Better Buildings Residential Network Peer Exchange Call Series:

Making the Grid Smart: Moving Toward Two-Way Communication in the Digital Age

May 9, 2018

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers:
  - **Ronny Sandoval**, Environmental Defense Fund
  - **John Farrell**, Institute for Local Self-Reliance
  - **Mark Frankel**, New Buildings Institute
- 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.

Opening Poll

- Which best describes your organization's familiarity or experience with two-way communication with the grid and its connection to residential energy efficiency?
  - Very experienced/familiar
  - Some experience/familiarity
  - Limited experience/familiarity
  - No experience/familiarity
  - Not applicable

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- Solution Center guided tours

Commitment:

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

Upcoming calls:

- May 24th: The Envelope Please…Lessons from Home Performance with ENERGY STAR Contractor of the Year Winners
- June 14th: How Health Is Reshaping the Residential Energy Efficiency Field
- June 28th: Renters and Residential Energy Efficiency

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*

Ronny Sandoval
Environmental Defense Fund

U.S. DEPARTMENT OF ENERGY

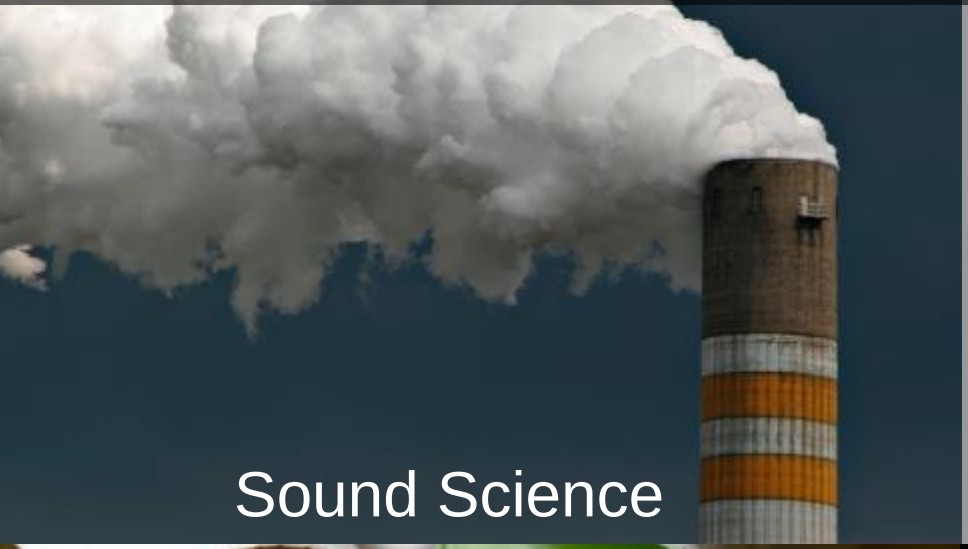
Grid Modernization

The foundation for climate change progress

Presented by:
Ronny Sandoval, Director, Grid Modernization

EDF
ENVIRONMENTAL DEFENSE FUND

Environmental Defense Fund's Approach



Sound Science

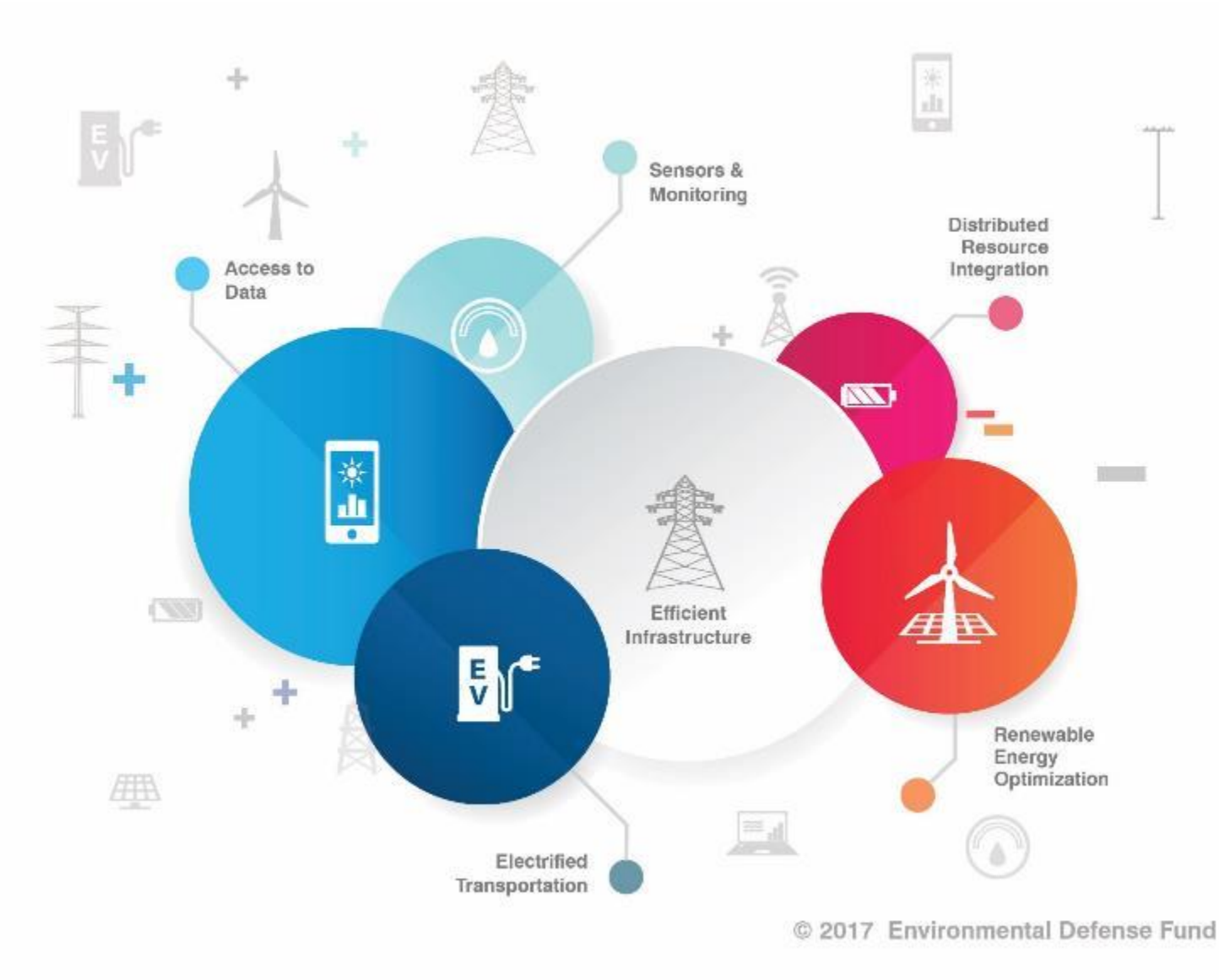
Corporate Partnerships

Market-Based Solutions

Non-Partisan Policy


CLIMATE + ENERGY
OCEANS
ECOSYSTEMS
HEALTH

How do we modernize the grid?



Sensing and Monitoring for Enhanced System Awareness

Creating a framework for full value: reliability, resiliency, efficiency and lower carbon

Key benefits:

- Greater visibility and control over the system
- Generate critical energy data

Intelligent Integration of Diverse Distributed Resources

Diversity of small-scale supply resources and increasingly engaged energy users add up to a stronger, cleaner grid

Key benefits:

- More affordable investments in managing the grid
- Rely on more clean, distributed energy
- Greater flexibility

Maximizing the Role of Renewable Energy

Flexibility from technologies and markets leads to optimization of carbon-free resources

Key benefits:

- Maximize effectiveness of clean energy resources with advanced forecasting
- Rely on more clean, renewable energy by lining up demand with renewable supply

Electrification of Transportation Systems

Zero-emissions vehicles drive new opportunities for utilities while significantly decarbonizing transportation

Key benefits:

- Smart charging of electric vehicles can align energy demand with clean, renewable resources
- Reduce harmful pollution from transportation

Helping consumers make smart decisions that benefit themselves and the shared electric grid

Key benefits:

- Increased communication for outages and restoration
- Support for community based projects
- More options for customers and third parties for smart energy management

Efficient Transmission and Distribution Management

Smarter, cleaner use of new and existing infrastructure

Key benefits:

- Rebuild our aging infrastructure and meet future energy needs
- Increase the utilization of equipment we already have
- Great efficiency, cost-effectiveness, and reliability

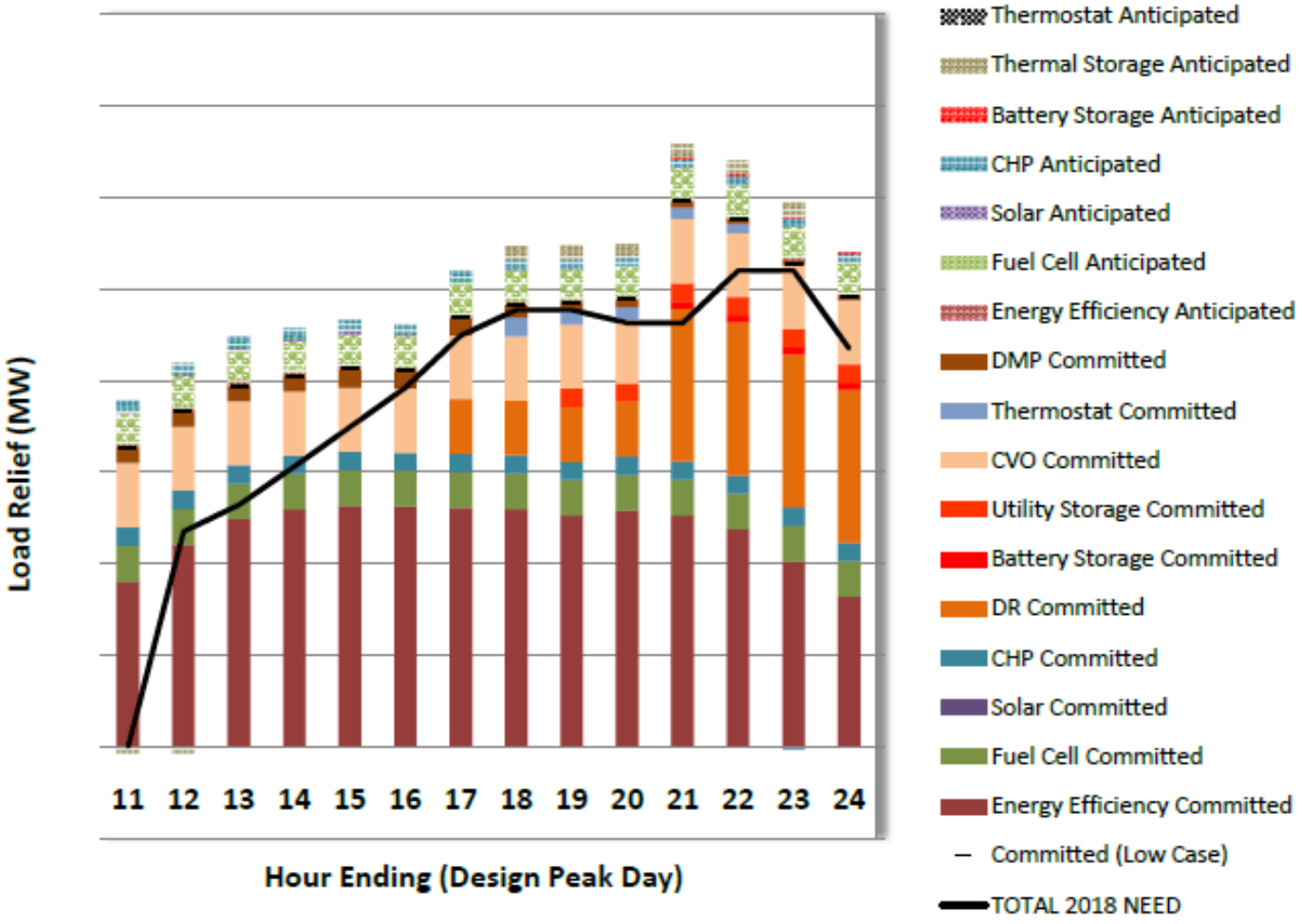
Benefits

- ✓ Increased system efficiency
- ✓ Low cost, reliable energy service
- ✓ Resiliency in the face of extreme weather events
- ✓ Greater customer choice of products and services
- ✓ Cleaner, more sustainable energy system

BQDM CUSTOMER, UTILITY SIDE SOLUTIONS PORTFOLIO

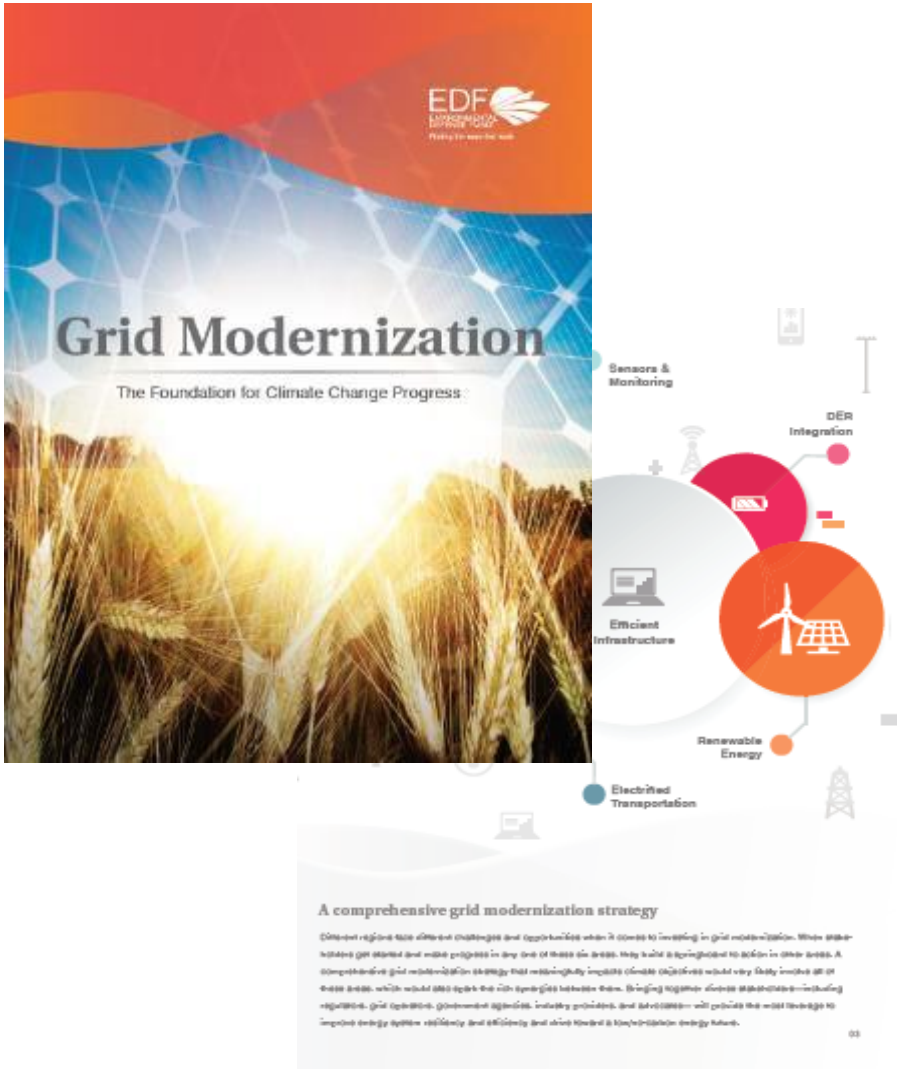
Summer 2018 Outlook

ACRONYMS
DR – Demand Response
CHP – Combined Heat and Power
DMP – Demand Management Program
CVO – Conservation Voltage Optimization
C&I – Commercial and Industrial



Source: Consolidated Edison

Grid Modernization:
The Foundation for Climate Change Progress



Report Now Available

Download at:

www.edf.org/moderngrid

GMI Scoring—Top Ten States

STATE SUPPORT
32PTS

- Grid Modernization Policy/Plan
- Data Access RPS/EERS
- Security Plans
- Education/Outreach/Measurement/ Reporting Requirements
- DER Incentives/Mandates
- Workforce/Economic Development

