Better Buildings Residential Network Peer Exchange Call Series:

Connected Homes and the Grid – Flipping the Switch on the Script

July 25, 2019

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers:
  - **Alice Rosenberg**, Consortium for Energy Efficiency
  - **Rod Sobin**, National Association of State Energy Officials (NASEO)
  - **Kara Saul Rinaldi**, AnnDyl Policy Group
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- Aug 8: Home Performance and Real Estate

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

For more information or to join, for no cost, email bbresidentialnetwork@ee.doe.gov, *or go to* energy.gov/eere/bbrn & *click Join*

Alice Rosenberg
Consortium for Energy Efficiency

U.S. DEPARTMENT OF ENERGY

CEE

Connected Homes and the Grid

Flipping the Switch on the Script

Alice Rosenberg
Senior Program Manager
DOE Better Buildings Residential Network
July 25, 2019

CEE MISSION

As the **Consortium for Energy Efficiency**, United States and Canadian efficiency program administrators develop cutting-edge strategies to accelerate commercialization of energy efficient solutions to benefit gas and electric customers, utility systems, and the environment.

- CEE was formed to bring new super efficient products and services to the market through strategic market based initiatives.
- 28 years in, time and location of efficiency has greatly enhanced opportunity for unprecedented financial, customer and system benefit

CEE's Managing Principles

Member Driven Initiatives:

- Extend the regulatory compact
- Are voluntary
- Analytically based
- Rely on organizations with standing
- Reward those who compete
- Are vetted with stakeholders
- Are technology and fuel neutral
- Address multiple measures, fuel types, and customer classes
- Create and leverage association, business and government relationships
- Maintain consistency in policies and positions while monitoring for change
- Inclusive of market stakeholders
- Instill lasting commitment with industry partners

the EVOLUTION of ENERGY

NEXT 25 YEARS

1890 – 1920s

First power plants

Cities and homes lit by electricity

Electric appliances becoming commonplace

More reliable service

1950s

Nuclear and hydro scale up

Rates remain stable, cleaner air

1970s – 1980s

More efficient plants built

Scrubber technology to reduce emissions introduced

Natural gas shortage contributed to higher energy prices

Greater awareness of energy conservation measures

2000s – present

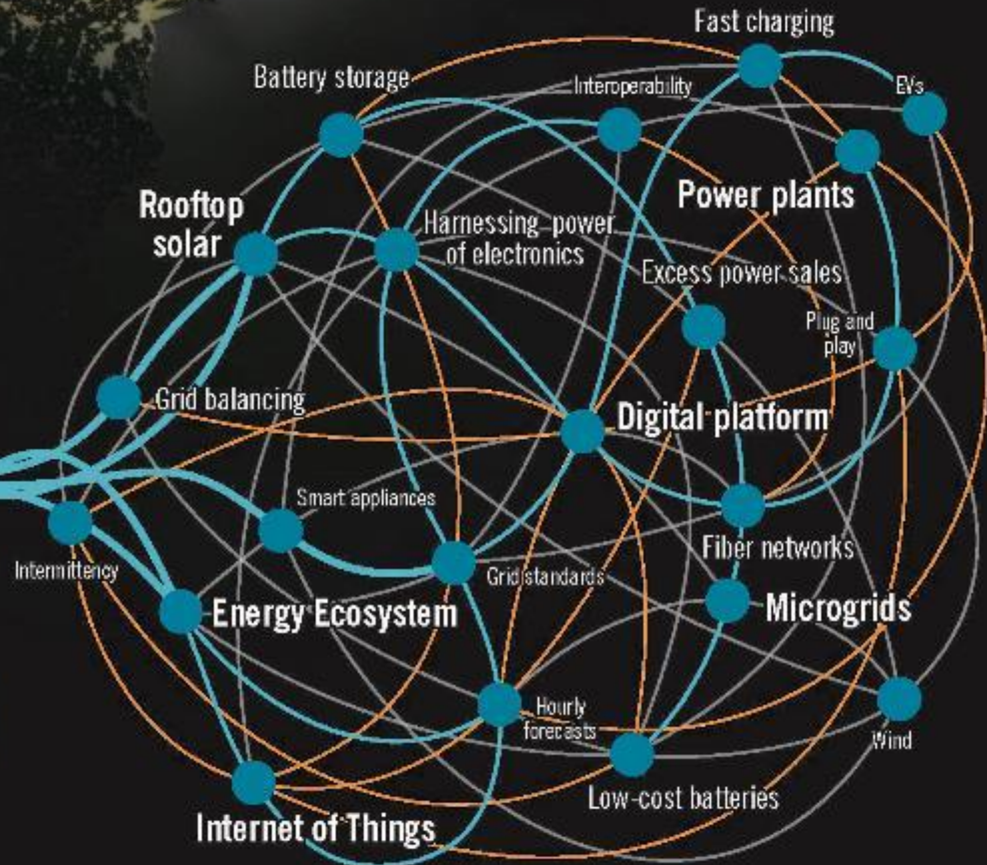
Installation of scrubbers on some older units

Increase in renewables (wind and solar)

Increase in natural gas combined-cycle generation

Environmental stewardship and energy conservation became mainstream

Reduction in air emissions: sulfur dioxide about 90%; nitrogen oxides about 80%



DUKE ENERGY.

Dynamics that Utilities Face

- Declining electric growth (from EE, DERs, etc.)
- Need for increased investment (reliability needs, aging grid, cybersecurity)
- Disruptive technologies (i.e. battery storage, electric vehicles, etc.)
- Operating within existing regulatory model (outdated paradigms)

Greater consumer access to energy information, controls, and technology, especially to distributed energy resources like solar PV, demand response, and energy storage is having an impact on the power sector, driving discussions on what a "utility of the future" should look like as we venture from a vertical power market to something that is more distributed

CEE IDSM Framework

- Demonstrates what utilities value to industry partners; Vision for a desired future state
- Supports "best practice" program design
- Guidance to CEE committees (and others) on expanded considerations
- Relevant for residential and C&I buildings; gas and electric
- Provide federal government and others with a single frame, point of contact; Who has complementary offerings?

