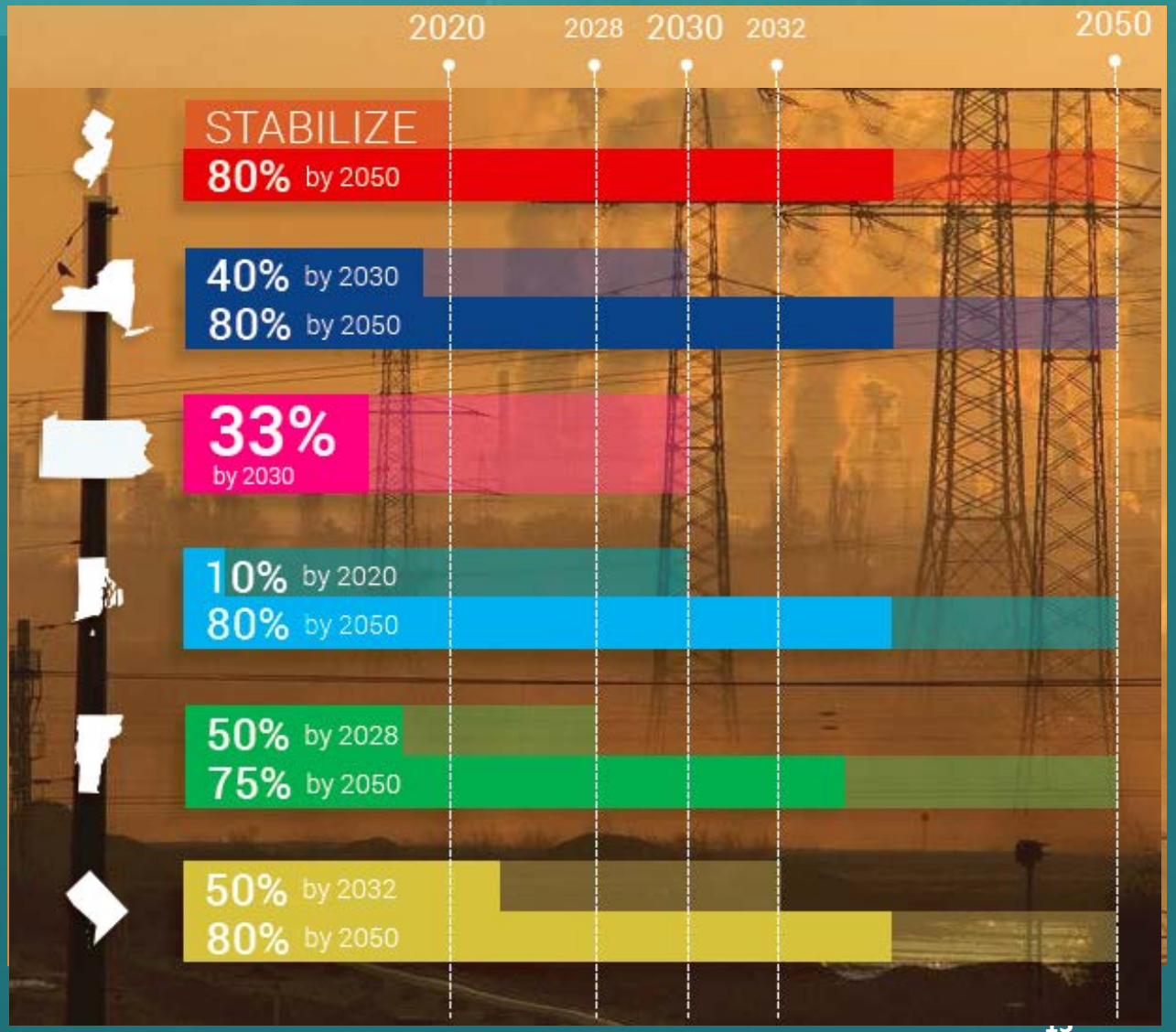
# The report is chock full of content

- This webinar is a complement to the report, not a supplement
- (Check out this TOC!)
  - Executive Summary
  - Introduction and Context Setting
    - Technological Definitions
    - The State of the Market
    - The Smart Energy Home: Driving Residential Decarbonization
  - Impacts, Trends, and Policies
    - Load Shaping: Teaching the Duck to Fly
    - State of Related Policies in the Market
    - Demand Response, Dynamic Rates, and the Role of a Smart Meter
  - Real World Examples and Case Studies**
  - Barriers and Opportunities Analysis
  - Recommendations, Strategies, and Next Steps
  - Conclusion
  - Appendix A**: Smart Energy Home Market Characterization Details
    - Smart Device Characterization
    - Other Developments in the Smart Home Space
  - Appendix B**: Distributed Energy Resources Market Characterization Details
    - Residential Solar Market
    - Residential Electric Vehicle Market
    - Residential Battery Storage Market
  - Appendix C**: Strategically Electrified Space, Water Heating, and Home Performance Market Characterization Details
    - ASHP Market
    - HPWH Market
    - The Need for Thermal Efficiency