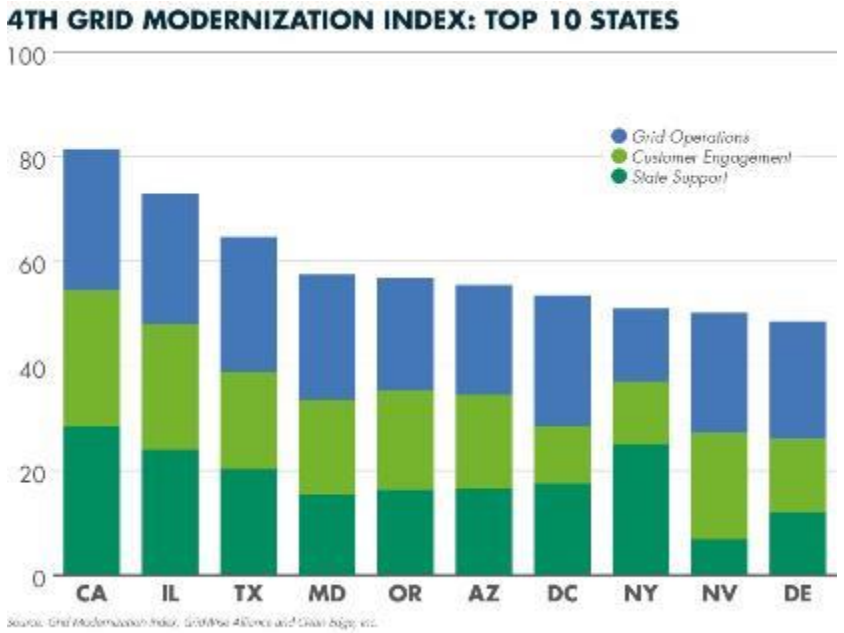
CUSTOMER ENGAGEMENT
31PTS

- Dynamic Tariffs/Rate Structures
- Communication with Customers
- DER Tariffs
- Data Access/Sharing
- Customer Segmentation/Analytics

GRID OPERATIONS
37PTS

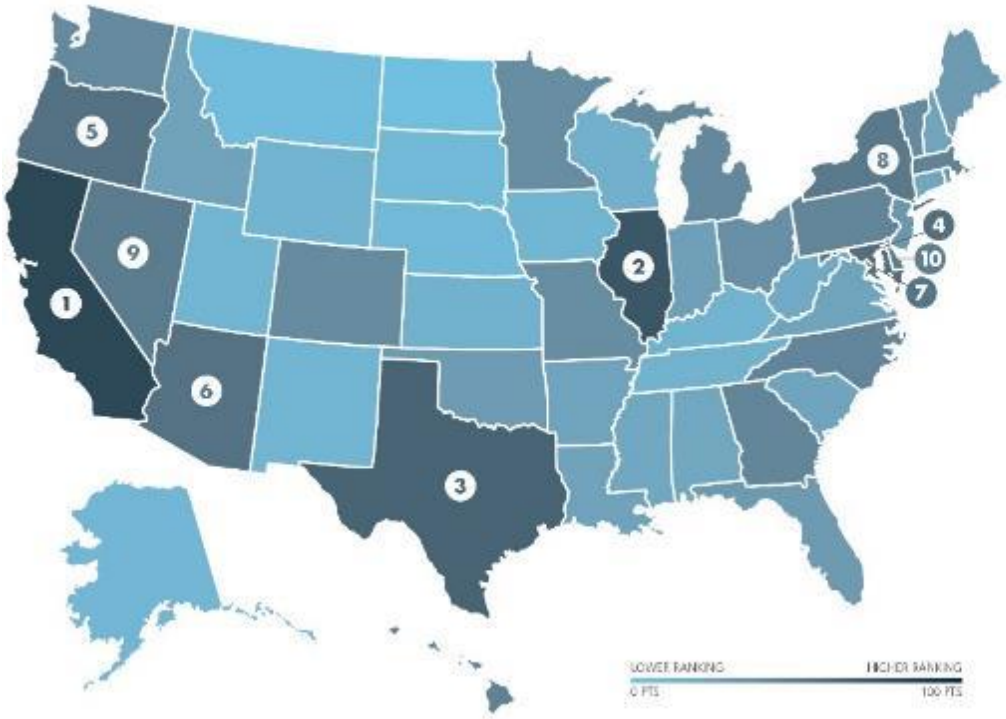
- AMI Penetration/Integration
- Advanced Sensors for Transmission & Distribution
- Energy Storage & Microgrids
- Integration of Distribution Management Systems
- Probabilistic Planning
- Advanced GIS & Visualization

100 TOTAL POINTS



Overall Results

OVERALL RESULTS



RANK	+/-	STATE	LEADERSHIP SCORE
1	0	California	81.5
2	0	Illinois	73.0
3	0	Texas	64.6
4	0	Maryland	57.5
5	2	Oregon	56.8
6	3	Arizona	55.5
7	-2	District of Columbia	53.5
8	8	New York	51.0
9	5	Nevada	50.1
10	-4	Delaware	48.5
11	1	Hawaii	46.0
12	8	Massachusetts	44.8
13	-5	Pennsylvania	44.0
14	4	Georgia	43.5
15	4	North Carolina	43.3
16	-1	Michigan	41.7
17	12	Washington	40.5
18	17	Colorado	40.0
19	-6	Vermont	39.6
20	2	Missouri	39.0
21	-2	Minnesota	38.8
22	-3	Ohio	36.8
23	25	Rhode Island	34.0
24	-2	New Jersey	32.3
25	-8	Florida	30.1
26	-5	Maine	29.5
27	-9	Oklahoma	29.0
28	-6	Indiana	27.0
29	4	Louisiana	24.4
30	2	Idaho	23.9
31	-8	Virginia	23.4
32	-2	Arkansas	23.2
33	1	South Carolina	23.1
34	-6	New Hampshire	21.6
35	-4	Connecticut	21.4
36	-7	Mississippi	21.3
37	-10	Alabama	21.0
38	-1	West Virginia	19.0
39	1	Wisconsin	15.1
40	-4	Kansas	14.4
41	3	Tennessee	13.2
42	-3	Wyoming	11.9
43	2	Kentucky	11.6
44	-3	New Mexico	11.0
45	1	Iowa	10.7
46	-8	Utah	10.5
47	0	Alaska	10.3
48	-6	South Dakota	9.0
49	1	Nebraska	8.5
50	-1	Montana	6.3
51	0	North Dakota	3.3

Key Takeaways

1 **The pace of grid modernization efforts has accelerated, particularly on the policy front.** Many states are undertaking grid modernization initiatives or proceedings, including facilitating the adoption of advanced metering infrastructure (AMI), DERs, implementing pricing schemes and demand response (DR) mechanisms, and enacting other related policies. These actions are aimed at expanding the use of renewable energy resources, storage, and electric vehicles; increasing operational efficiency; and improving resilience.

2 **Recent hurricanes and other extreme weather events, as well as human-caused cybersecurity and physical security threats, are focusing attention on grid resilience.** While some states are leading the way, GMI-4 shows that several states are actively planning for and incentivizing resiliency and security. These efforts will begin to expand to other states, ensuring that customers are less vulnerable to natural and man-made disasters.

3 **Leading states continue to make progress toward comprehensive grid modernization.** Each state follows its own approach to policy, business and regulatory models. Unique local and regional circumstances compel each state to develop its own approach to grid modernization. However, it is critical that states pioneering new ideas effectively communicate lessons learned to states that can build on their experience.

4 **Many states are just beginning their own grid modernization efforts.** As innovative new technologies become more cost-effective, additional states are joining the leaders in actively pursuing grid modernization agendas. As more and more initiatives and programs show clear benefits, additional states are actively engaging in the discussion and implementation of grid modernization efforts.

5 **Some of the early movers may be seeing their momentum slow, particularly in the Grid Operations category.** Some states that received an influx of American Recovery and Reinvestment Act (ARRA) funding to modernize their grid are being surpassed by states with ongoing, locally-funded efforts.

6 **Utilities are prioritizing efforts to address customer demands for greater choice and the capability to manage their own energy usage.** The trend is towards greater utility engagement and communications with customers. Investments in a range of technologies enable these efforts, providing greater visibility to customers and enhancing situational awareness for grid operators. Innovative utilities are creating better methods for communicating critical information to customers.

7 **Clean energy targets by states, cities, and corporations are driving utility efforts to accommodate rapid growth in DERs.** With some states, cities, and corporations now targeting up to 100% renewables, efforts by a growing number of utilities to meet these goals are impacting their long-range planning, product and service offerings, and grid operations.