Utility Value Streams

- Energy Savings
- Energy Shifting
- Environment / Carbon Reduction
- Load Forecasting / Resource Planning
- Ancillary Grid Services
- IDSM Program Administration
- New Customer Amenity

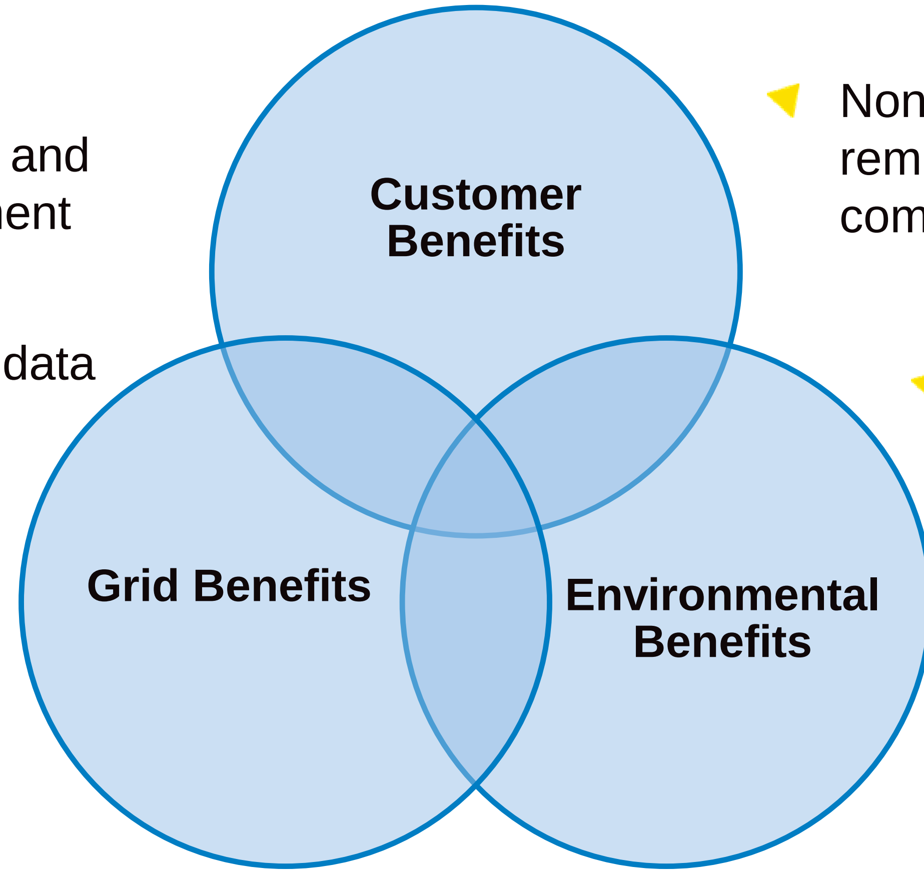
NY REV: Value Stack

Locational System Relief Value
Additional value for location specific relief in distribution network, based on geographic zones, identified by network. $/kW-year value.

Avoided Demand
Quantity of demand reduction by system compared to distribution network's peak demand. Compensation tied to performance over 10 highest usage hours/year

Potential Benefits of Connected

- Grid balancing and load management
- Program M&V data
- Enhanced customer engagement
- Ancillary services



- Non-energy benefits: remote control, enhanced comfort, health/wellness
- Financial savings from new EE and DR opportunities
- Air quality/ carbon
- New Integrated DSM program offerings

Defining Connected
CEE Consensus Principles

- Use of **open, non-proprietary, communication standards** to achieve interoperability are required….
- Establishing **multiple pathways to connect** is likely necessary to ensure the majority of consumers realize benefits…
- Maintaining a **direct line of site to location of** connected products at the “substation level” will maximize the load management benefits…
- Acceptable communication pathways must **secure customer data** and adequately protect privacy…
- Products are “controllable” and **responsive to price signals**…
- Connected devices must be “discoverable” and **disclose their ability for a utility signal** (or equivalent) to reach the connected product consistently…
- Capability to share **basic energy data** is required

https://www.cee1.org/content/principles-connectivity

Opportunities for the Consumer

- Non-energy impacts and amenities
  - Health
  - Security
  - Comfort
  - Entertainment
  - Safety
  - Environment

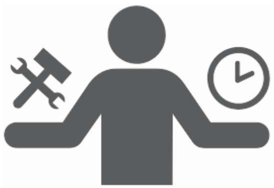
- Money saving potential
- Control of personal products and data
- Voice control features and capabilities

Opportunities for Manufacturers

- Higher margin for connected products
  - Added value to consumers for connected features
  - Potentially greater volume of sales

- Long-term customer engagement
  - Ability to offer additional services
- Enhanced product design cycles
  - Diagnostics and remote maintenance
  - Informing features for future improvements

Opportunities for Programs



- New grid balancing and capabilities
  - Leverage locational & time dependent valuation

- Enhancement of EM&V
  - Access to enhanced, real-time energy usage
  - Greater disaggregation of data at interval levels

- Incorporation of behavior change
  - Application of, and credit for, behavioral tools and insights that leverage connected capabilities

- Customization and targeting capacities
  - Ability to personalize recommendations
  - Access to diagnostic and maintenance

CEE Connected Criteria

CEE Specification	Authorized Connected Criteria	Guidance Recommendations	Criteria Currently in Development	Potential Future Criteria
Clothes Washers	✓			
Room Air Conditioners	✓			
Heat Pump Water Heaters	✓			
Clothes Dryers	✓			
Connected Thermostats		✓		
New Construction		✓		
Central HVAC			✓	
Pool Pumps			✓	
Lighting			✓	
Refrigerators				✓
Smart Plugs				✓
Electric Vehicles				✓
Dishwashers				✓
Televisions				✓