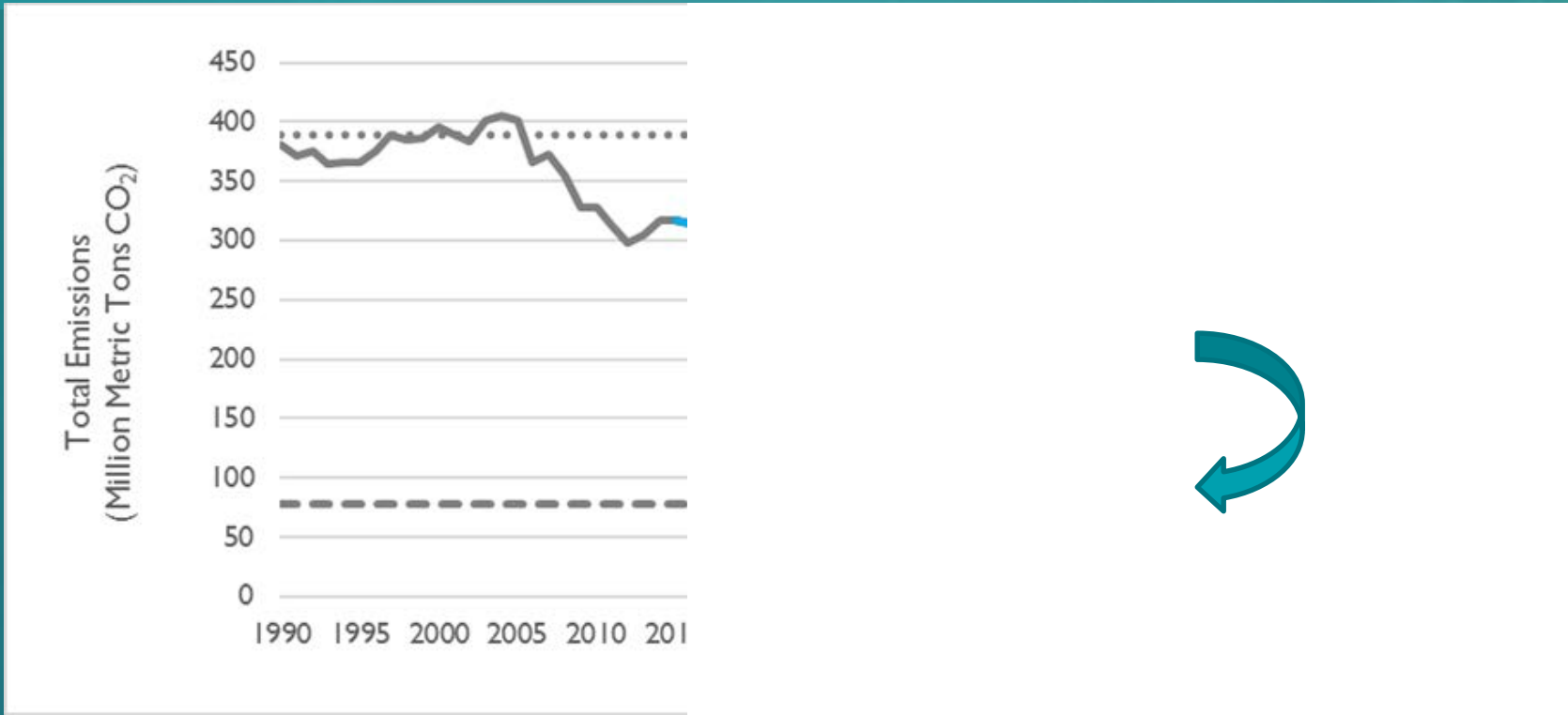
# Context Setting

# Region's Aggressive Carbon Reduction Targets



# Are we on the path to 80% CO2 reductions?




- Not without strategic electrification, we aren't!

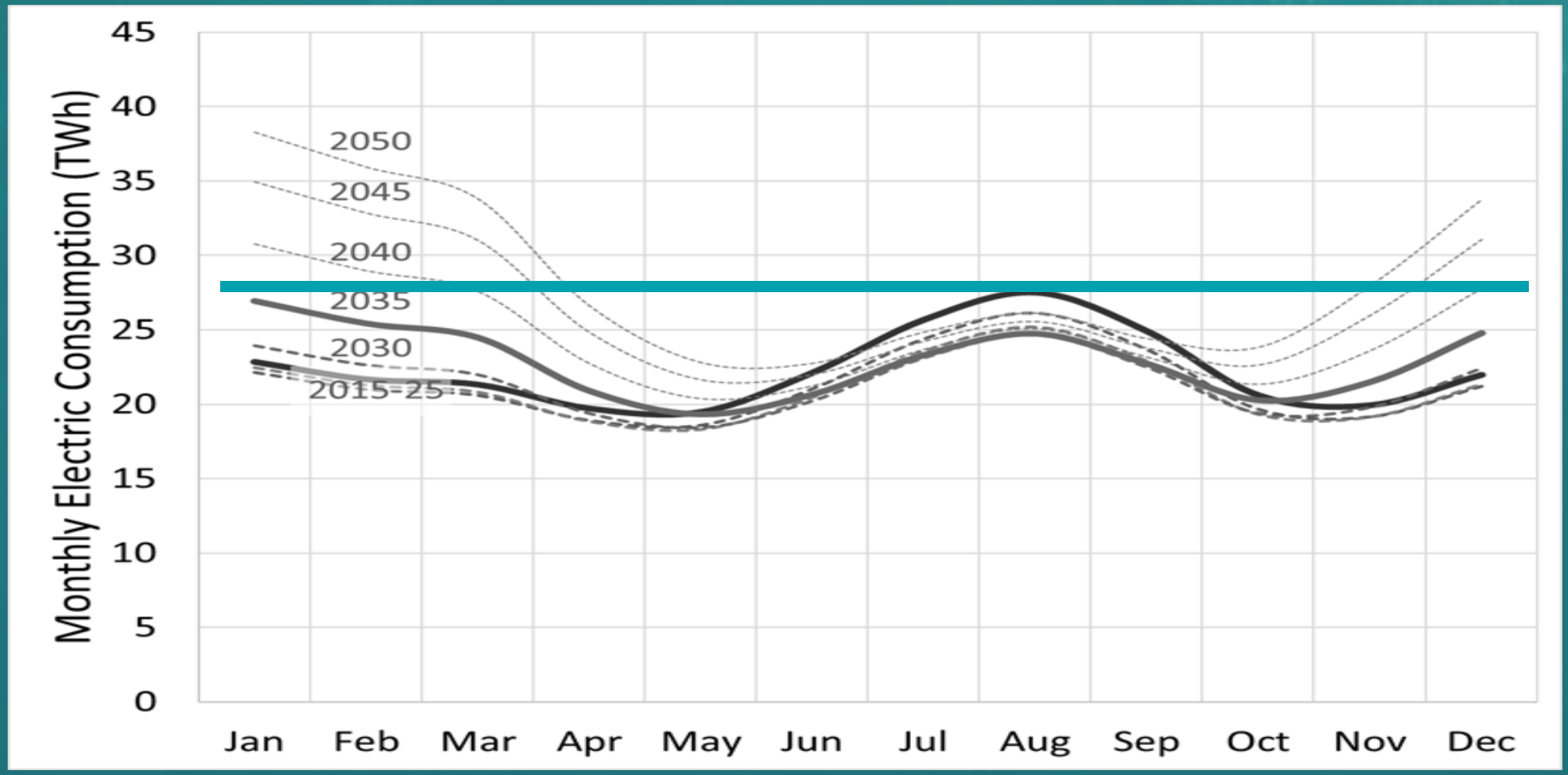
# To get there, need a 3 pronged strategy:


Use less energy

Have clean generation for electricity

*Strategically s*hift energy use towards electricity

# Electrification sounds great, but…
# Shifting *seasonal* loads over the next 30 years



# How the Smart Energy Home can drive residential decarbonization (in 5 easy steps!)

**Step 1**
- Electric loads of homes will **grow**.

**Step 2**
- Many end-use loads can be **shifted** to be used or charged at strategically beneficial times.

**Step 3**
- **Renewable generation** is growing, but it is more variable.

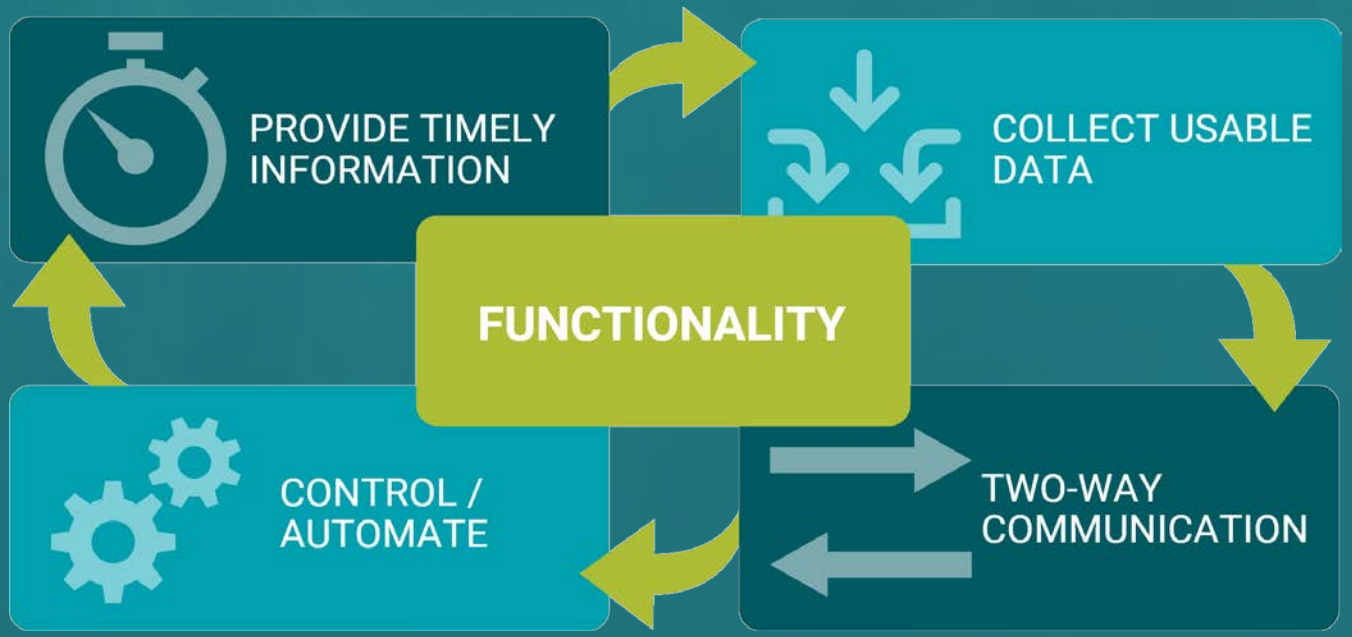
**Step 4**
- **Flexible end uses** are critical to managing this growing electric need.