Download the Grid Modernization Index:
http://www.gridwise.org/

GRIDWISE ALLIANCE

Thank You

Presentation Highlights: Ronny Sandoval

- Grid modernization offers increased system efficiency, affordable and reliable energy service, weather resiliency, increased customer choice and a cleaner, more sustainable energy system.

- Modernization requires a multi-faceted approach
  - Access to actionable energy data
  - Integrated electrified transportation
  - Robust sensors and monitoring capabilities
  - Distributed resource integration
  - Renewable Energy Optimization
  - Efficient Infrastructure

John Farrell
Energy Democracy Initiative, Institute for Local Self-Reliance

U.S. DEPARTMENT OF ENERGY

FINDING MEGAWATTS IN LARGE HOME APPLIANCES

GRID SAVINGS START AT HOME

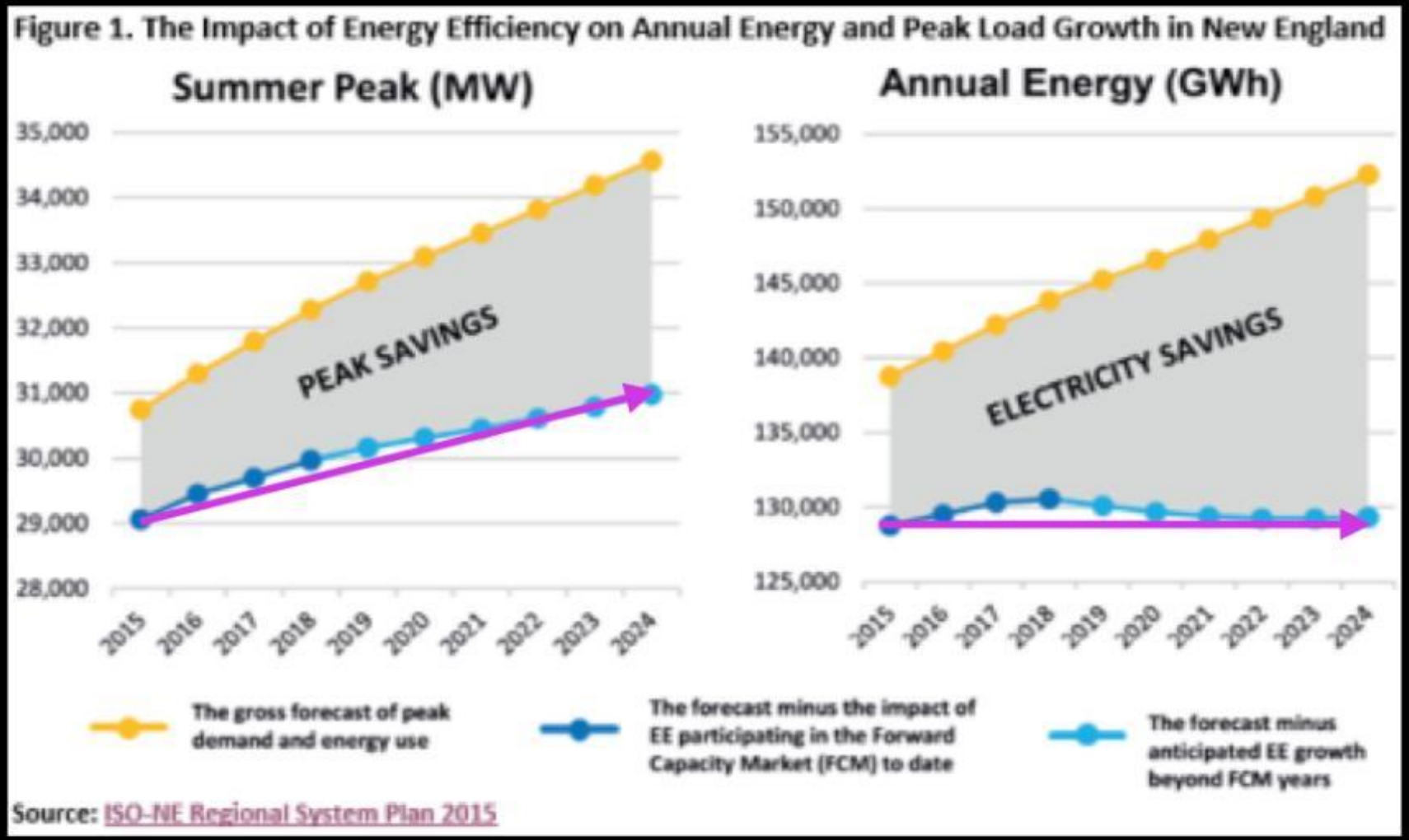
John Farrell
May 10, 2018

Better Buildings Residential Network Peer Exchange Call

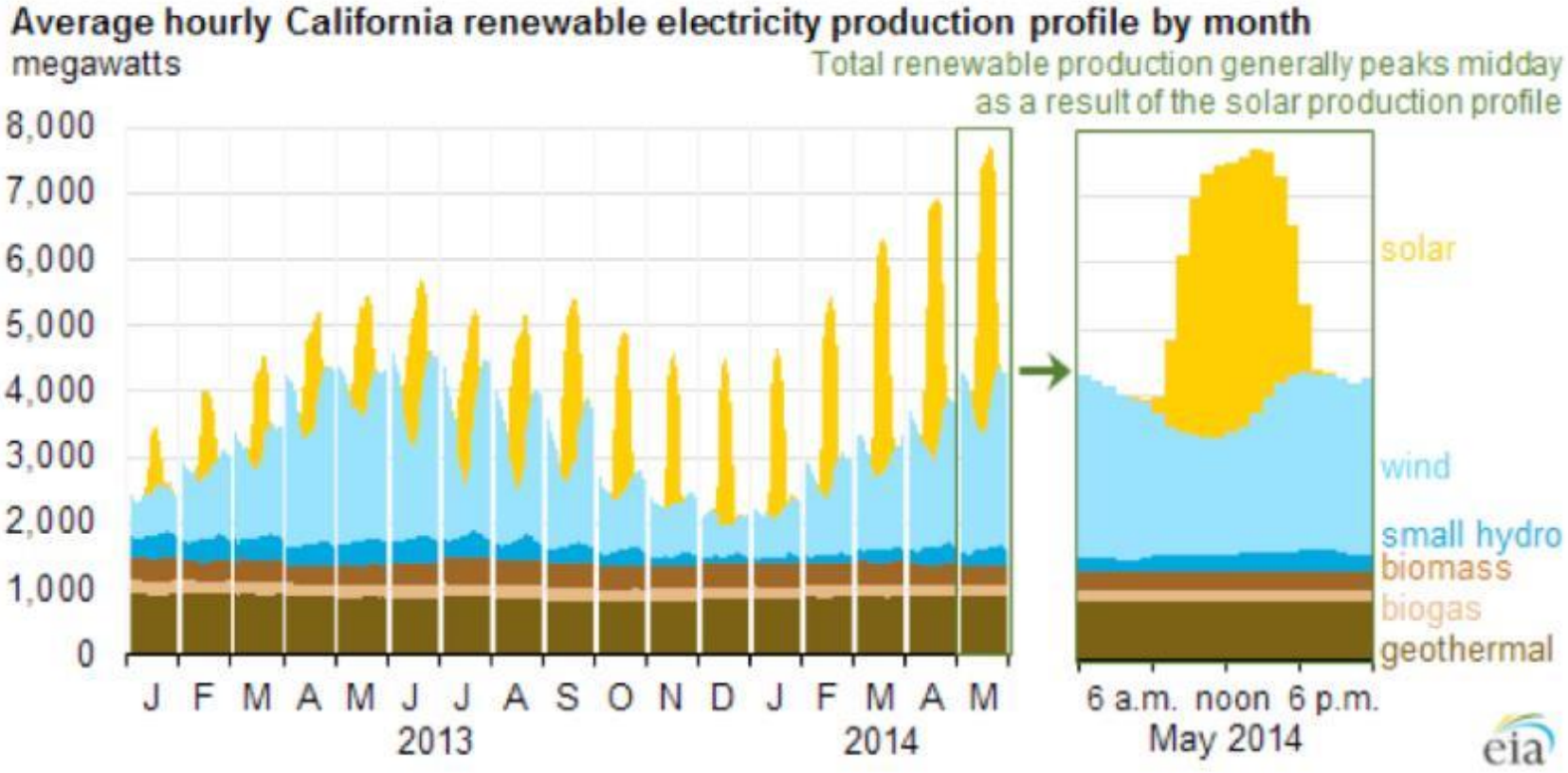
ILSR's ENERGY DEMOCRACY INITIATIVE

Photo credit: Flickr user dollen

RISING PEAK, STAGNANT SALES