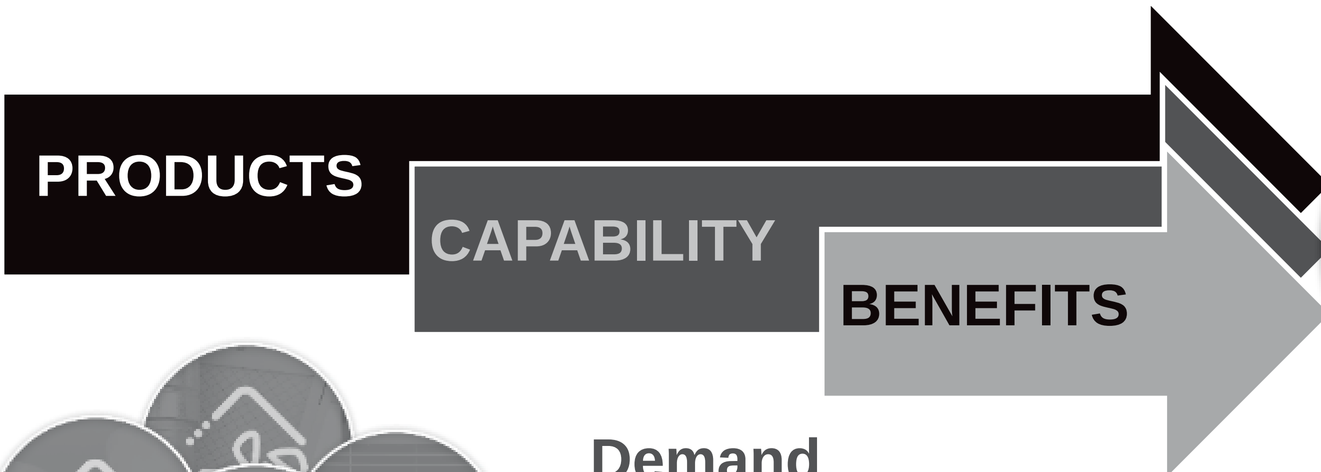
CEE Connected Criteria

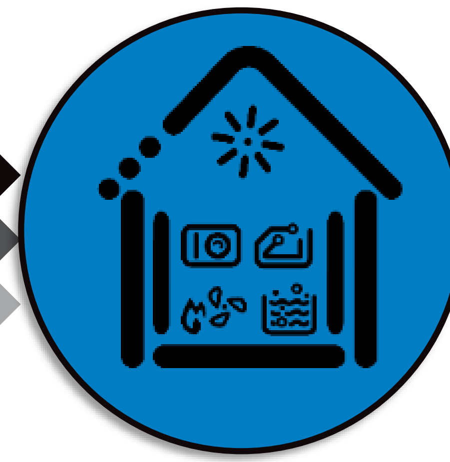
- Optional requirements within existing CEE Initiatives
- Commercially available products may not exist in the market as of yet
- Guidance or outlined savings opportunities for areas in development
- Collaborative engagement with industry partners and trades throughout the process
- Establishes basis for larger CEE Integrated Home platform and longer term vision

Industry Leadership Efforts

- Development of AHAM CHA-1 standard for communication elements of connected appliances and AHAM SA-1 standard for common commands of connected appliances
- Development of ANSI Standard 1380 for demand response-ready variable capacity central air conditioners and heat pumps
- ANSI C137 Lighting Systems Committee developed ANSI C137.0-2017, a standard for definitions. Other C137 standards in development include energy prediction and measurement, data modeling, user interfaces and security
- ENERGY STAR connected criteria for select product areas
- DOE test procedures to address connected capabilities
- Coordination of pilots using CTA-2045, work toward functional specifications for end-uses: water heaters, thermostats, electric vehicle supply equipment, HPWHs, variable speed pool pumps, and PTACs
- Development of ANSI Standard CTA-2045A

CEE's Integrated Home Platform

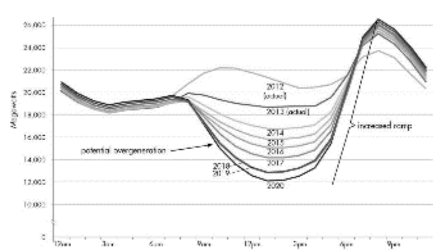




Energy Efficient and Connected Specifications

Demand Response

- Direct Load Control
- Behavioral Price Signals or Messages



Energy Management Dashboards

- Consumer Engagement

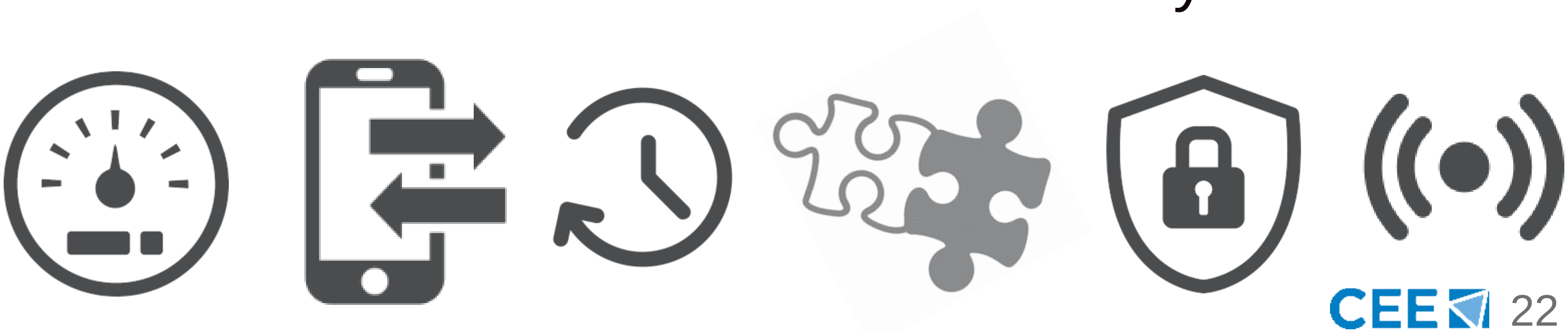
Energy Efficiency
+
Load Management
+
Behavior Change