**Step 5**
- **"Smart" technologies** can manage this **"generation-to-load"** matching.

- Customers are buying many smart products
- Many smart devices have lower barrier to entry than other major EE investments
- Many opportunities for integration and matching

# What is *Smart*?

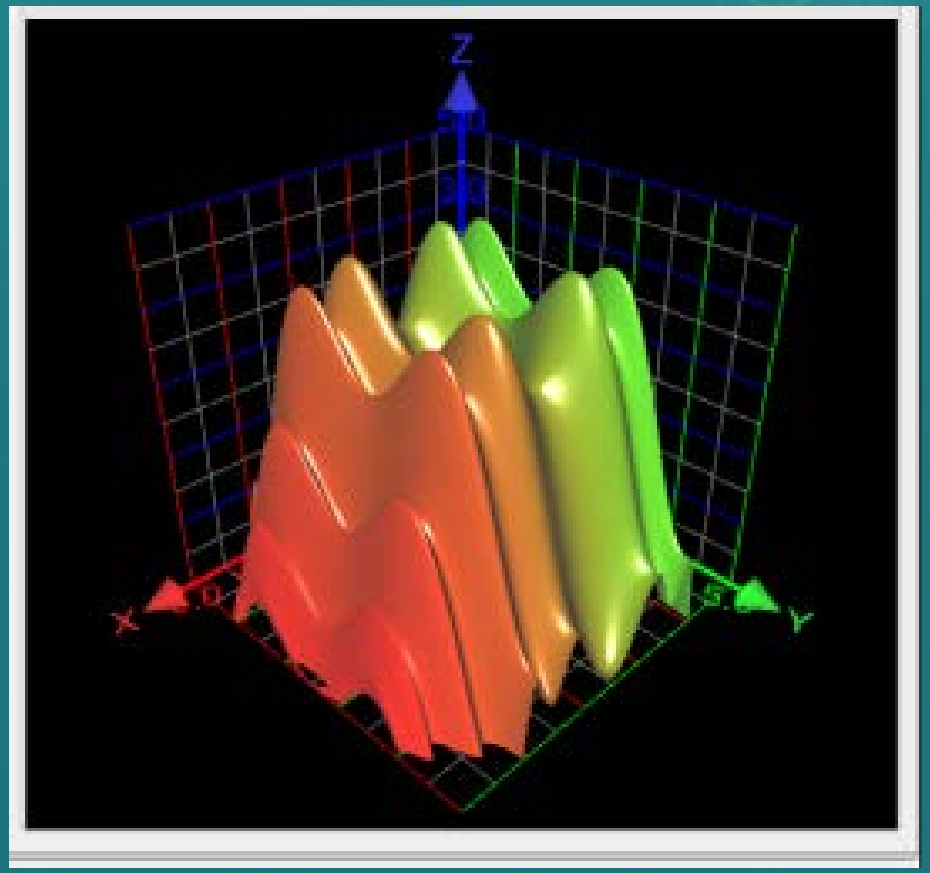
- (*NEEP's definition*) "smart": have a chip/connection, and a mechanism to know what to do with it!
- **Ideally**, smart devices have this functionality:



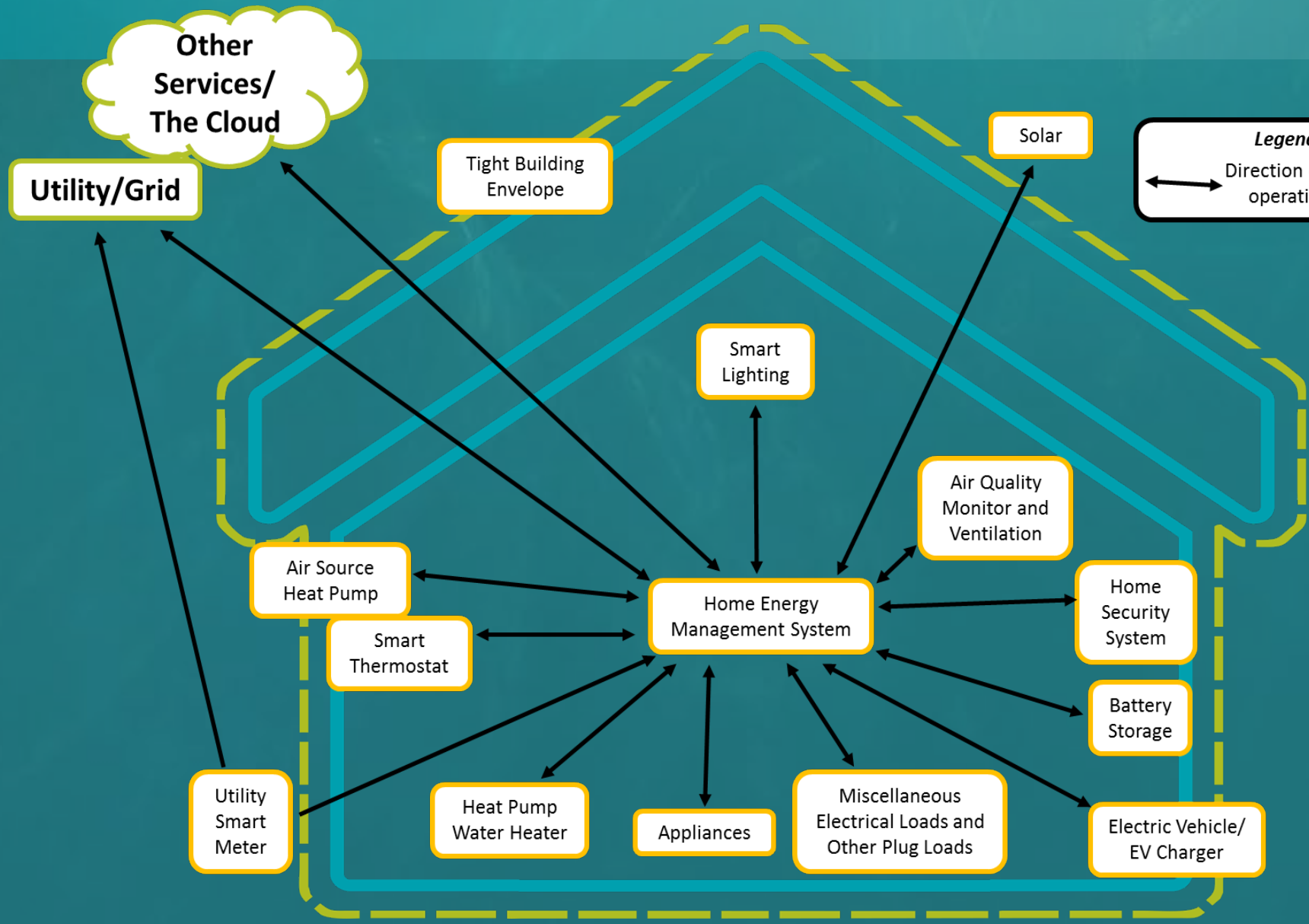
# “Collective” Visioning Process

- Report contributors felt if we could agree upon the end goal, we’d have an easier time working towards it
- Not one adoption curve….