VARIABLE SUPPLY



POWERFUL TOOLS

A GIANT BATTERY

100,000

1 gigawatt-hour

GREAT RIVER ENERGY™

PLENTY OF PRACTICE

400,000 air conditioners

300 megawatts

Xcel Energy®

UNPRECEDENTED POWER

BIG SAVINGS WITH SMART TOOLS

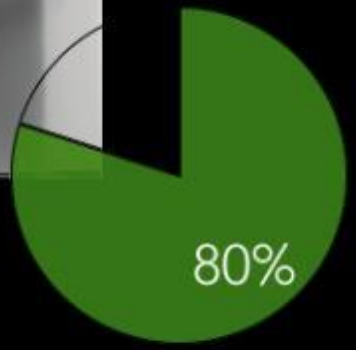
2 kilowatts per customer

OG&E

UNPRECEDENTED POWER

4 APPLIANCES TO UNLOCK SAVINGS

1. REFRIGERATOR



	WATTS
FRIDGE	600

Photo credit: Flickr user Goedeker's

2. DISHWASHER

	WATTS
FRIDGE	600
DISHWASHER	1200

Photo credit: Flickr user HomeSpot HQ

3. CLOTHES WASHER

	WATTS
FRIDGE	600
DISHWASHER	1200
CLOTHES WASHER	500

Photo credit: Flickr user Bart Everson

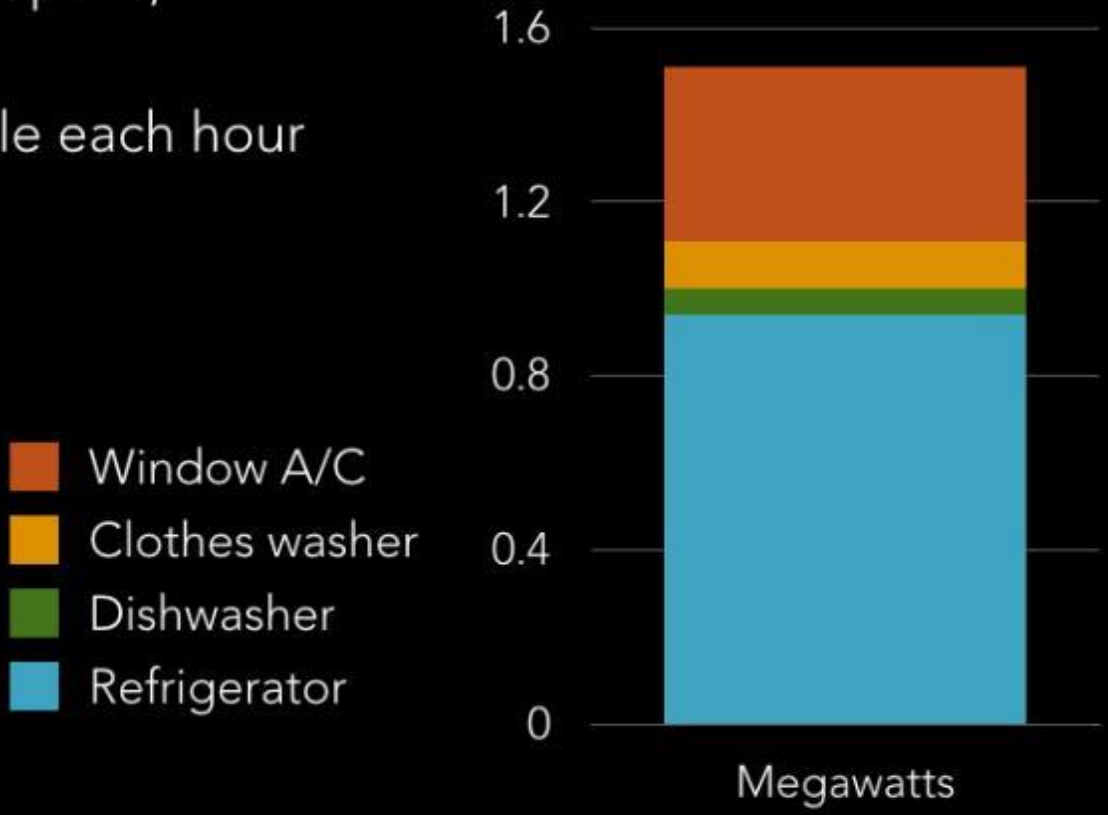
4. WINDOW A/C UNITS

	WATTS
FRIDGE	600
DISHWASHER	1200
CLOTHES WASHER	500
WINDOW A/C	1000
TOTAL	3300

Photo credit: Flickr user noricum

IMPACT: 4% OF PEAK DEMAND

- Simulation in Minneapolis, Minn.
- 10,000 households
- 20% of units available each hour



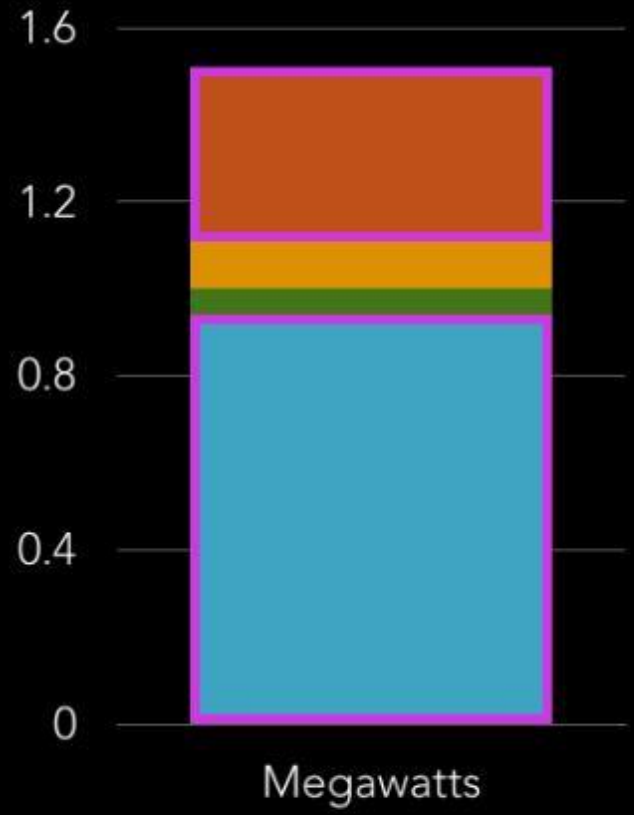
IHSRs
ENERGY DEMOCRACY
INITIATIVE

MANUAL OR AUTOMATIC?