CEE's Integrated Home Scope

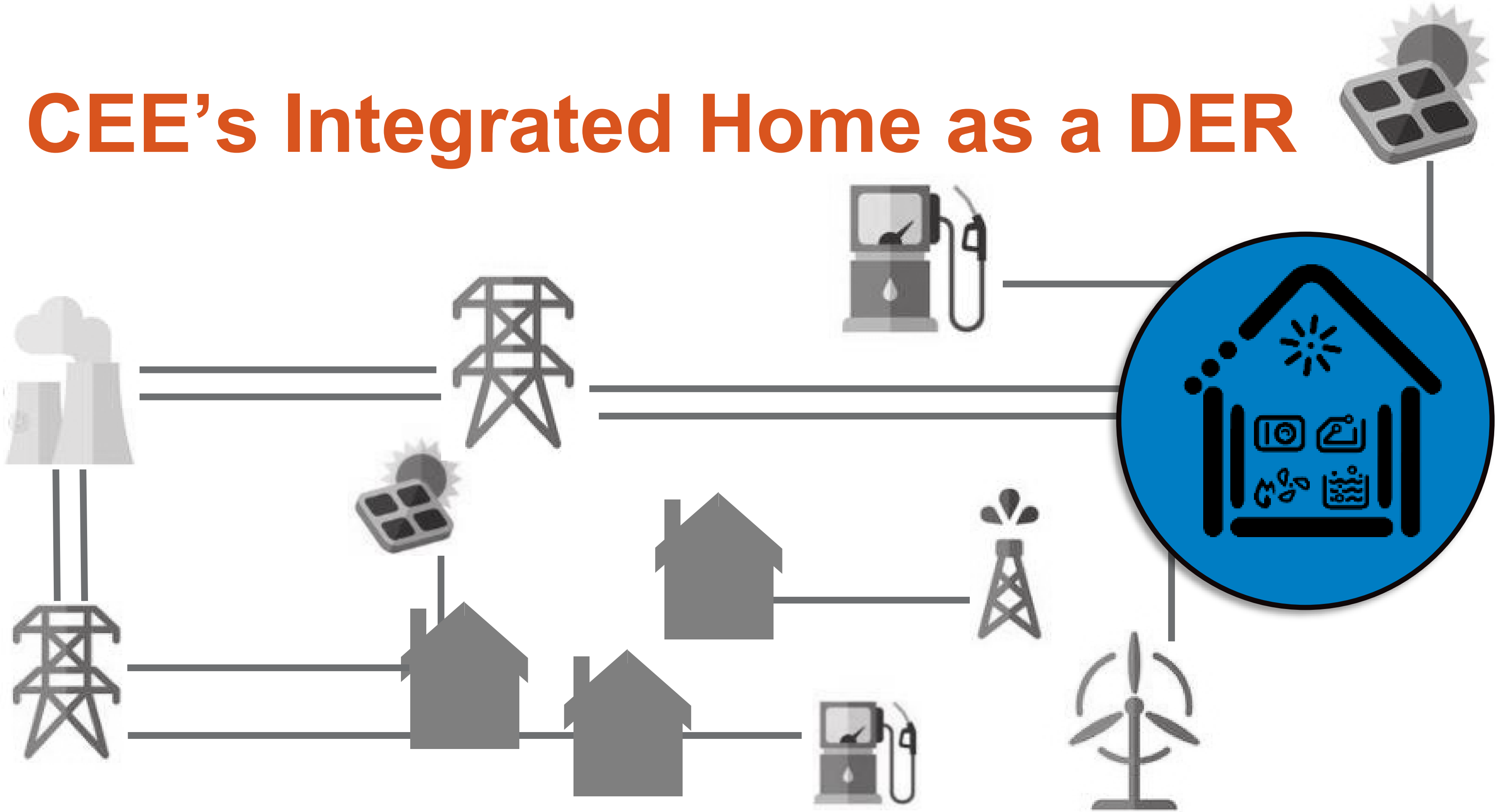
- **Services, hardware, or software** serving to optimize overall energy use of a home
- **Fuel types** delivering these objectives:
  - Electric
  - Natural Gas
  - Other
- **Application levels** achieving these benefits:
  - Product
  - System
  - Whole House

CEE's Integrated Home Components

- Cybersecurity and Privacy Concerns
- Connectivity and Multiple Pathways
- Assurance of Desired Amenities
- Data Exchange Capabilities
- Enablement of Innovation and Flexibility



CEE's Integrated Home as a DER



- Energy efficiency
- Load management, demand response
- Energy storage
- Integration of renewables

Questions and Discussion

Alice Rosenberg

Senior Program Manager

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arosenberg@cee1.org

Key Points

- CEE's Integrated Home Platform is a collection of energy efficient and connected home specifications.

- It leverages demand response capabilities, including direct load control and behavioral price signals or messages.

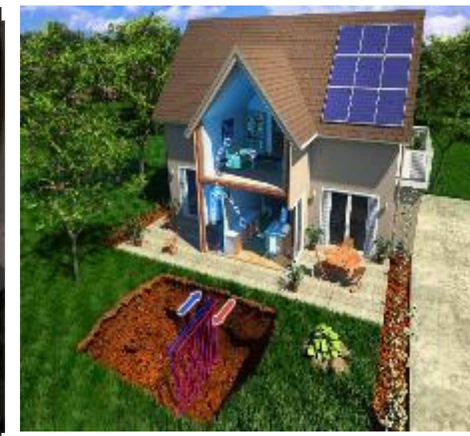
- This work ultimately aims to deliver energy efficiency, load management and behavior change.