- Report provides more details on the state of the various markets (in Appendices), including:
  - Smart devices
  - Residential distributed energy resources (DERS)
  - Strategically electrified technologies (HVAC, water heating, and thermal efficiency)



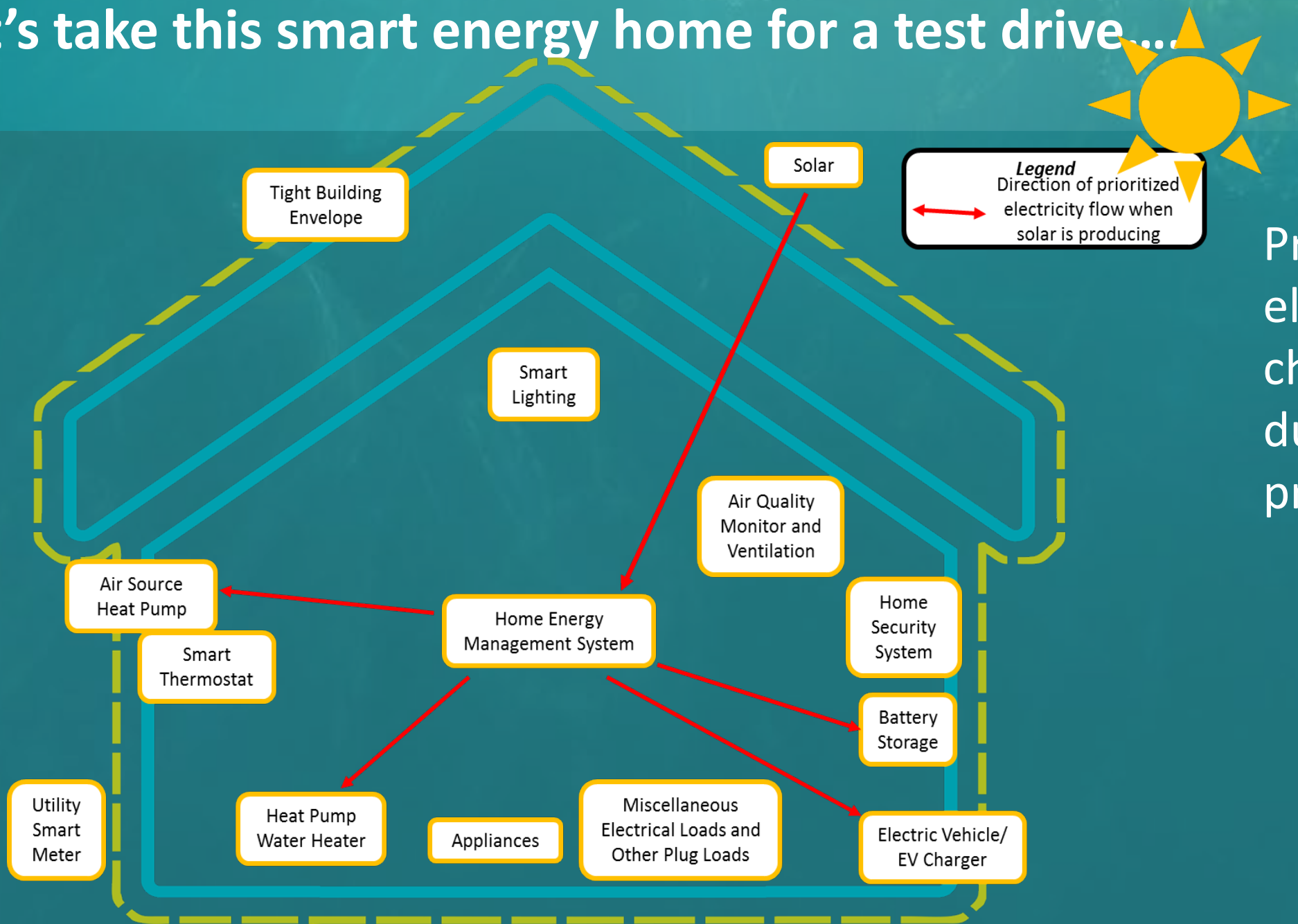
# The Vision of the Smart Energy Home of the Future!




