Regulatory Paradigms to Support Dynamic Load Flexibility

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U.S. DEPARTMENT OF ENERGY

In Demand: Regulatory Considerations for Load Flexibility

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National Association of Regulatory Utility Commissioners

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What is Demand Flexibility?

Demand flexibility (also known as **load flexibility**) is the capability of distributed energy resources (DERs) to adjust demand profiles across different timescales.

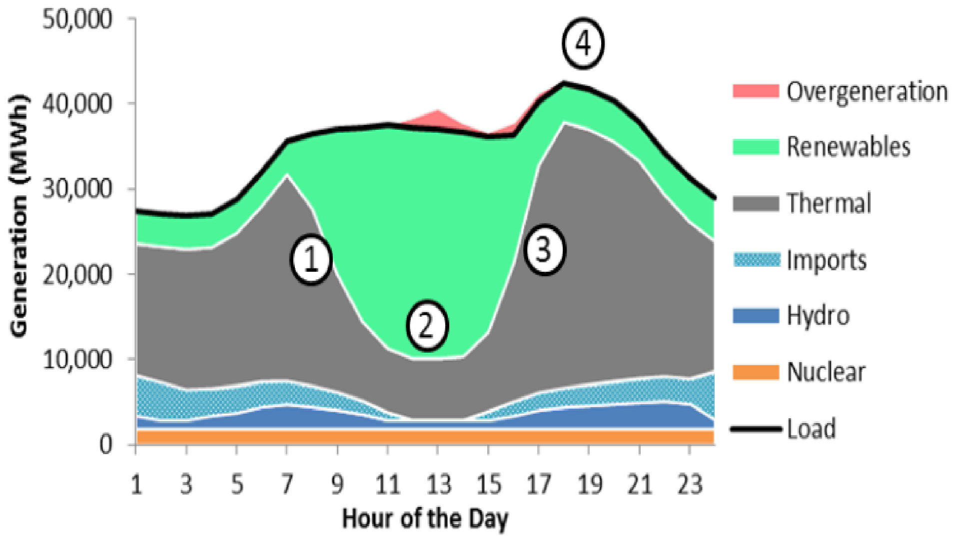
Source: U.S. Department of Energy's Grid-interactive Efficient Buildings

Benefit	Utility System	Society
Reduced operating & maintenance costs	✓	✓
Reduced generation capacity costs	✓	✓
Reduced energy costs	✓	✓
Reduced transmission & distribution costs	✓	✓
Reduced transmission & distribution losses	✓	✓
Reduced ancillary services costs	✓	✓
Increased system reliability	✓	✓
Increased safety	✓	✓
Increased resilience	✓	✓
Increased DER integration	✓	✓
Improved power quality	✓	✓
Reduced customer outages	✓	✓
Increased customer satisfaction	✓	✓
Increased customer flexibility and choice	✓	✓
Reduced environmental compliance costs	✓	✓
Other environmental benefits	-	✓
Economic development benefits	-	✓

Source: Woolf et al, forthcoming

Demand Flexibility and State Goals

- Helps meet multiple state policy goals
  - Energy-related goals like resilience and reliability, energy affordability, emissions, energy efficiency, renewable energy generation, electrification, energy security, grid modernization
  - Other goals such as economic development and critical infrastructure
- Reduces stress on grid
  - Growth in peak demand
  - Infrastructure constraints for T&D systems
  - Increasing share of variable renewable generation — utility-scale and distributed
  - Electrification of space and water heating, industrial processes and transportation
- Provides higher value than traditional grid solutions with additional benefits:
  - For consumers — e.g., asset value, more control over energy use
  - For society — e.g., jobs, energy security, resilience, environmental and public health benefits
- Improves building performance
  - States can lead by example to reduce energy waste, emissions, and electricity costs and improve resilience.