Rod Sobin
National Association of State Energy Officials

U.S. DEPARTMENT OF
ENERGY

Grid-Interactive Efficient Buildings: NASEO-NARUC Working Group

NASEO
National Association of State Energy Officials



Rodney Sobin
Senior Program Director
National Association of State Energy Officials

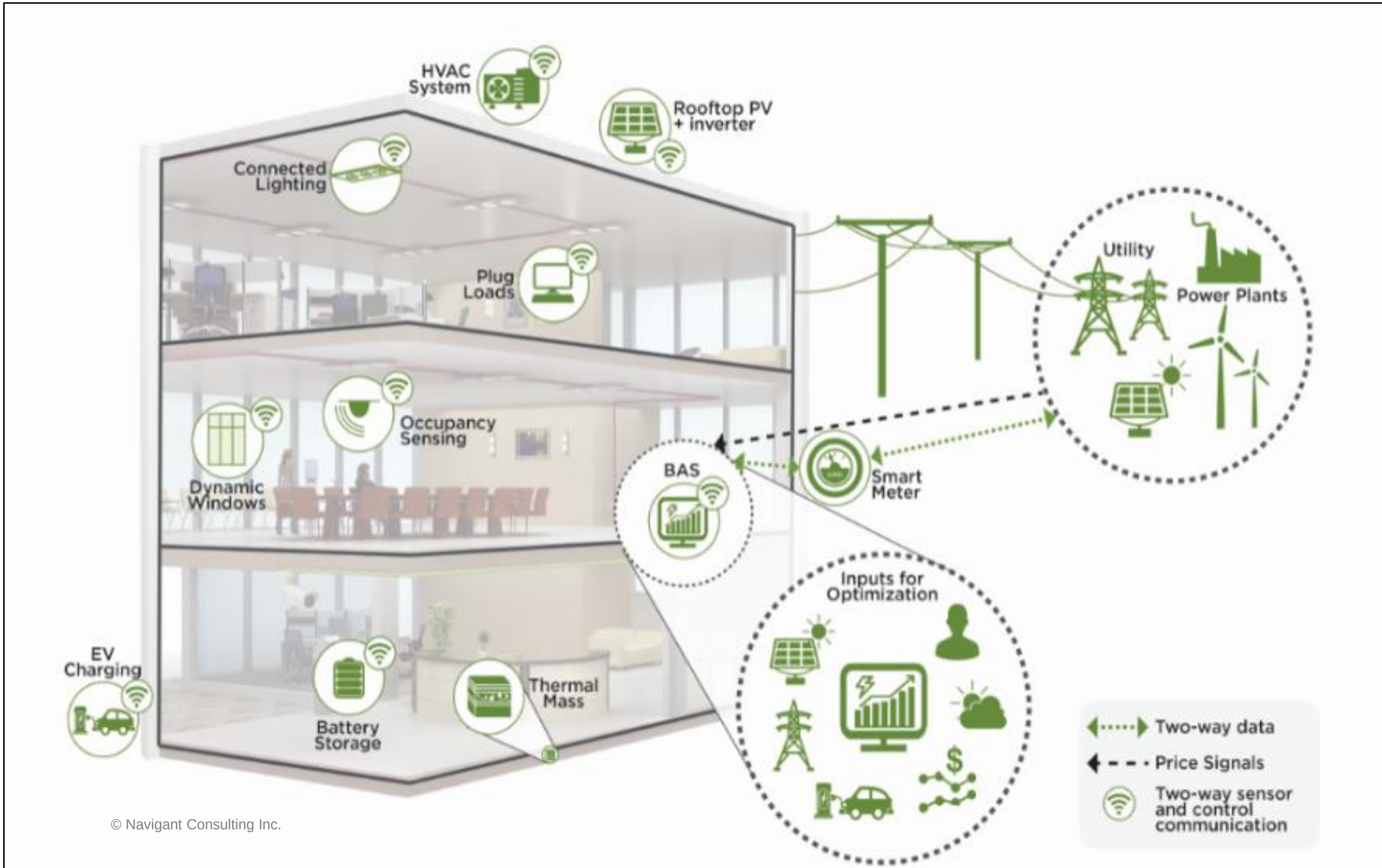
Connected Homes and the Grid
Better Buildings Residential Network Peer Exchange
July 25, 2019

+ Grid-Interactive Efficient Building Opportunities

- Advancing technologies open opportunities for more flexible building/facility load management:
  - Reduce costs, enhance resilience, reduce emissions
  - Reduce peaks, moderate ramp rates, provide grid services
  - Enhance energy efficiency
  - Integrate distributed and renewable resources

- **How can we optimize facility interactions with the grid?**
- **How can states fashion policies, programs, and regulations to advance such optimization through GEB?**
- **What are roles for states, facility operators, utilities, product and service providers, and others?**

Grid-interactive Efficient Building




Information Sheet
Colorado

Xcel Energy

Community Energy Storage Project in Stapleton Neighborhood

Project overview

As the demand for solar energy at our customers' homes and businesses increases, Xcel Energy is examining how battery storage can help integrate higher concentrations of photovoltaic (PV) solar energy on our system. As part of an energy storage demonstration project, Xcel Energy is installing six customer batteries and six larger grid batteries in Denver's Stapleton neighborhood. The batteries will operate to manage solar integration and also support other areas of the grid.

This pilot project is one of two approved in March 2016 by the Colorado Public Utilities Commission (PUC) under the company's Innovative Clean Technology (ICT) Program.

Xcel Energy is particularly interested in learning about how battery storage can help:

- Increase the ability to accommodate more solar energy on our system
- Manage grid issues such as voltage regulation and peak demand

Enabling Clean Energy in Disadvantaged Communities using Integrated PV+Storage - Willowbrook

COLORADO
Energy Office

The Colorado Residential Retrofit Energy District ("Colorado RRED")