# A Few Notes…

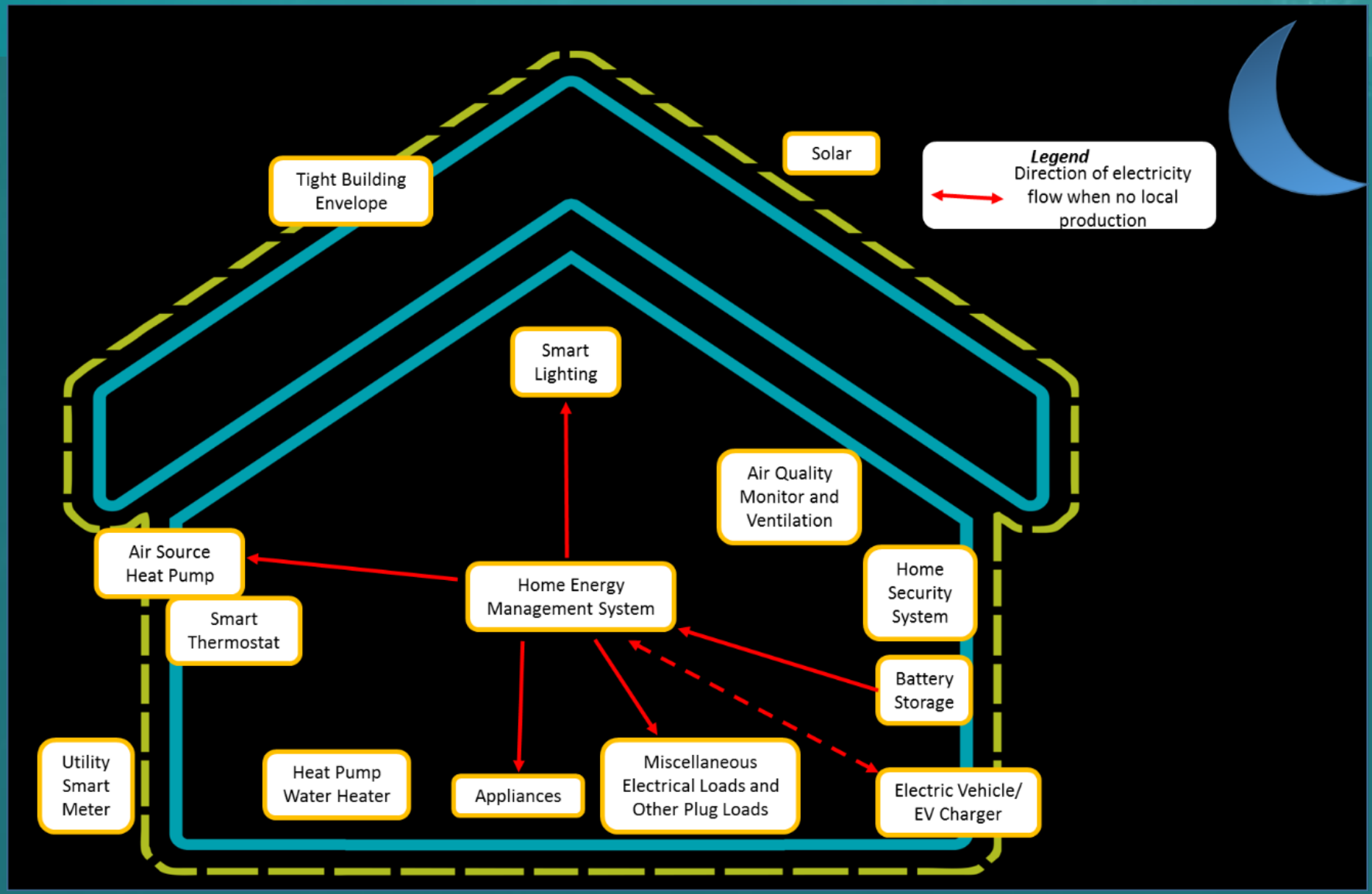

- About the HEMS…
  - Right now, most smart home controls are at the device level, optimizing for consumer preference
  - Some homes (and more buildings) have DERMS managing DERs, optimizing for grid benefit
  - Our goal: These systems work together. Doesn't need to be a physical "thing", just needs to be able to interface together these connected systems and send/receive have optimization signals (i.e. for consumer, for grid, for carbon)
- About the Smart Meter (AKA advanced metering infrastructure AKA AMI)….
  - Not really "smart" by our definitions, BUT AMI will be necessary for dynamic rate structures
  - Without AMI, dynamic pricing and more widespread demand response are not possible at scale.
  - States that haven't already made the AMI investment face challenge justifying the expense.
    - There is some current work arounds leveraging AMR that may be worthwhile to consider.

# Let's take this smart energy home for a test drive….




Prioritized electricity charging during solar production

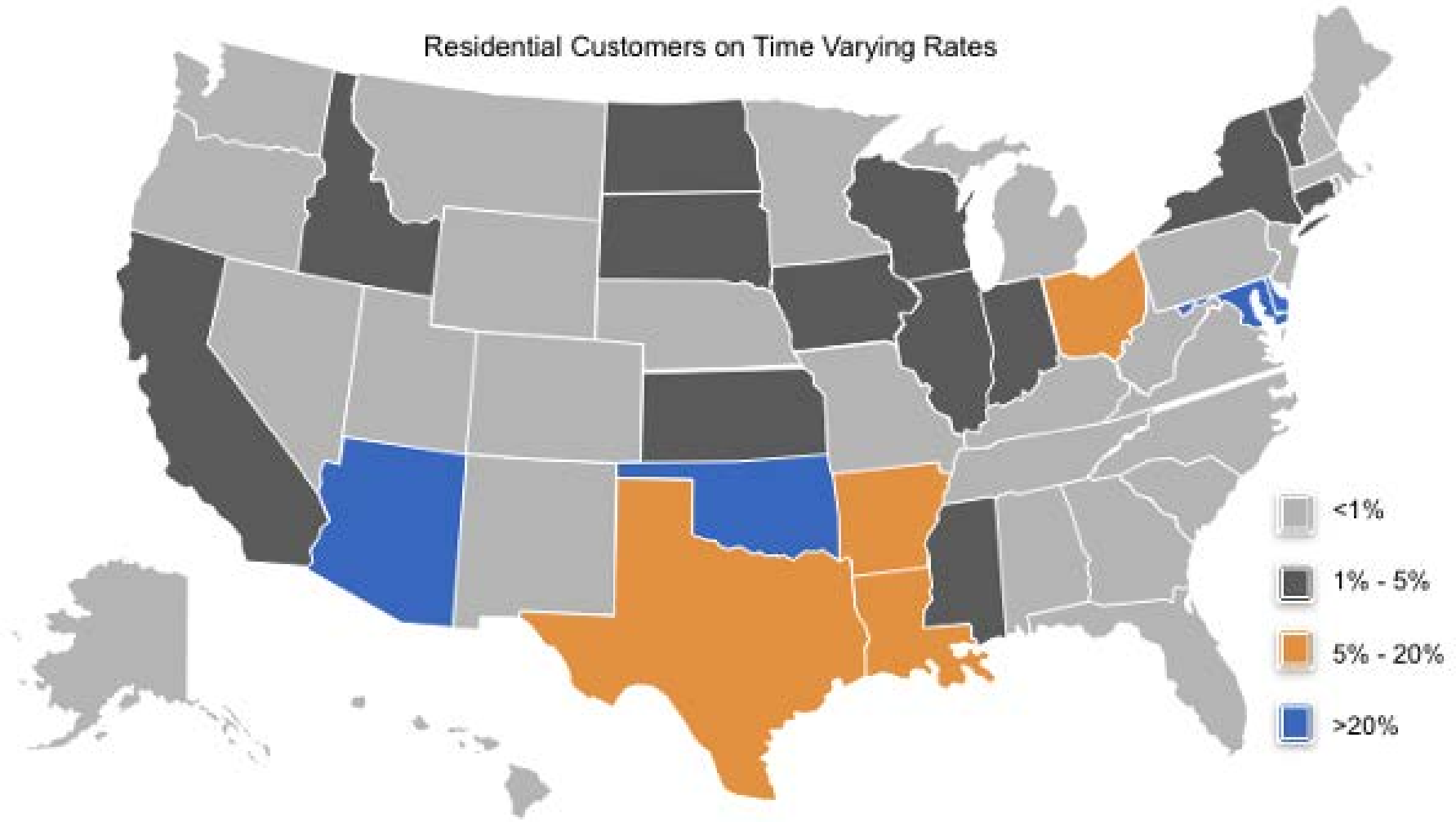
# Let's take this smart energy home for a test drive….