E3 analysis of system flexibility challenges in California

Key Actions States (and Local Governments) Can Take to Advance Demand Flexibility	**Gov. Office**	**PUC**	**SEO**	**Other Agencies***	**City/County**	**Utilities**	**RTO/ISO**	**Bldg. Owners****
1. Gather Information and Identify Opportunities								
Consider how demand flexibility can support goals	●	●	●	●	●	●	●	●
Inventory options and select opportunities for early action	●	●	●	●	●	●	●	●
Participate in pilot projects and share best practices		●	●	●	●	●		●
2. Develop and Implement Strategies in Integrate Demand Flexibility								
Develop a roadmap to advance demand flexibility	●	●	●	●	●	●	●	●
Develop mechanisms to allow building owners, operators, and occupants to earn compensation for providing grid services		●	●			●	●	●
Conduct outreach and education about opportunities and benefits		●	●	●	●	●	●	●
3. Accelerate Adoption								
Assess and remove barriers to advancing demand flexibility in buildings for grid services	●	●	●	●	●	●	●	●
Update economic valuation methods for DERs as energy assets for utility programs, plans and procurements		●				●		●
Establish practices for robust and cost-effective assessments of demand flexibility performance for utility programs and electricity markets		●	●	●	●	●	●	●
Regularly assess and report on progress	●	●	●	●	●	●	●	●

*For example, state departments of general services, codes, environment, economic development, and transportation, and financing authorities.

**Opportunities for owners and operators of privately owned buildings to support state and local activities.

Select LBNL Resources

- State and Local Energy Efficiency Action Network (SEE Action Network). *Grid-Interactive Efficient Buildings: An Introduction for State and Local Governments.* Prepared by L. Schwartz and G. Leventis, Lawrence Berkeley National Laboratory. Forthcoming.
- SEE Action Network. *Determining Utility System Value of Demand Flexibility From Grid-Interactive Efficient Buildings.* Prepared by T. Eckman, L. Schwartz, and G. Leventis, Lawrence Berkeley National Laboratory. Forthcoming.
- SEE Action Network. *Retrospectively Assessing Demand Flexibility Performance of Grid-Interactive Efficient Buildings.* Prepared by S. Schiller, S. Murphy, and L Schwartz, Lawrence Berkeley National Laboratory. Forthcoming.
- T. Woolf, B. Havumaki, D. Bhandari, M. Whited, and L. Schwartz. *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments.* Lawrence Berkeley National Laboratory. Forthcoming.
- Satchwell, A., P. Cappers, J. Deason, S. Forrester, N. Frick, B. Gerke, and M.A. Piette. *A Conceptual Framework to Describe Energy Efficiency and Demand Response Interactions.* Lawrence Berkeley National Laboratory. Forthcoming.
- Developing and Evaluating Metrics for Demand Flexibility in Buildings: Comparing Simulations and Field Data. Forthcoming.
- Time and locational sensitive value of efficiency
  - Reports: Time-Sensitive Value of Efficiency: Use Cases in Electricity Sector Planning and Programs (2019); Time-varying value of electric energy efficiency (2017); Time-varying value of energy efficiency in Michigan (2018); Locational Value of Distributed Energy Resources. Forthcoming
- End-Use Load Profiles for the U.S. Building Stock - U.S. DOE Building Technologies Office funded project that is a multi-lab collaboration to create end-use load profiles representing all major end uses, building types, and climate regions in the U.S. building stock.
  - End-Use Load Profiles of the U.S. Building Stock: Market Needs, Use Cases and Data Gaps
  - End-Use Load Profile Inventory
- Electricity Markets and Policy energy efficiency research
- Peak Demand Impacts from Electricity Efficiency Programs
- Energy Efficiency in Electricity Resource Planning. Forthcoming.

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Click here to join the Berkeley Lab Electricity Markets and Policy Department mailing list and stay up to date on our publications, webinars and other events. Follow the Electricity Markets and Policy Department on Twitter @BerkeleyLabEMP