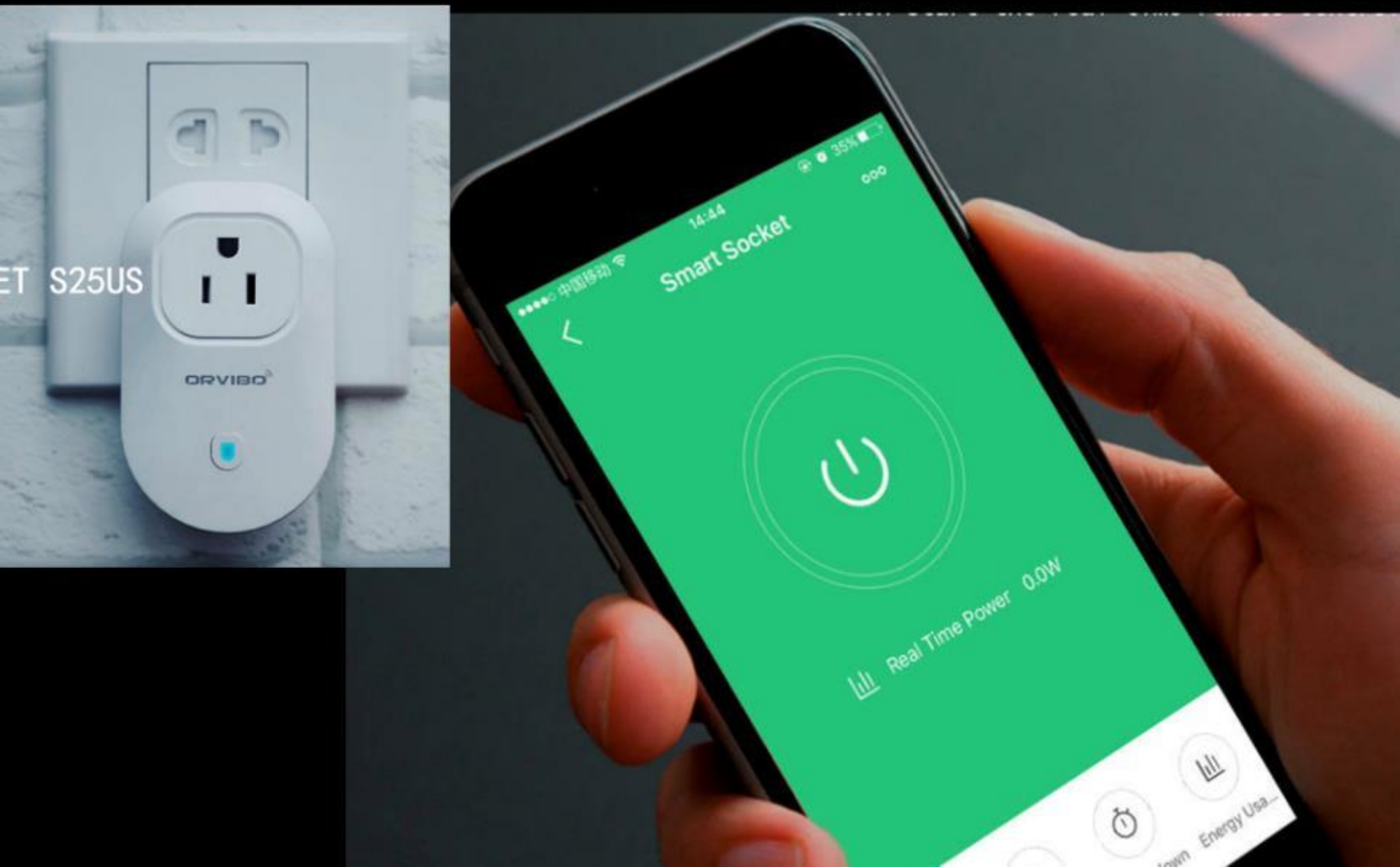
Photo credit: Flickr user Willem van de Kerkhof

IMPACT: 4% OF PEAK DEMAND

Automation works

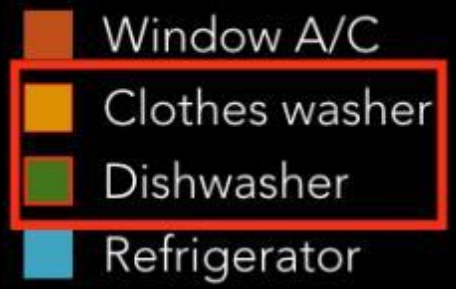


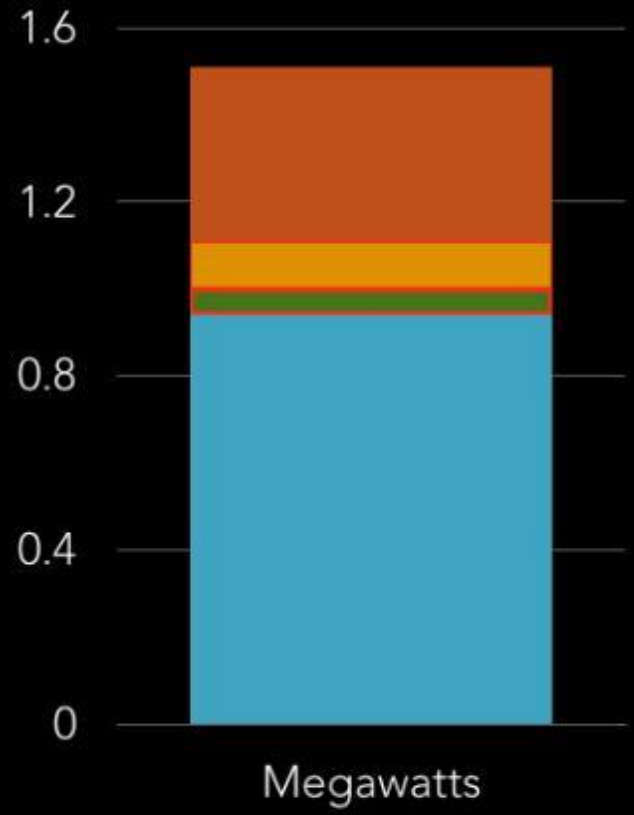
OVER THE COUNTER AUTOMATION



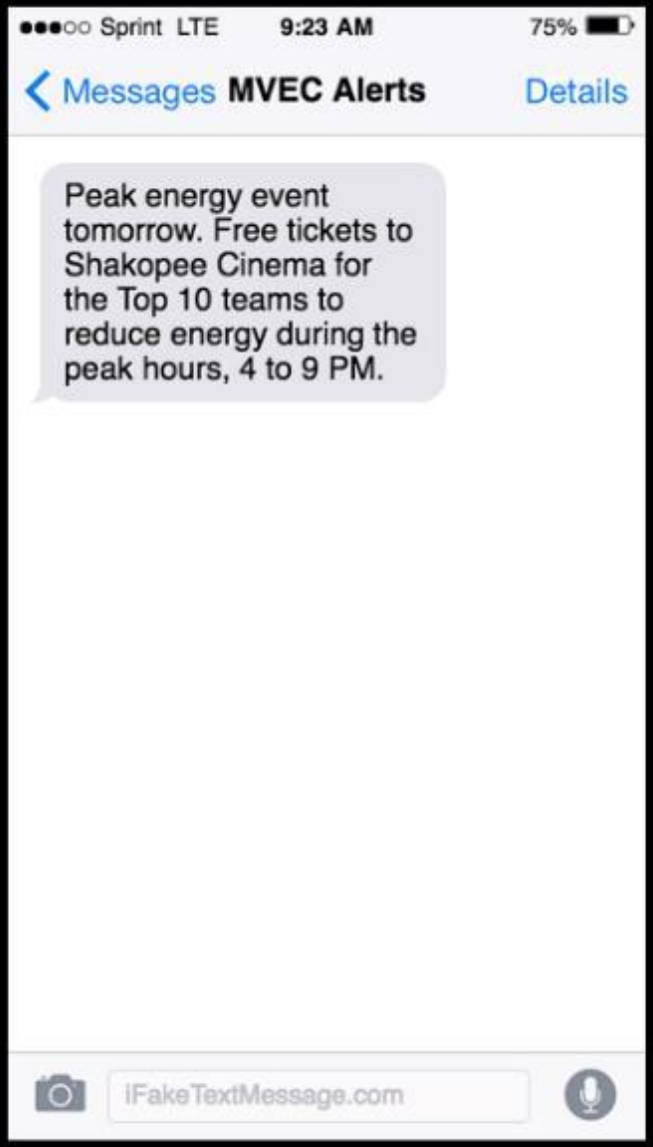
IMPACT: 4% OF PEAK DEMAND

Automation is harder





MANUAL AND AUTOMATED RESPONSE



12 megawatts (7.5%)

MVEC
Minnesota Valley Electric Cooperative
Your Touchstone Energy® Cooperative

Report: Inclusive Financing for Efficiency and Renewable Energy

by John Farrell | Date: 11 Nov 2016 |

Energy efficiency and renewables represent the most promising pathway to lower energy costs for individual consumers and utilities. But limited access hinders progress. Utilities can knock down major barriers to energy efficiency and renewables by allowing customers to make site-specific investments and recovering utility costs through an opt-in tariff. ... Read More

energy efficiency, homepage, on-bill financing, on-bill repayment, renewable energy, report, roanoke