Nighttime electricity flow when no production

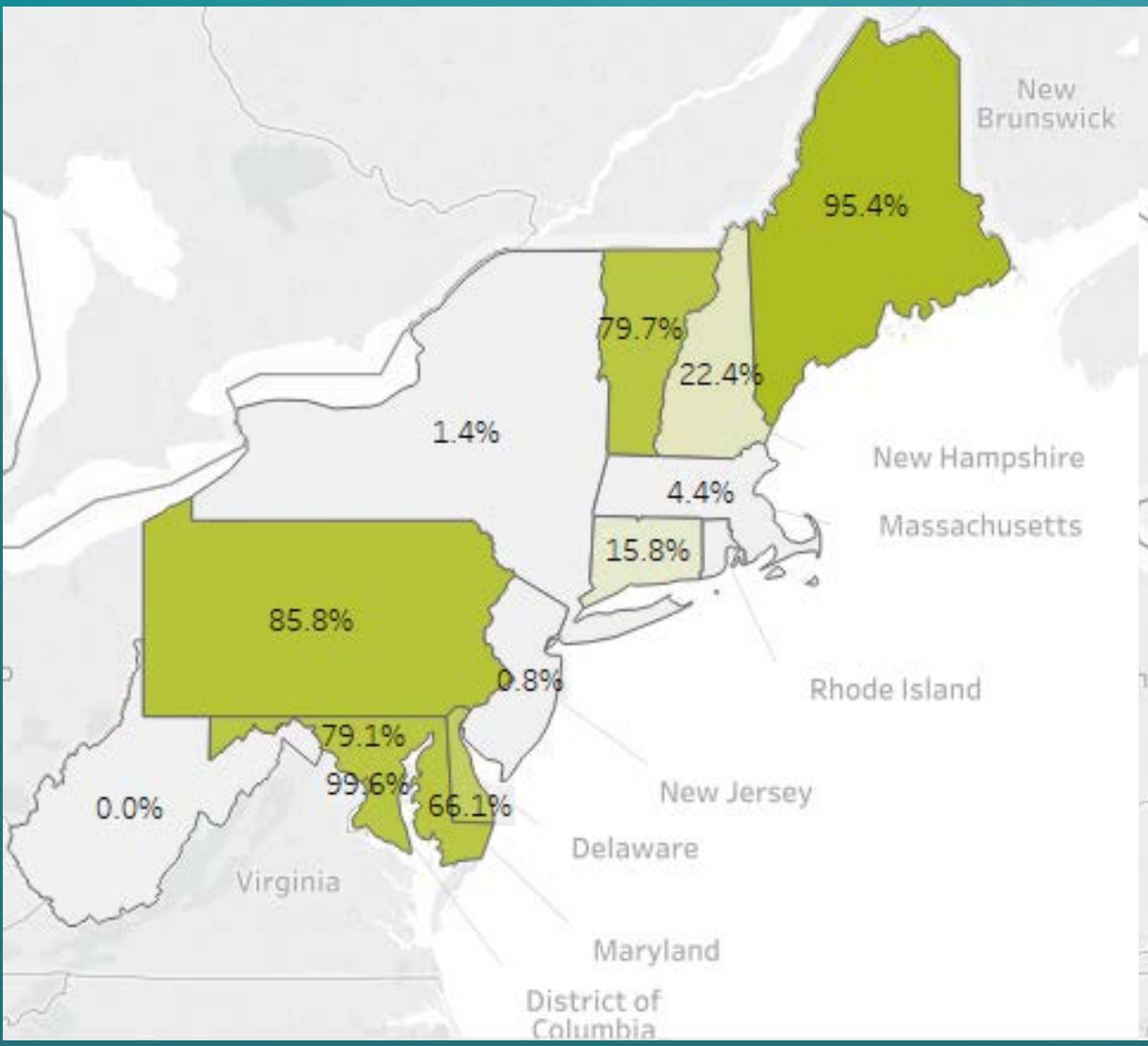
# Policy considerations of note
# (3000 Words, or A Tale in Three Pictures)

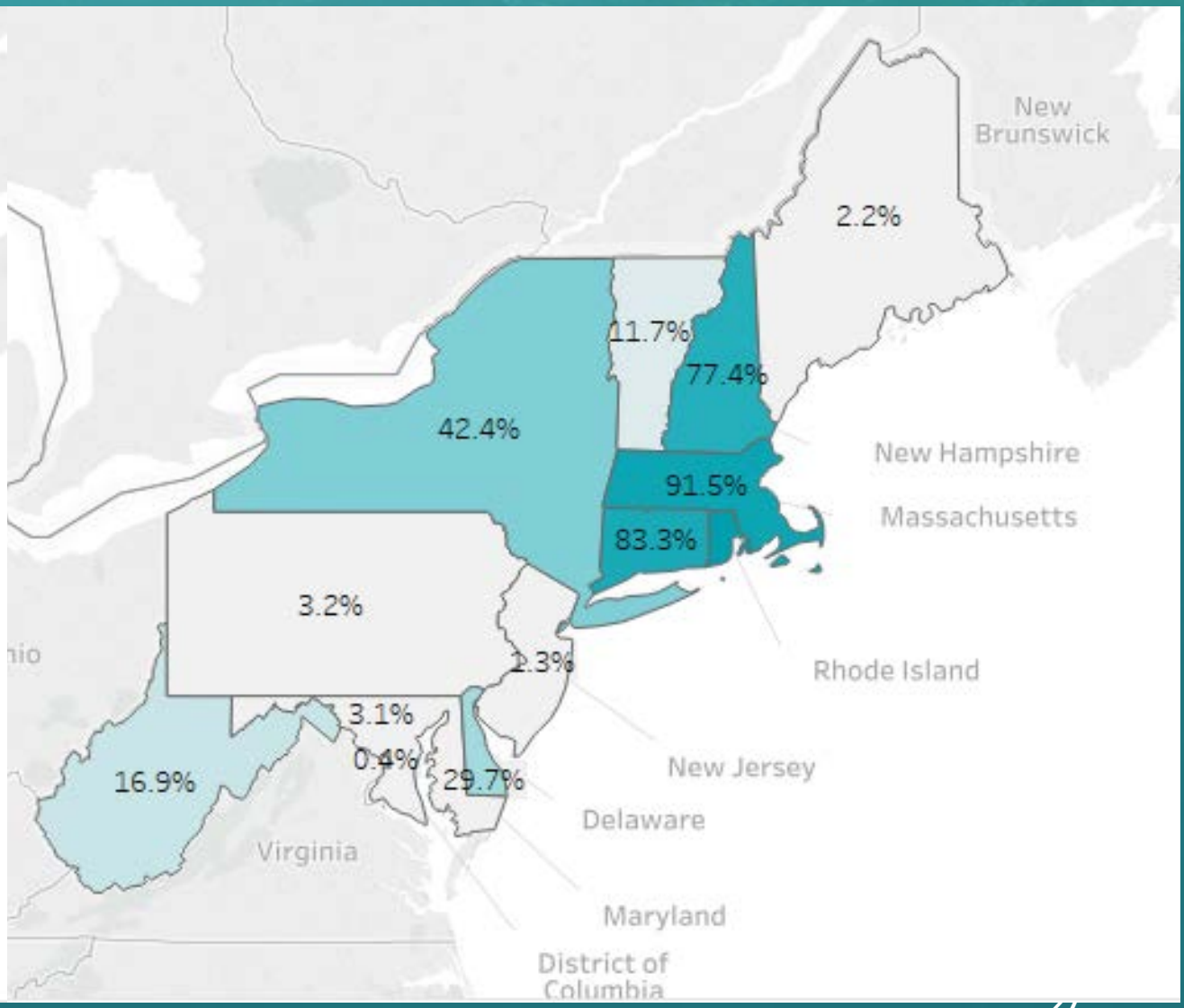
# Time Varying Rates




Source: U.S. Energy Information Administration Form EIA-861 released November 2017 with annual data for 2016