The National Potential for Load Flexibility

VALUE AND MARKET POTENTIAL THROUGH 2030

PRESENTED BY

Ryan Hledik

NARUC 2020 Winter Policy Summit

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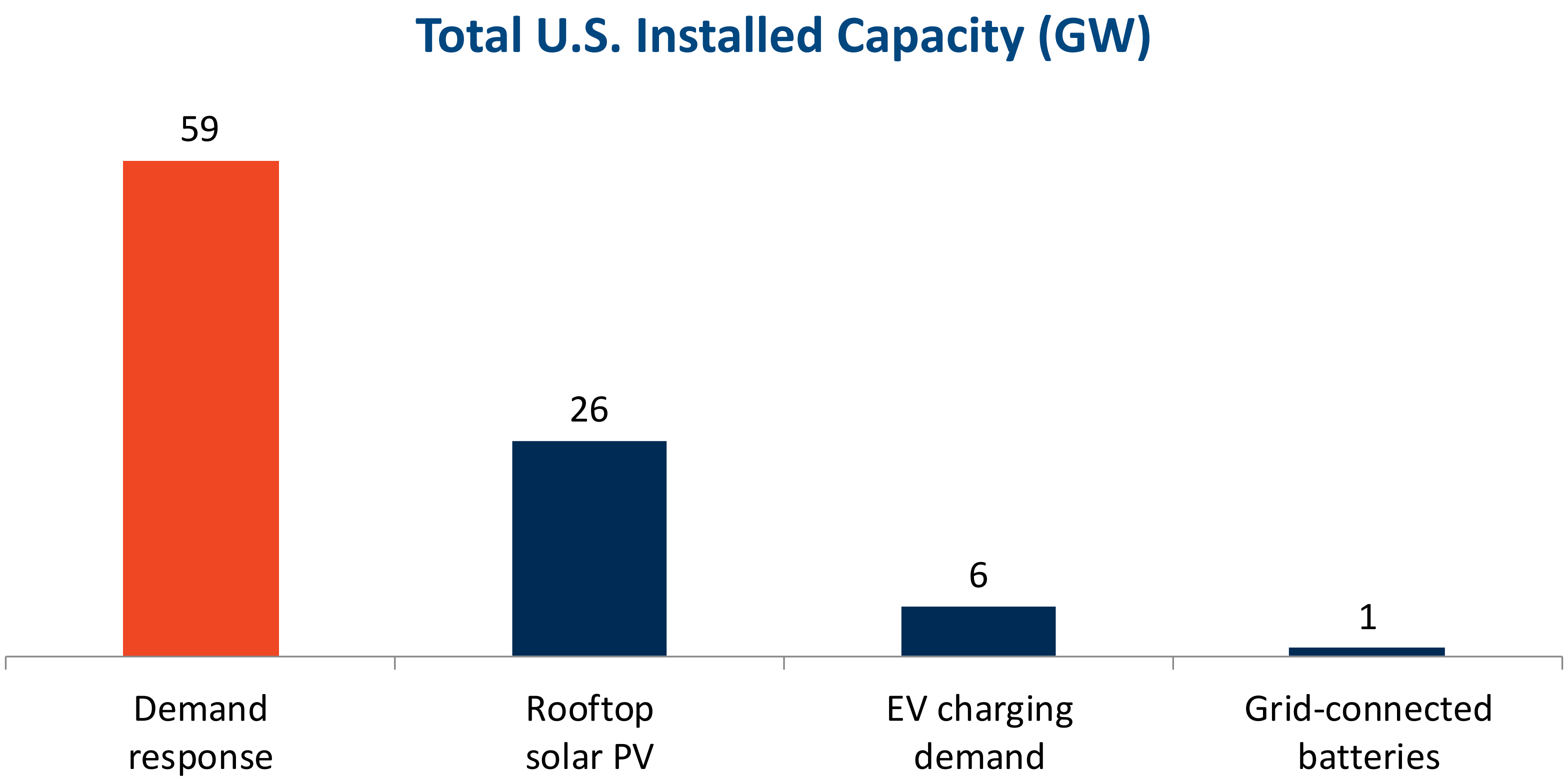
THE Brattle GROUP

You can’t spell “DER” without “DR”

DR is the largest distributed energy resource (DER) in the U.S.