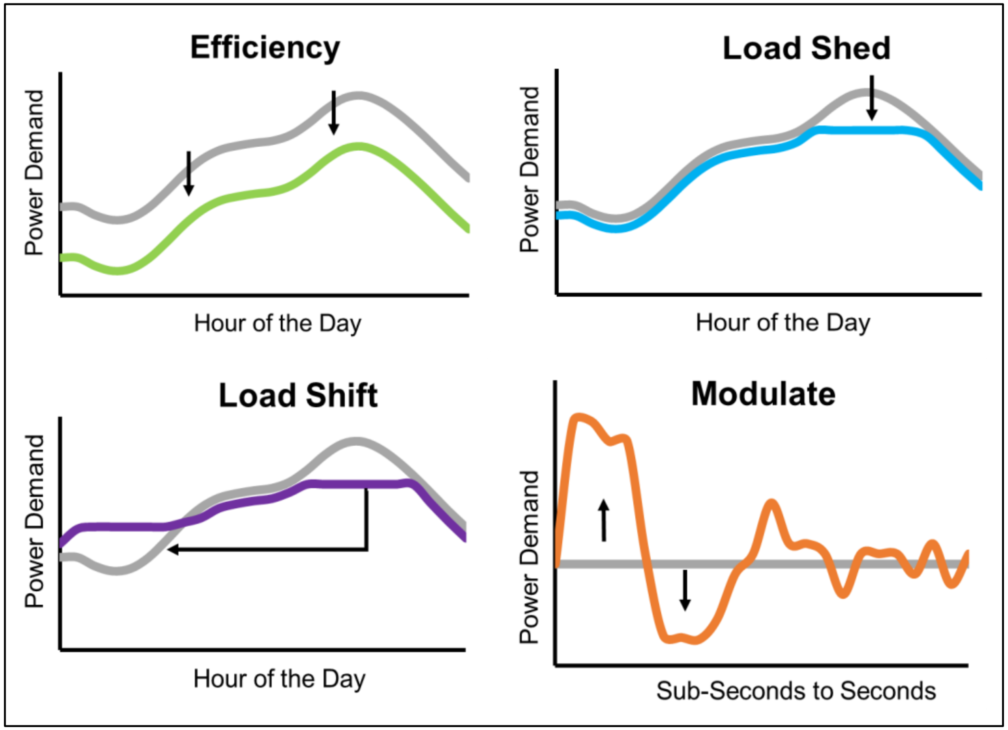
Project Overview

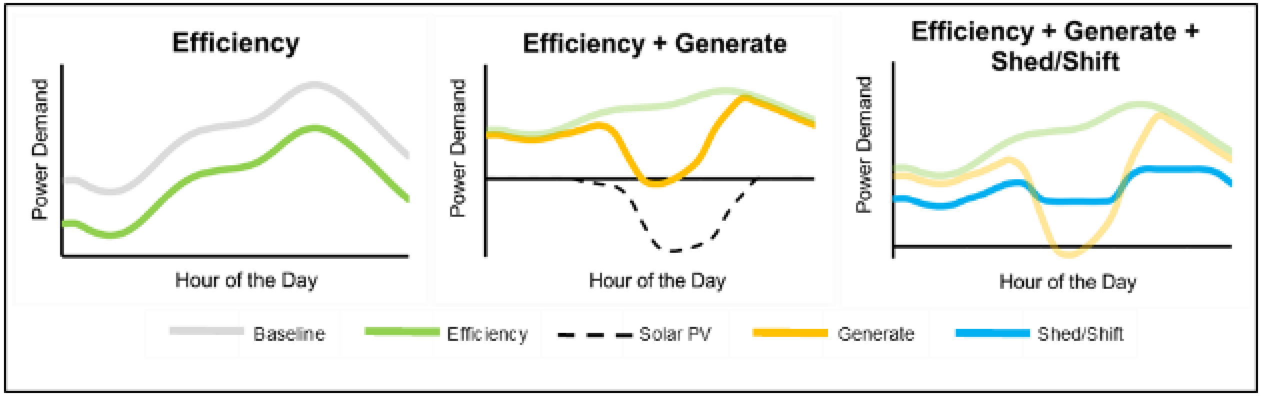
CEO-- along with the National Renewable Energy Laboratory, the Rocky Mountain Institute and Xcel Energy-- is proposing to scope, construct, study and evaluate a residential energy district through building retrofits. An energy district is a system of interconnected buildings that incorporates distributed energy resources, energy-efficient technologies, energy storage, and advanced building controls to optimize energy load and performance. Energy districts have the opportunity to provide greater demand-side management (DSM) and system benefits than individual measures, such as distributing load across an extended time period, mitigating grid constraints, and increasing system reliability and resiliency.

Key Characteristics of GEB

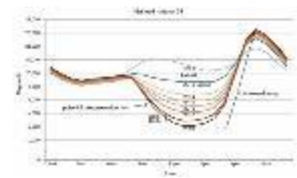
EFFICIENT	CONNECTED	SMART	FLEXIBLE
Persistent low energy use minimizes demand on grid resources and infrastructure	Two-way communication with flexible technologies, the grid, and occupants	Analytics supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences	Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate energy use

Demand Flexibility Provided by GEB

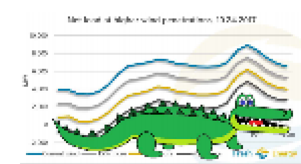




+ NASEO-NARUC Grid-Interactive Efficient Buildings Working Group



- NASEO-NARUC GEB Working Group
  - Supported by U.S. DOE BTO
  - Inform states about GEB technologies and applications
  - Identify opportunities and impediments
    - Non-technical and technical
  - Identify and express state priorities, concerns, interests
  - Recognize temporal and locational value of EE and other DERs
  - Enhance energy system reliability, resilience, and affordability



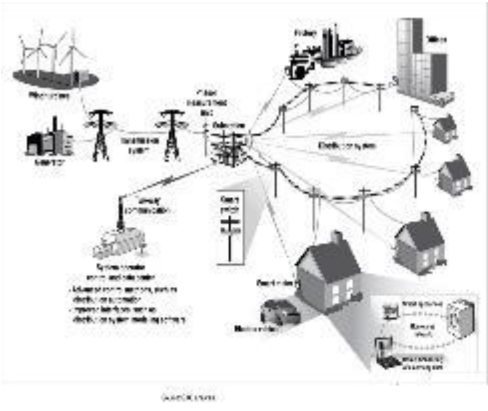
  - **Inform state planning, policy, regulations, and programs**
    - Advance potential roadmaps and pilots

+ NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

- NASEO-NARUC GEB Working Group
  - Webinar series—available to all states
  - Briefing papers planned
    - Non-technical and technical considerations
  - Working Group state engagement
    - State specific calls
    - Topical calls and exchanges
    - Workshop (at NASEO Annual Meeting, Sept 16, 2019)
  - Scoping of model GEB road mapping kit
    - Help states to explore GEB in their state contexts
  - Scoping potential state pilots
    - Inform development of pilots to explore priority issues

+ NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

- Potential National Laboratory help for Working Group states
  - Scope potential pilots, roadmaps
    - Outline elements, questions, considerations for GEB pilot projects
    - Support state convenings, research, technical consultations
    - Identify policy and regulatory options to facilitate GEB pilots/demonstration
    - Can lead to policy and regulatory pilots
    - Can lead to physical pilots/demonstrations



NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

- Working Group co-chairs:
  - Kaci Radcliffe, Oregon Dept. of Energy
  - Hanna Terwilliger, Minnesota PUC staff
- Working Group states:

Colorado	New Jersey
Connecticut	New York
Florida	Oregon
Hawaii	South Carolina
Massachusetts	Tennessee
Michigan	Virginia
Minnesota	Wisconsin

GEB Resources

- DOE GEB page https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings
  - Factsheet https://www.energy.gov/sites/prod/files/2019/04/f62/bto-geb-factsheet-41119.pdf
  - Overview https://www.energy.gov/sites/prod/files/2019/04/f61/bto-geb_overview-4.15.19.pdf

- Webinar: NASEO-NARUC Grid-Interactive Efficient Buildings Working Group: GEB and Automated Demand Response https://naseo.org/event?EventID=6791 April 10, 2019
  - Rodney Sobin (NASEO), Monica Neukomm (U.S. DOE), Mary Ann Piette (LBNL)

- 2019 NASEO Energy Policy Outlook Conference https://energyoutlook.naseo.org/pre-conference-meetings
  - Grid-interactive Efficient Buildings - David Nemtzow
  - Buildings-to-Grid: Critical Issues for Decision Makers - Natalie Mims Frick

- 2018 NASEO Annual Meeting (Detroit) https://annualmeeting.naseo.org/agenda
  - Grid-Interactive Efficient Buildings: Energy Efficiency & Grid Optimization - David Nemtzow (U.S. DOE)
  - What's Next for Energy Efficiency: Grid Interaction - Chris Baker (The Weidt Group)
  - Grid Interactive Efficient Buildings - Jan Berman (PG&E)
  - Smart Neighborhood - James Leverette (Southern Co.)

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

Questions/inquiries:

Rodney Sobin rsobin@naseo.org

Danielle Sass Byrnett dbyrnett@naruc.org

Key Points

- Key characteristics of GEB include efficiency, connectivity, intelligence and flexibility with respect to interactions between buildings and the grid.

- NASEO's working group on the subject aims to provide its stakeholders and other interested parties with a variety of resources to assist GEB advancement.

- The working group will inform state planning, policy, regulations and programs.

Kara Saul Rinaldi
AnnDyl Policy Group

U.S. DEPARTMENT OF ENERGY

Grid-Interactive Efficient Buildings in the Residential Sector

Connected Homes and the Grid

Kara Saul Rinaldi
President/CEO
AnnDyl Policy Group, LLC

Better Buildings Residential Network
Peer Exchange Call, July 25, 2019

Outline of Presentation

- **Smart Home Report** (October 2018)
  - Background/Findings
  - Recommendations
- **Residential GEB Report** (forthcoming: Fall 2019)
  - Overview
  - Barriers and Challenges
  - Policy/Regulatory Opportunities

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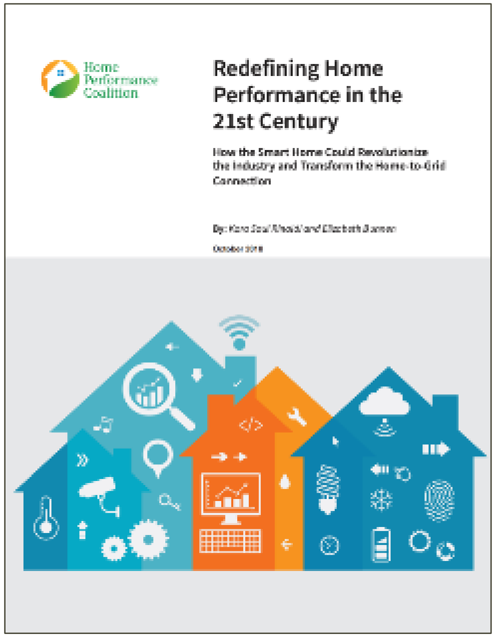
Redefining Home Performance in the 21st Century:

How the Smart Home Could Revolutionize the Industry and Transform the Home-to-Grid Connection



BUILDING PERFORMANCE ASSOCIATION

http://www.building-performance.org/sites/default/files/HPC_Smart-Home-Report_201810.pdf

Background/Findings

- Boom of smart devices, home energy management systems (HEMS)
- Opportunities and benefits for:
  - Homeowners
  - Utilities and the grid
  - Home performance professionals
- Importance of Non-Energy Benefits

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Recommendation #1

Combine smart home technologies and solutions with home performance retrofit programs to maximize home performance program efficiency.

Image credit: 123RF

AnnDyl Policy Group

Recommendation #2

Use Smart Home technology to reach low-income families with home performance and energy efficiency programs.