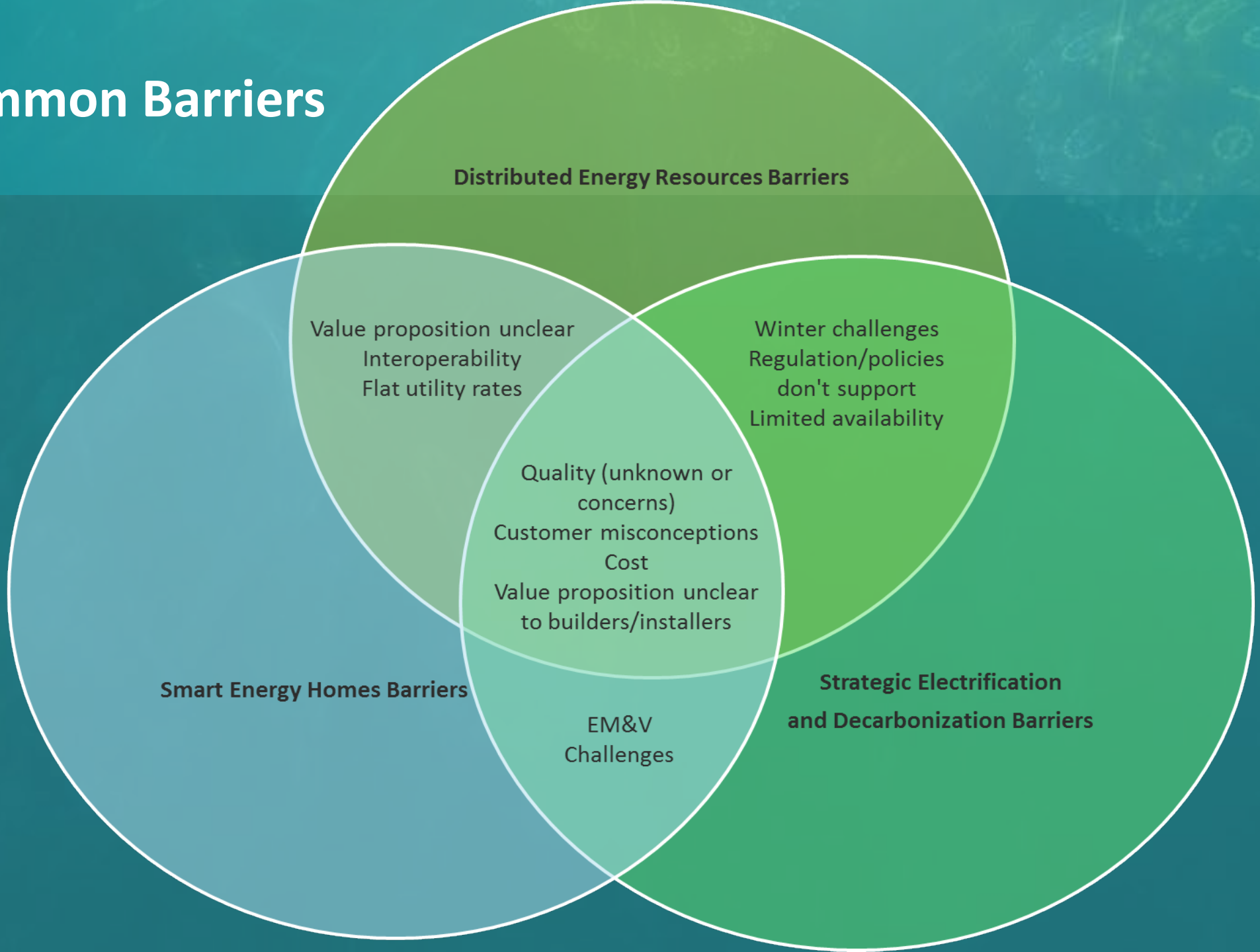
# AMI vs AMR


New Brunswick
95.4%
79.7%
22.4%
1.4%
New Hampshire
4.4%
Massachusetts
15.8%
85.8%
0.8%
Rhode Island
79.1%
99.6%
66.1%
0.0%
New Jersey
Delaware
Virginia
Maryland
District of Columbia

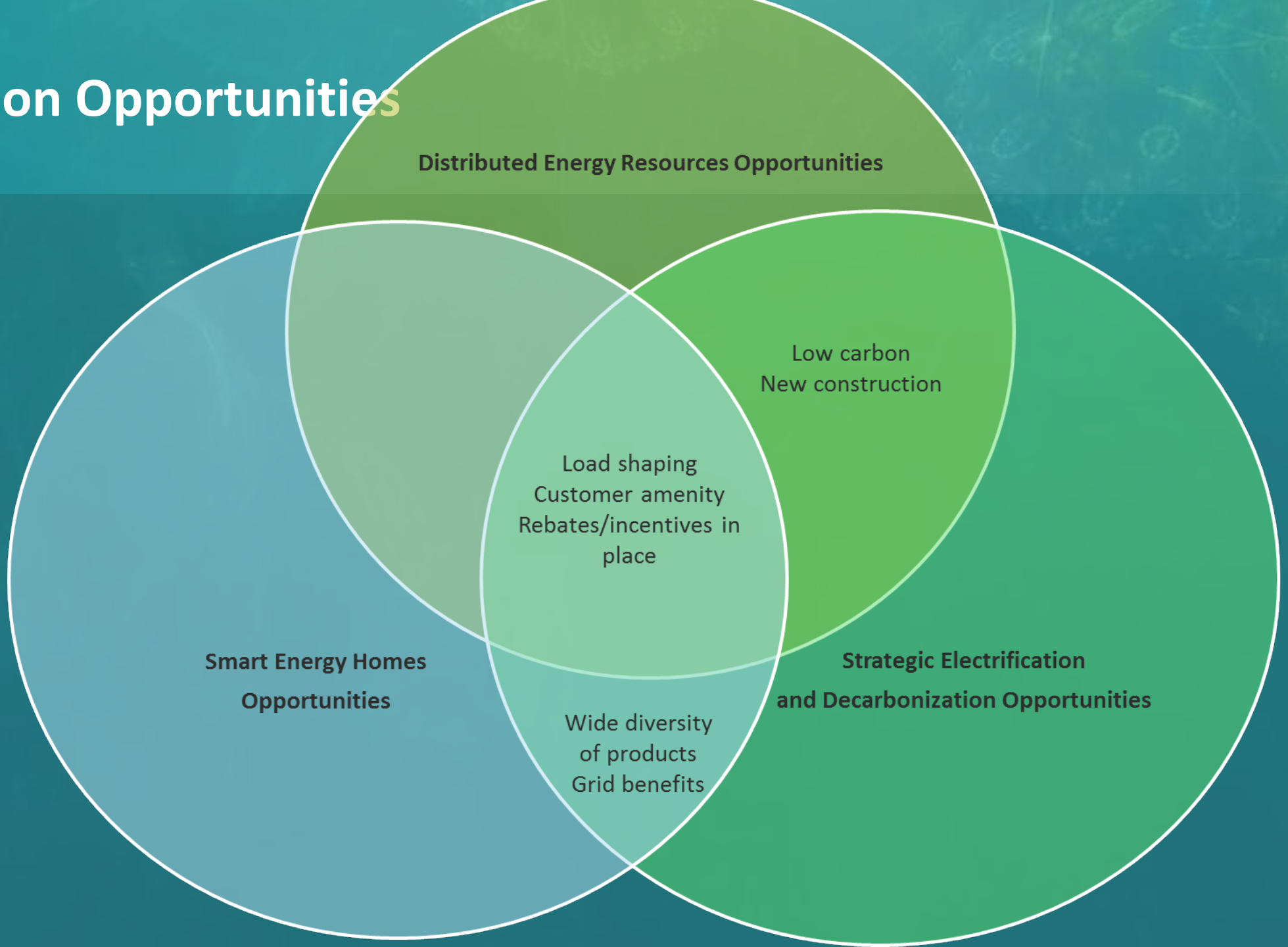

New Brunswick
2.2%
11.7%
77.4%
42.4%
New Hampshire
91.5%
Massachusetts
83.3%
3.2%
1.3%
Rhode Island
3.1%
0.4%
29.7%
16.9%
New Jersey
Delaware
Virginia
Maryland
District of Columbia

# Common Barriers and Opportunities

# Common Barriers



# Common Opportunities



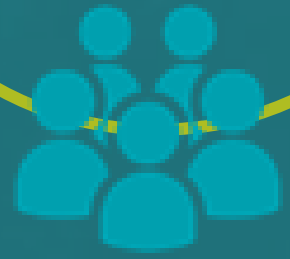
# Strategies Moving Forward

# Recommendations

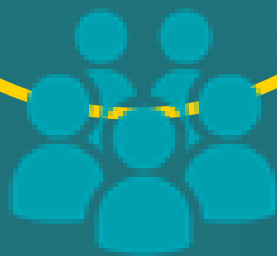
- Area of Focus #1: Policy and Carbon
  - In order for a decarbonized residential building stock to be fully appreciated, incentivized, and realized, public policies must evolve to recognize and value carbon reductions as a critical consideration and motivator for decision making.