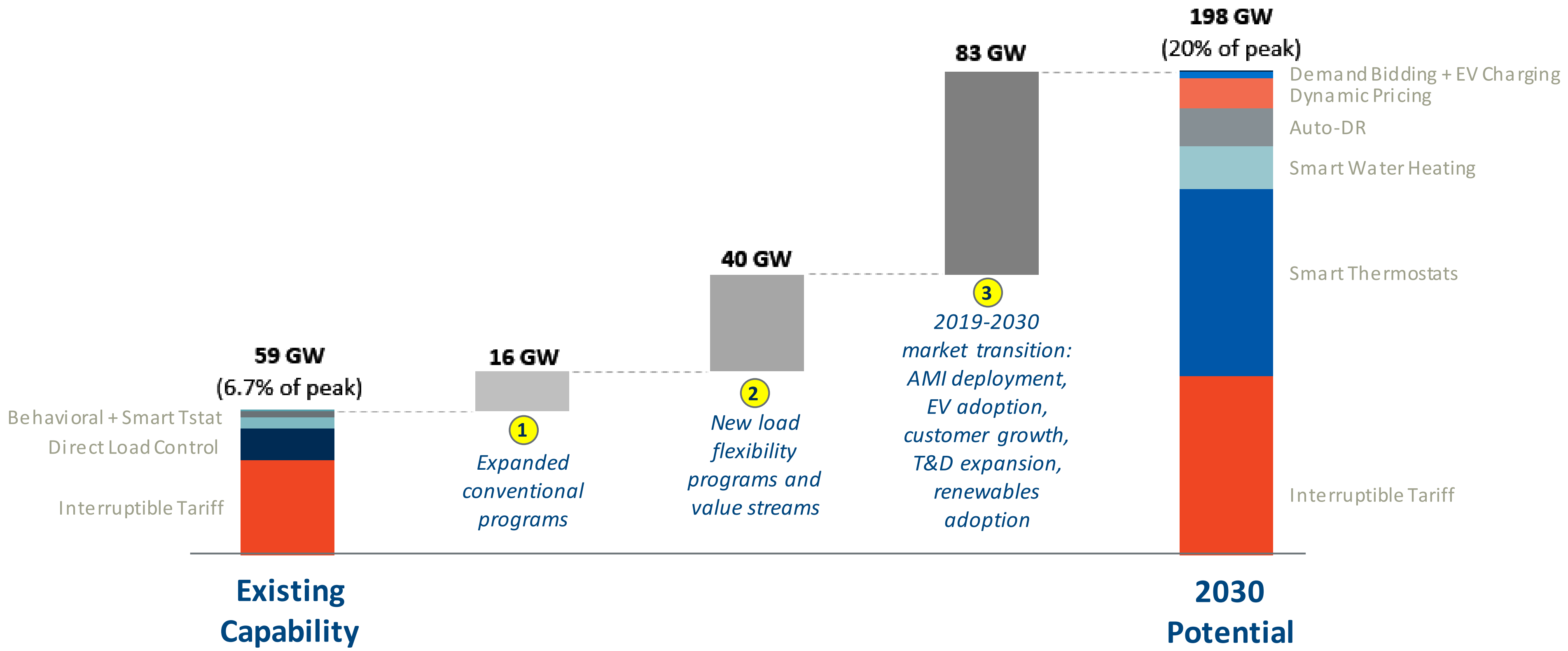


Notes:
EV charging demand assumes 6 kW charging demand per EV, does not account for coincidence of charging patterns. Rooftop solar PV estimate is installed capacity, does not account for derated availability during peak. Existing DR is the sum of retail DR from 2017 EIA-861 and wholesale DR from 2018 FERC Assessment of Demand Response and Advanced Metering; values are not modified to account for possible double-counting between wholesale and retail DR.

The national potential for load flexibility

A portfolio of load flexibility programs could triple existing DR capability, approaching 200 GW (20% of system peak) by 2030, with annual benefits exceeding $15 billion