READ MORE

@johnffarrell

DOWNLOAD OUR FULL REPORT

Sparking Grid Savings Starts at Home

John Farrell
October 2016

ILSR's ENERGY DEMOCRACY INITIATIVE

www.ilsr.org

@johnffarrell

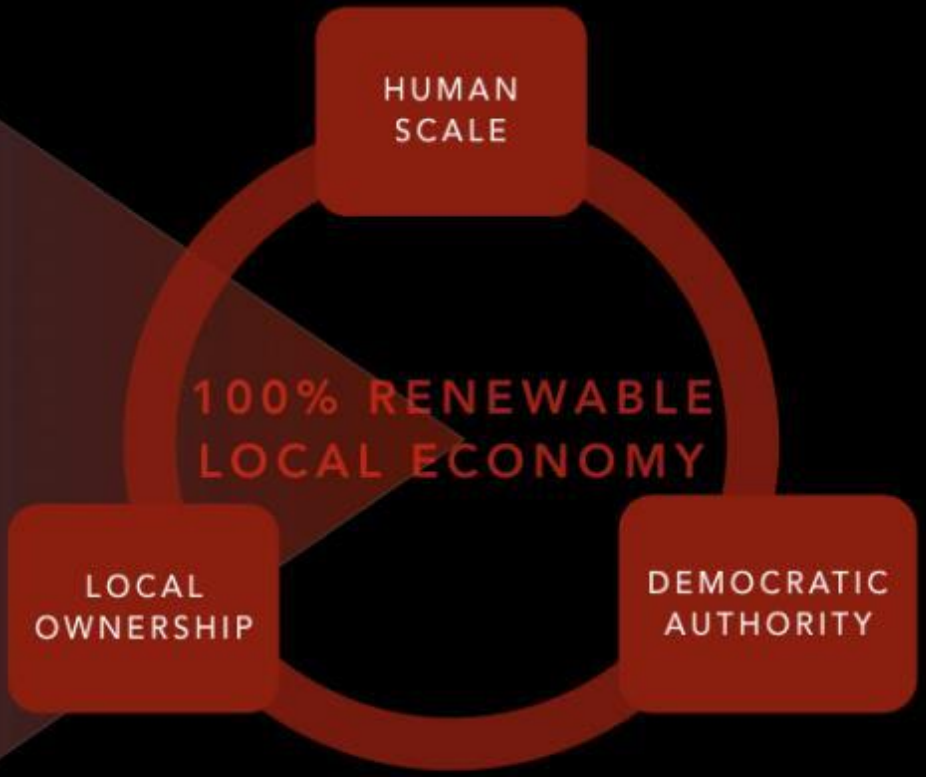
www.ilsr.org

THANK YOU!

ILLUSTRATING THE VISION

PROVIDING TOOLS

CHANGING THE RULES



ILSR's

ENERGY DEMOCRACY INITIATIVE

Presentation Highlights: John Farrell

- Need to reconcile increasing peak demand with proliferation of variable renewable production
- Leverage currently-available resources
  - Electric water heaters as “big batteries”
  - Smart tools offer energy savings and optimized control
- Need better automated-response technologies
- Address limited access to energy efficiency and renewables
    - Encourage utilities to support energy efficiency and renewables access via financing

Mark Frankel
New Buildings Institute

U.S. DEPARTMENT OF ENERGY

The GridOptimal™ Initiative

A New Rating System and Metric For Building-Grid Interactions

New Buildings Institute
U.S. Green Building Council

GridOptimal: Why is it Needed?

- The way buildings interact with the electric grid is evolving rapidly.
- Buildings will face increasing regulatory and economic pressure to be able to respond to changing utility price and delivery structures.
- Designers will need to understand and incorporate strategies that allow buildings to directly interact with the utility grid.
- Adapting to the *Interactive Grid* will be critical to maintaining building services and comfort, and to grid dependability.
- Efforts to decarbonize the electrical grid will require better integration of distributed energy resources

GridOptimal: Why is it Needed?

There are currently no metrics that define building-level grid citizenship, or rate building-grid interaction quality

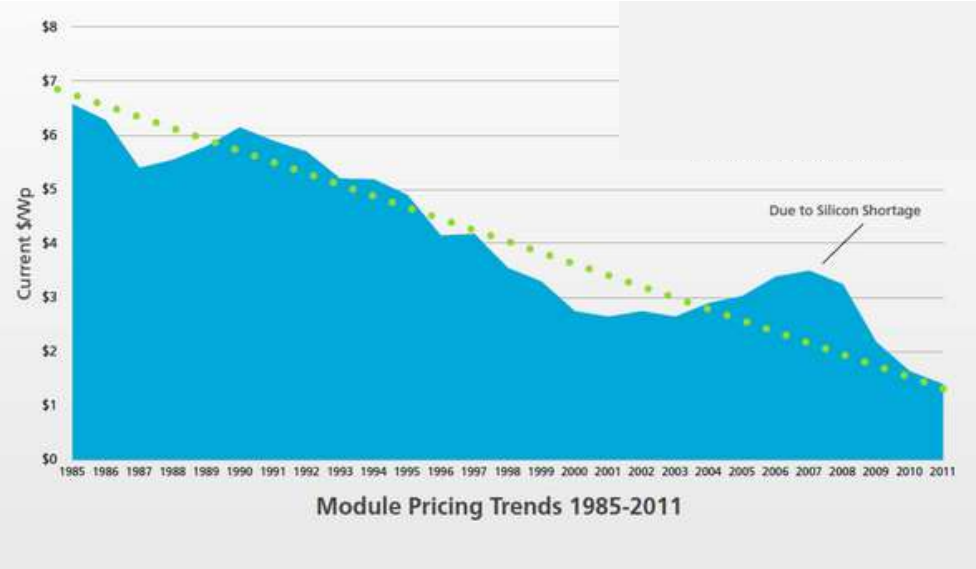
- Different players have **different language** to discuss the topic
- Grid operators and utilities are struggling to **integrate renewable energy** onto the grid
- Catalyze **harmonization** of building design with grid interaction to **reduce curtailment**.

Grid Evolution

One-way power consumption has evolved to a two-way transaction at the building level

“Use As Much As You Want, Whenever You Want”

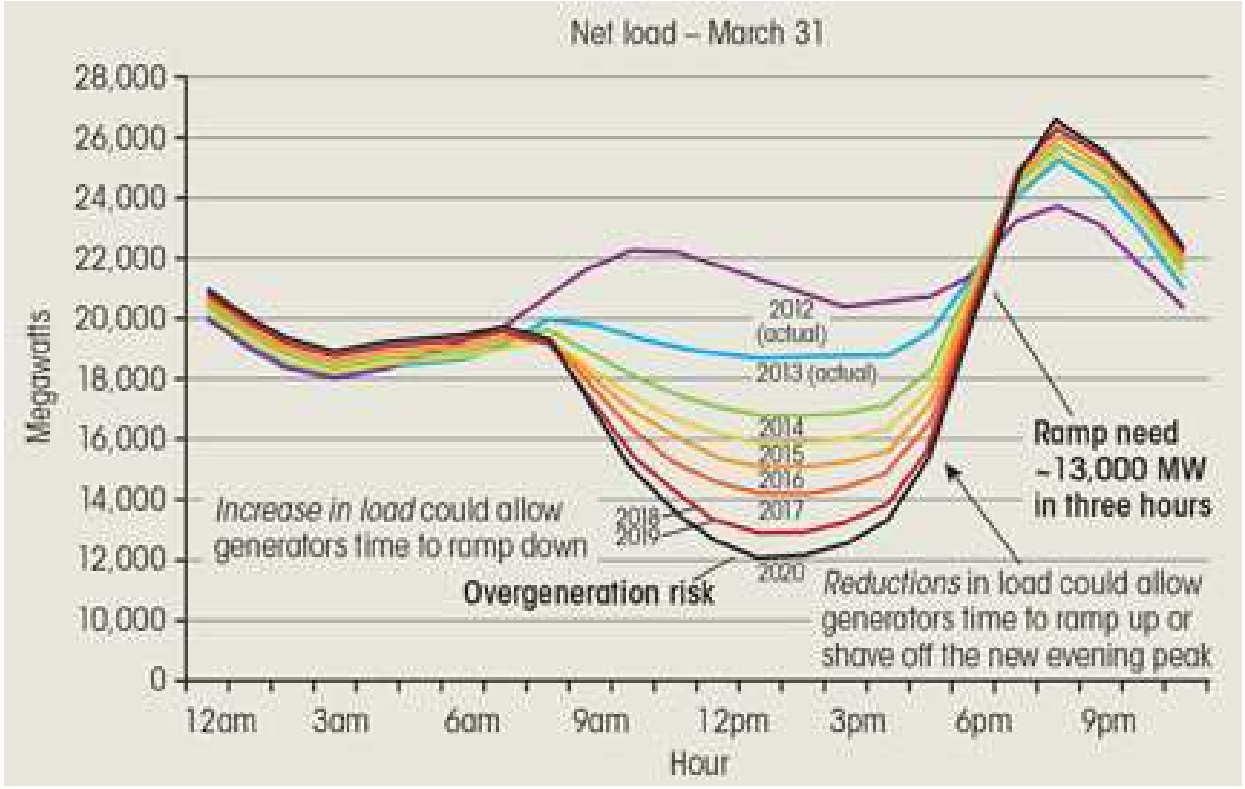
PV Cost Trend Increases Solar Deployment



Source: P. Mints, Navigant Solar Services Program, 2011

2016: 55¢

The Ominous "Duck Curve"



Renewables offset conventional electricity use, but don't reduce the need for peak capacity generating plants. Surplus daytime generation often offsets other renewable energy resources, not conventional generation.