**Address Fuel-Switching**

**Build Grassroots Support for Carbon Reduction**

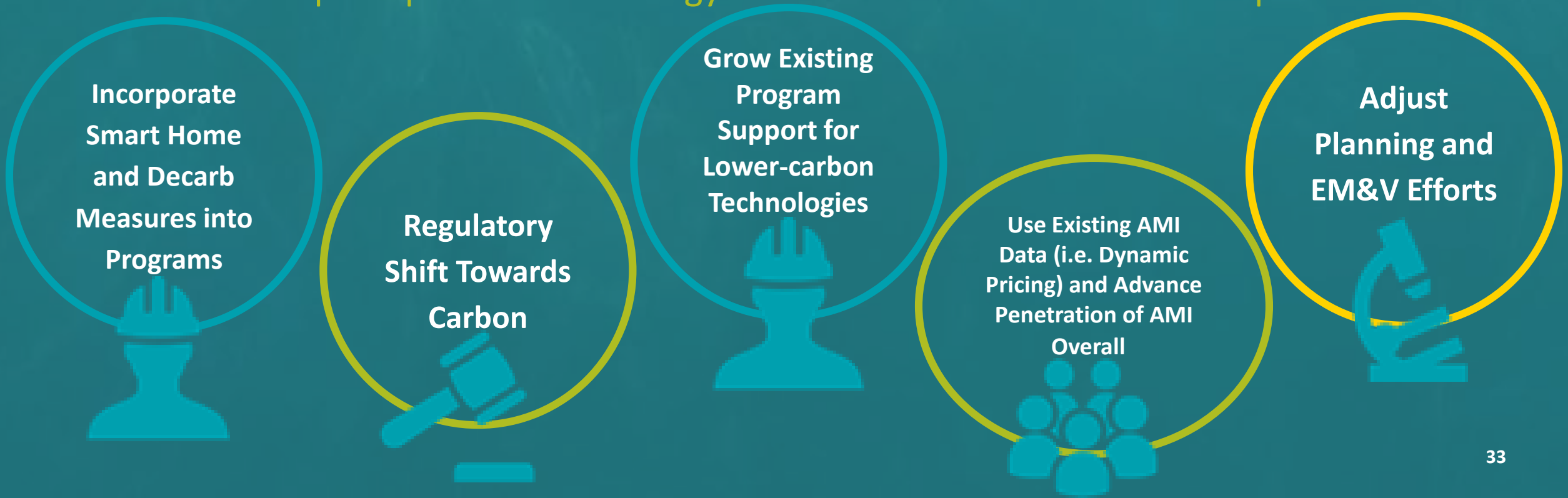


**Pathways to the Future**



# Recommendations

- Area of Focus #2: Utility Regulatory Structure
  - Future utility programs will take into account carbon reductions, promote lower-carbon strategic electrification activities, have dynamic pricing, and serve as a "one-stop-shop" for smart energy homes and their associated components.



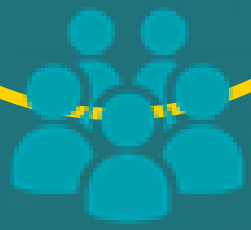
# Recommendations

- Area of Focus #3: Smart Energy Homes Drive Smart Home Performance
  - As the grid decarbonizes and strategic electrification efforts increase, peak events are likely to move towards the winter; tight, low-load homes are critical to the success of strategic electrification and broader residential decarbonization. Low home electric loads will be reinforced by smart energy home efforts that increase the performance of existing homes.

**Bundle and Improve Smart Energy Home Offerings**

**Push Home Performance Through Smart Technology**

**Raise Awareness of and Promote Smart Home Performance Across all Customers**



# Recommendations

- Area of Focus #4: Quality Assurance and Transparency in Technology
  - Products installed in smart energy homes of the future are high quality, easy to find, and work well together to enable a low-carbon residential sector.



# Recommendations

- Area of Focus #5: Focus on the Locational Value of Smart Energy Homes and Energy Efficiency
  - A modernized grid that can take into account a range of grid constraints when sending and receiving demand signals, particularly around location and geo-targeting of savings.

**Expand Upon Existing, While Keeping Grid Modernization in Sight**

**Support Development of Geo-targeting Programs**

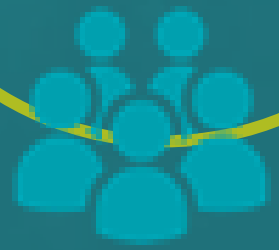
**Ensure Equity in Locational Efforts**

# Recommendations

- Area of Focus #6: New Construction and Smart Energy Home Integration with Building Codes
  - New buildings are built to meet the future vision of flexible, low-load, electric homes.

**Evolve New Construction Programs**

**Embrace the Smart Energy Home in Residential Labeling/Code Efforts**



**Enable Success Through Codes and Building Energy Standards**

# Conclusion and Discussion

# Conclusion

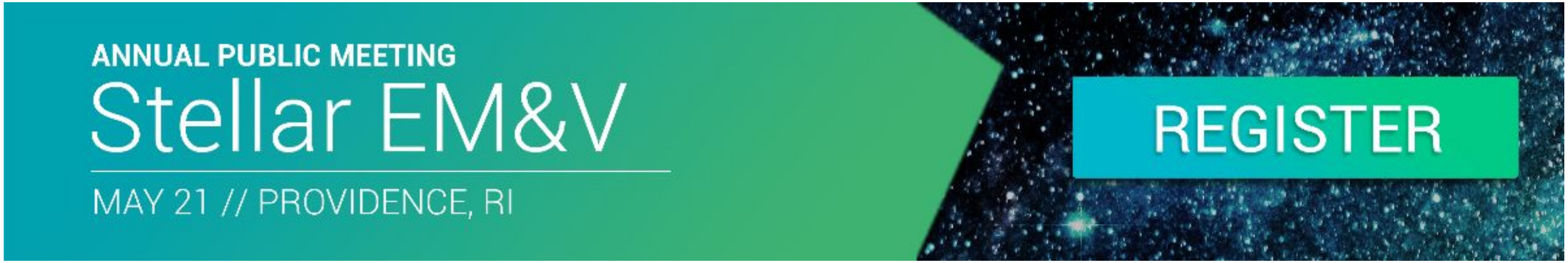
- Smart energy homes sit at the center of residential building decarbonization success.
- Through dedicated focus and collaboration, we can reach our goals!
- An evolution in efficiency program structure and changes in policies will go a long way towards helping the markets grow
  - but it is also incumbent on customers and industry players to create interconnection between smart technology and other residential products such as electric vehicles, solar, battery storage, ASHPs, and HPWHs
- Home energy management systems (HEMS) being tested today are showing potential to manage a home full of smart end uses and pairing with a grid full of renewable energy.
  - Commercially-available products must integrate further to achieve this reality.

# More Resources

- The Smart Energy Home is (almost) here!
  - You can help make it a reality!
- More Resources:
  - HPC smart homes track! Chicago 4/1-4/4!
    - Including 9 session track and contractor training
  - HEMS Working Group—let me know if you want to talk more
  - NEEP Webinar series and NEW report
  - Sign up for Decarb Central!
- Let's talk more!
  - cmiziolek@neep.org

# Can’t get enough?! More from NEEP



# Q&A

## THANK YOU!

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