Image credit: 123RF, Shutterstock

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Recommendation #3

Use Performance-based Policies and Incentives

Image credit: 123RF, Shutterstock

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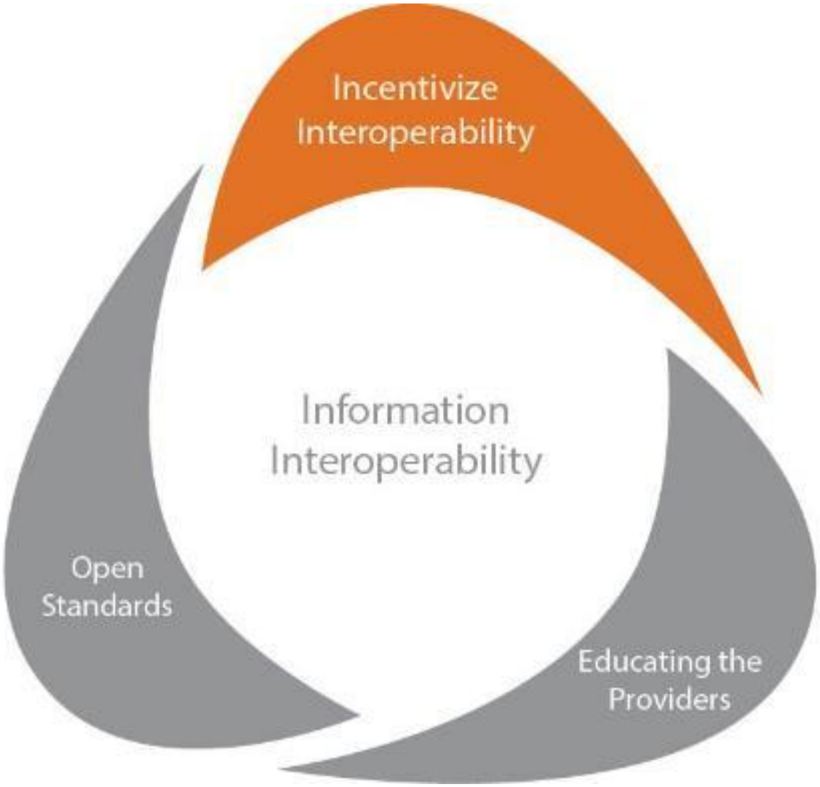
Recommendation #4

Incentivize Interoperability



Recommendation #5

Improve Data Access and Data Transfer Policies and Increase Data Sharing

Image credit: 123RF

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Recommendation #6

Develop Replicable Best Practices for Privacy and Security

Image credit: Unsplash_Sai Kiran

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Recommendation #7

Focus on the Customer

Image credit: Shutterstock

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Recommendation #8

Promote Contractor Certifications

Recommendation #9

Implement Time of Use Pricing

Recommendation #10

Pay Attention to Appliances

Image credit: Unsplash_Jens Kreuter, Unsplash_Naomi Hebert, LG, Philips, Nest

AnnDyl Policy Group

Residential GEB Report

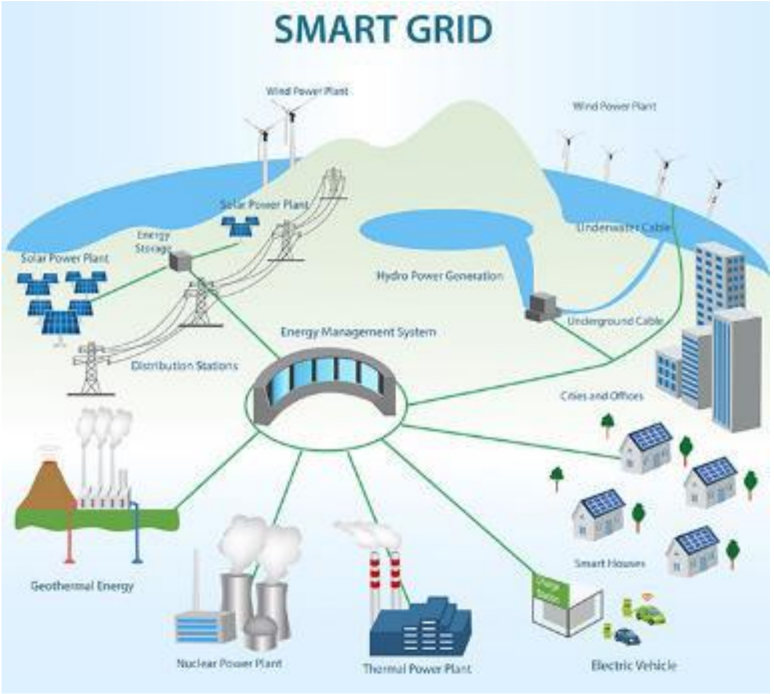
National Association of State Energy Officials

- NASEO-NARUC GEB Working Group briefing paper: **“Residential Roadmap to Grid-Interactive Efficient Building Technology and Policy”**
  - Focus primarily on single-family homes
  - Interviews with software providers, device manufacturers, utilities, utility commissioners, state energy officials, and industry experts
  - Literature review

AnnDyl Policy Group

Why Connected Homes?

- Changing electric grid
  - Renewables = new peaks, valleys
  - DERs, two-way power flows
  - Goals: clean, affordable, resilient, reliable
- Residential buildings are an under-addressed contributor to peak demand
- ***GEBs provide occupant and grid benefits***



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Components of a Residential GEB

1. Traditional energy efficiency measures are the foundation
2. Home Energy Management Systems (sensors, intelligent control, optimization)
3. Storage: Battery, Thermal, EV chargers
4. Distributed Generation
5. Smart Meters & Interoperability

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Barriers & Challenges

- EE, DR, other DERs are siloed
- Valuing all GEB benefits
- Traditional utility planning + infrastructure investment
- Educating and engaging homeowners & contractors
- Interoperability/data access/ standard communications protocols
- Equity and rural broadband access

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Policy/Regulatory Opportunities

- Integrated Demand Side Management (IDSM)
- Cost-Effectiveness Testing
- Utility planning & incentive structures
- Time-Varying Rate Structures
- Measured savings models (P4P)
- Use real-time granular data to verify savings, improve programs
- Access to utility data
- Low and Moderate Income (LMI)
- Building codes
- Interoperability Incentives/Requirements
- Energy Policy Goals: RPS, EERS, Clean Peak Standard (CPS), emissions targets

AnnDyl Policy Group

Thank you!

Kara Saul Rinaldi
President & CEO
AnnDyl Policy Group
kara@anndyl.com

AnnDyl Policy Group

Key Points

- Residential buildings are an under-addressed contributor to peak demand.
- Components of a residential GEB include traditional EE measures, a home energy management system, energy storage, distributed generation, and smart meters & interoperability.
- GEBs provide occupant and grid benefits.

Explore the Residential Program Solution Center

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.

https://rpsc.energy.gov

Thank You!

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Office of Energy Efficiency and Renewable Energy Facebook

Please send any follow-up questions or future call topic ideas to:
bbresidentialnetwork@ee.doe.gov