U.S. Cost-Effective Load Flexibility Potential

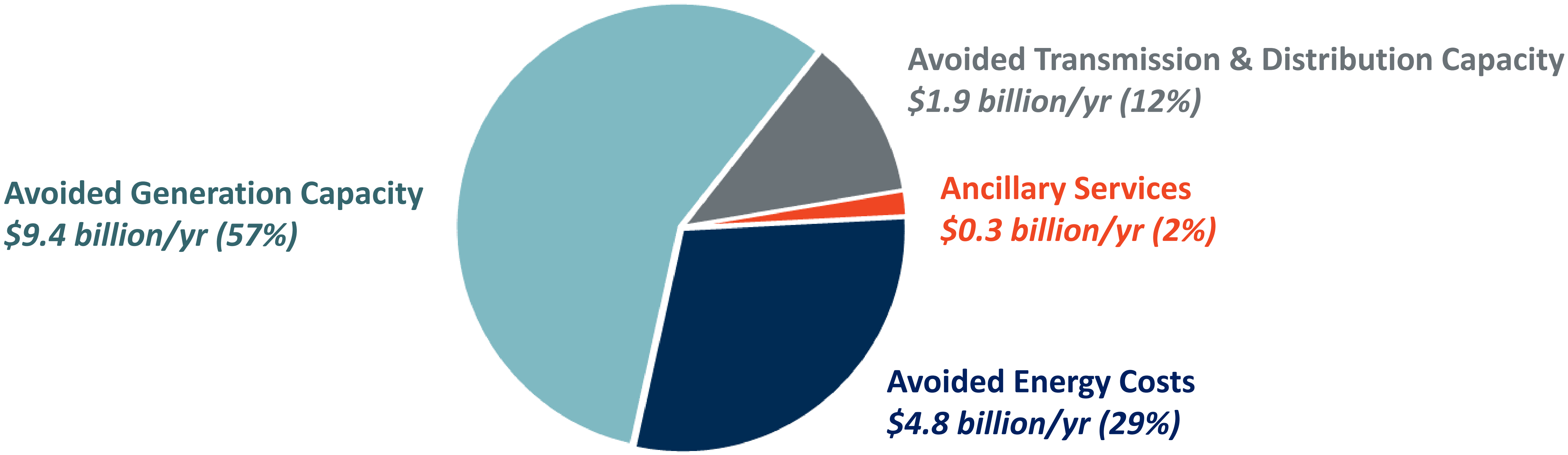


Notes: Existing DR capability does not account for impacts of retail pricing programs, as fewer than 1% of customers are currently enrolled in dynamic pricing rates and the impacts of long-standing TOU rates are already embedded in utility load forecasts. See appendix for summary of key modeling assumptions.

Load flexibility value

Avoided generation costs are the largest source of load flexibility value under national average conditions. There is significant regional variation in this finding.

2030 Annual Benefits of National Load Flexibility Portfolio



Notes: Values shown in 2030 dollars. Values are gross benefits, before netting out costs of the load flexibility programs.

Next steps for regulators and utilities

Market sizing & resource planning	• What is the potential size of the load flexibility resource? • What is the potential value of the resource? • What barriers will prevent this potential from being realized?
Regulatory decision-making	• What policy developments are on the horizon? • How should rates be redesigned to promote load flexibility? • Are new regulatory incentives needed? • How can markets be more effectively opened to the demand-side?
Pilot program design and evaluation	• How to design new pilots, programs, and participation incentives? • What are the measured impacts of the new programs? • How to communicate these findings to industry stakeholders?
Strategy development	• Is the organization aligned around a consistent view of DR value? • What are successful DR business models in other markets? • What business models have failed and why?

Selected Brattle load flexibility & DR work products

- The Potential for Load Flexibility in Xcel Energy's Northern States Power Service Territory, prepared for Xcel Energy, June 2019.
- The Hidden Battery: Opportunities in Electric Water Heating, prepared for NRECA, NRDC, and PLMA, January 2016.
- Demand Response Market Research: Portland General Electric, *2016 to 2035*, prepared for PGE, January 2016.
- Valuing Demand Response: International Best Practices, Case Studies, and Applications, prepared for EnerNOC, January 2015.
- Exploring the Role of Natural Gas and Renewables in ERCOT, Part III: The Role of DR, EE, and CHP, prepared for the Texas Clean Energy Coalition, May 2014.
- Demand Response Market Potential in Xcel Energy's Northern States Power Service Territory, prepared for Xcel Energy, April 2014.
- PacifiCorp Demand-Side Resource Potential Assessment for 2015-2034, Volume 3: Class 1 and 3 DSM Analysis, prepared for PacifiCorp with EnerNOC Utility Solutions, May 2014.
- Estimating Xcel Energy's Public Service Company of Colorado Territory Demand Response Market Potential, prepared for Xcel Energy with YouGov America, June 2013.
- Bringing Demand Side Management to the Kingdom of Saudi Arabia, prepared for ECRA with Global Energy Partners and PacWest Consulting, May 2011.
- The Demand Response Impact and Value Estimation (DRIVE) Model, developed for FERC, 2010. Available on FERC website.
- National Action Plan on Demand Response, prepared for FERC, June 2010.
- A National Assessment of Demand Response Potential, prepared for FERC with Freeman Sullivan and Global Energy Partners, June 2009.

Presenter Information

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Ryan Hledik specializes in regulatory and planning matters related to the emergence of distributed energy technologies.

Mr. Hledik has consulted for more than 80 clients across 35 states and 9 countries. He has supported his clients in matters related to energy storage, load flexibility, distributed generation, electrification, retail tariff design, energy efficiency, and grid modernization.