Load imbalance means utilities sometimes have to pay consumers to use energy

NP Newswire Post.
News Commentary Entertainment

News | Politics | Health | Science & Tech | Political

Negative Electricity Rates from Wind-Power Surplus

It's been very windy across Europe this week. So much so, in fact, that the high wind load on onshore and offshore wind turbines across much of the continent has helped set new wind power records.

Opportunities for Building Integration with Grid

- **Permanent Efficiency**
  - Reduce building energy loads…
- **Peak Shifting**
  - Design to modify time of peak building energy use to adapt to grid…
- **Dynamic Response**
  - Actively reduce building energy use in response to short-term grid constraints…
- **Dispatchable Energy Storage**
  - Actively manage energy use patterns based on grid signals…

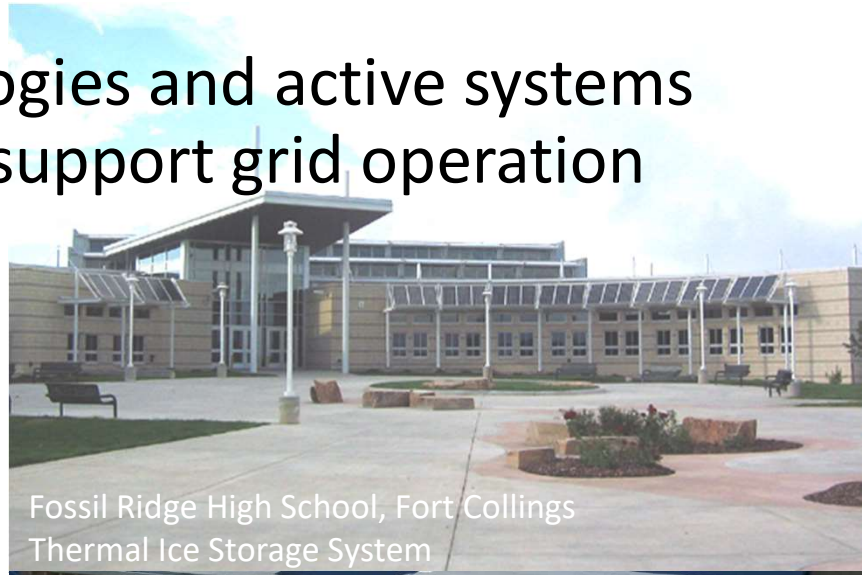
Conventional passive features, carefully deployed, support grid management and resiliency goals

- Thermal Mass
- Daylighting
- Passive Solar Gain
- Natural Ventilation
- Solar Shading
- Super-Insulation

2,600 ft2 home in St. Peter, Minnesota, designed by Sarah Nettleton Architects. Photo Don Wong.

New grid-integrated technologies and active systems becoming more common to support grid operation

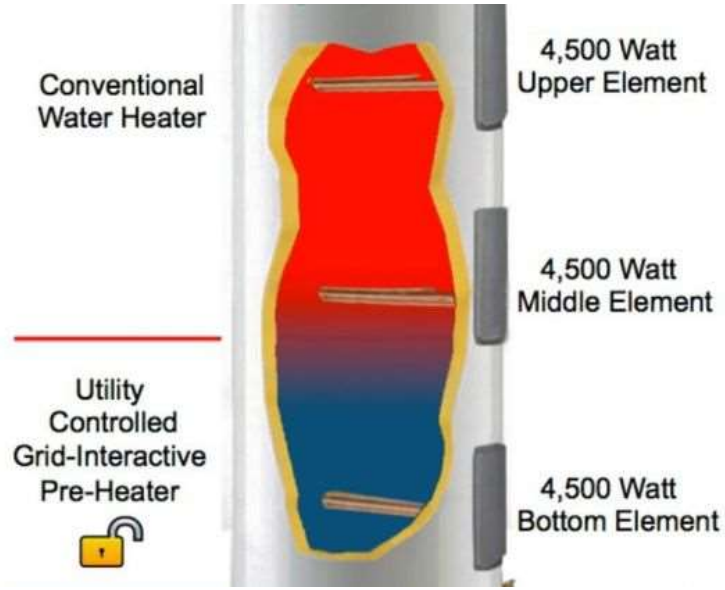
- Direct Demand Response Capabilities
- Thermal Storage
- Dynamic Glazing
- Grid-Integrated Appliances
- On-Site Storage
- Renewable Generation
- Integrated Vehicle Charging
- Staged Workstations



Fossil Ridge High School, Fort Collings
Thermal Ice Storage System

Smart Building Technologies

Variable-Capacity Grid Interactive Water Heater



Which of these devices is not a potential component of the dynamic power grid?

Puerto Rico, 9/22/17 (NBC)

Grid Resiliency

Grid Integration Features in Buildings also Support Resiliency Goals

- Independent power sources (PV) may allow grid-independent operation
- Passive features support building habitability during no-power operation
- Staged start up capabilities can support faster grid recovery after outages
- On-site energy storage can provide emergency support for communities (communication, refrigeration, etc.)

Stakeholders

- Building Industry
  - Designers
  - Owners
  - Operators
- Utilities
  - Resource Planners
  - Distribution Managers
  - Program Implementers
- Regulators and Programs
  - Policymakers
  - Utility Regulators
  - Program Managers
- Service Providers
  - Aggregators
  - Energy Service Providers
  - Equipment Providers

GridOptimal™: How will we do it?

- Bring together **key stakeholders and experts** to develop standards
- Establish **framework for rating system** that will result in program implementation
- Develop the **rating system**, leveraging existing standards
- Identify **pilot projects** and participants
- Outline **incentive programs** and financing mechanisms
- Provide **Educational Guidance**

The GridOptimal™ Initiative

A New Rating System and Metric For Building-Grid Interactions

New Buildings Institute
U.S. Green Building Council

mark@newbuildings.org

nbi new buildings institute

Presentation Highlights: Mark Frankel

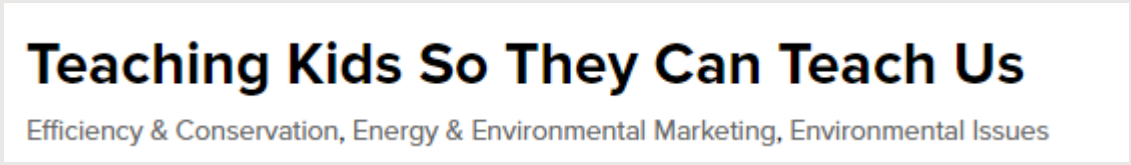
- Building-Grid interaction is changing rapidly
- Opportunities for integration include permanent efficiency, peak shifting, dynamic response and dispatchable energy storage
- Conventional passive features, new grid-integrated technologies and active systems are becoming more common
- Many appliances/devices are potential components of the dynamic power grid
- Grid integration features in buildings also support resiliency

Upcoming Seasonal Messaging Opportunities

Now is the time to start planning energy efficiency messaging!

August and September are Back-to-School season

U.S. DOE's Energy Saver



Shelton Group

Health in Buildings for Today and Tomorrow: Making Connections

- This interdisciplinary event brings together the health and buildings communities to accomplish common goals.
  - July 19 – 20
  - NIH Campus Natcher Center

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!

Follow us to plug into the latest Better Buildings news and updates!

Share with us your top stories on how your organization is accelerating energy savings through efficiency upgrades, strategies, and investment!

Better Buildings Twitter with #BBResNet

Better Buildings LinkedIn

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