Mr. Hledik's work has been cited in regulatory decisions establishing procurement targets for energy storage and demand response, authorizing billions of dollars in smart metering investments, and approving the introduction of innovative rate designs. He is a recognized voice in debates on how to price electricity for customers with distributed generation. He co-authored Saudi Arabia's first Demand Side Management (DSM) plan, and the Federal Energy Regulatory Commission's landmark study, A National Assessment of Demand Response Potential.

Mr. Hledik has published more than 25 articles on retail electricity issues and has presented at industry events throughout the United States as well as in Brazil, Belgium, Canada, Germany, Poland, South Korea, Saudi Arabia, the United Kingdom, and Vietnam. His research on the "grid edge" has been cited in *Forbes*, *The New York Times* and *The Washington Post*, and in trade press such as *GreenTech Media*, *Utility Dive*, and *Vox*. He was named to *Public Utilities Fortnightly's* Under Forty 2019 list, recognizing rising stars in the industry.

Mr. Hledik received his M.S. in Management Science and Engineering from Stanford University, where he concentrated in Energy Economics and Policy. He received his B.S. in Applied Science from the University of Pennsylvania, with minors in Economics and Mathematics. Prior to joining Brattle, Mr. Hledik was a research assistant with Stanford's Energy Modeling Forum and a research analyst in Charles River Associates' Energy Practice.

In Demand:

Regulatory Considerations for Load Flexibility

Phil Markham
Smart Buildings R&D Manager
Southern Company
Feb 11th, 2020

Grid-interactive Efficient Buildings (GEB) Research

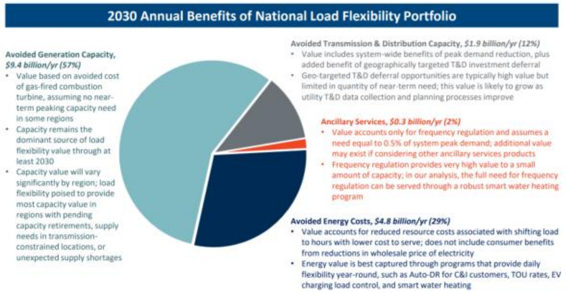
GEBs will be the fastest growing form of load flexibility in the next decade.

For many residential customers, controlling the HVAC & water heater means controlling 50% of the home's electric load.

An electric vehicle will be the home's largest or second largest load.

Flexible Load | Knowledge & Technology Gaps

What's the realistic resource opportunity?



What's the customer experience like?

Is flexible load a reliable resource, even in extreme weather?

Southern Company Smart Neighborhood Initiatives

Understanding tomorrow's home today

Two first-of-a-kind smart home communities at the intersection of energy efficiency, distributed energy resources & buildings-to-grid integration and the traditional utility model

Alabama Power

SMART NEIGHBORHOOD®

- 62 single family homes
- Birmingham, AL
- Built to ~2035 building codes
- Flexible load control:
  - HVAC
  - Water heater

OAK RIDGE National Laboratory

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Carrier®

Rheem®

Demonstrated the ability to dispatch the loads against a 15-min signal

Observed variations in customer comfort preferences

HVAC control in particular requires greater sophistication to be successful

Southern Company Smart Neighborhood Initiatives

Understanding tomorrow's home today

Two first-of-a-kind smart home communities at the intersection of energy efficiency, distributed energy resources & buildings-to-grid integration and the traditional utility model

Georgia Power Smart Neighborhood™

- 46 townhomes in Atlanta, GA
- Flexible load control:
  - Solar
  - Battery storage
  - HVAC
  - Water heater
  - EV charger

Oak Ridge National Laboratory | EPRI Electric Power Research Institute | Delta | ecobee

Quantify the value of the added flexibility of the battery storage system and EV charger

Seek to incorporate greater sophistication in control algorithms e.g. personalized comfort models, occupancy detection, etc.

Flexible Load | Regulatory Considerations

Suggested Next Steps:

- Run pilots in partnership with regulators so that we all understand the opportunities and risks

- Demonstrate the performance and reliability of flexible load for operational applications before relying on them for longer-term planning decisions

Questions to Address:

- Can valuations for potential services provided by flexible load be developed accurately and fairly?

- Can we maintain (and hopefully improve) reliability?

THANKYOU!

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