NASEO-NARUC Grid-Interactive Efficient Buildings Working Group:

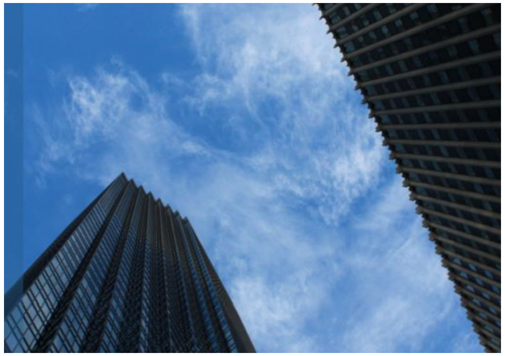
NREL Energy Efficiency and Demand Flexibility State Potential Study and National Lab TA Update

May 17, 2023, 3:00 pm ET

Welcome: ***Rodney Sobin***

Matt Leach*, National Renewable Energy Lab (NREL)*

Natalie Mims Frick*, Lawrence Berkeley National Lab (LBNL)*



States updates and discussion

Wrap-up and Upcoming

NASEO National Association of State Energy Officials

NARUC National Association of Regulatory Utility Commissioners

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group:

NREL Energy Efficiency and Demand Flexibility State Potential Study and National Lab TA Update

May 17, 2023, 3:00 pm ET

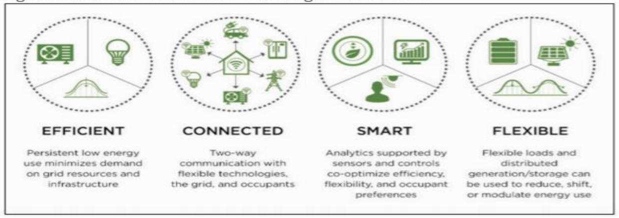
Logistics:

- Please mute when not speaking
- This Forum is meant to be interactive – we encourage discussion. Please use “raise hand” to be recognized. Chat function also available.
- We will record for internal use only; will *not* be disseminated.

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

https://naseo.org/issues/buildings/naseo-naruc-geb-working-group

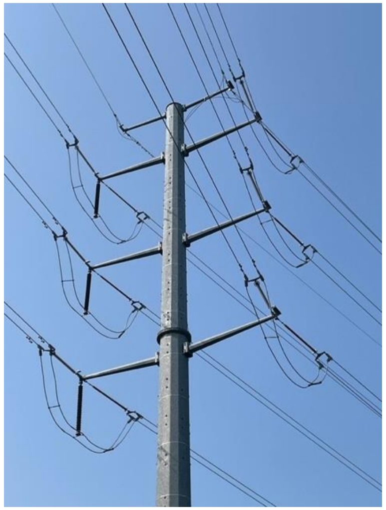
Figure 1. Grid-interactive efficient building characteristics



Source: U.S. Department of Energy

- Working Group co-chairs:
  - Liz Reichart, WA Dept. of Commerce
  - Ashley Norman, Hawaii PUC staff
- Working Group – 28 states:

Arkansas	Maryland	Oregon
Arizona	Massachusetts	South Carolina
California	Michigan	Tennessee
Colorado	Minnesota	Utah
Connecticut	Mississippi	Vermont
Florida	Nebraska	Virginia
Georgia	New Jersey	Washington
Hawaii	New York	Wisconsin
Idaho	Pennsylvania	Wyoming
Illinois		



Inquiries: GEB@naseo.org

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

https://www.naseo.org/issues/buildings/naseo-geb-resources

New/recent:

- The Brattle Group, **Real Reliability: The Value of Virtual Power** (May 2023) - This report explores the cost and ability to serve critical resource adequacy needs using VPPs.
- **NASEO-NARUC DER Integration and Compensation Initiative Webinar: Grid Modernization Strategies to Accelerate Deployment of DERs**, April 13, 2023
- **NASEO-NARUC GEB Working Group Forum: Demand Flexibility and Performance-Based Regulation**, March 15, 2023 - *Demand Flexibility within a Performance-Based Regulatory Framework*
- **NREL Workshop on Modern Distributed Energy Resources (DER) Capabilities and Deployment Considerations,** March 8, 2023
- **NARUC-SEPA-DOE Workshop "Demystifying Virtual Power Plants: What is a VPP? How are VPPs deployed today? What are the opportunities and challenges for regulators, utilities, and other stakeholders?",** February 15
- **Connected Communities cohort kick-off: "Lessons From Past Connected Communities Projects"** - (1) California Advanced Energy Communities; (2) Smart Neighborhoods (Southern Co. Alabama and Georgia) ; (3) AI-Driven Smart Community for Accelerating PV Adoption and Enhancing Grid Resilience (Basalt Vista Community, CO)

Upcoming:

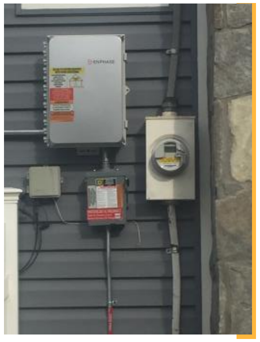
- Webinar in planning: June 21, 2023, 3:00pm – 4:30pm ET –
  joint with NARUC Financial Toolbox series on Virtual Power Plants (VPP)
- Forum: (tentative) Wednesday, July 26, 2023, 3:00 pm ET – topic TBD – possible Connected Communities focus.

+ NARUC CPI Upcoming Events

- NARUC Financial Toolbox series: Virtual Power Plants (VPPs)
  Wednesday June 21, 3:00pm – 4:30pm ET
  Presentations from Ryan Hledik, Brattle Group and others

- Virtual Power Plant Workshop add-on to NARUC Summer Policy Summit, Austin, Texas
  Wednesday July 18, 1:00pm – 4:30pm CT
  Presented in collaboration with DOE and SEPA

+ NASEO-NARUC Grid-Interactive Efficient Buildings Working Group



Questions:

- Has your state examined or considered examining EE potential by building or user type? DF potential?
- How might your state use such information to inform—
  - Utility policies and programs? Utility planning?
  - Building policies (e.g., codes, performance standards)?
- What next steps or follow-on work from the NREL study may be of interest to your state?

Prioritizing Demand Flexibility Investments:

Identifying High-Value Actions for State and Local Decision-makers, Building Owners & Energy Managers

Matt, Leach, Joyce McLaren, Thomas Bowen, Chioke Harris
National Renewable Energy Laboratory

This work described in this section of the presentation was funded by the U.S. Department of Energy Building Technologies Office under Agreement # 36588.

Background: Technical Assistance to Support GEB Working Group

- Grid Modernization Lab Consortium project made technical assistance (TA) available to states that are members of the National Association of State Energy Officials (NASEO) -National Association of Regulatory Utilities Commissioners (NARUC) Grid-interactive Efficient Buildings (GEB) Working Group
- States identified several areas of interest through surveys, interviews and working group meetings:
  - Designing pilots (PNNL)
  - Legislative and regulatory processes (LBNL)
  - Program design best practices (LBNL)
  - ***Technical potential (NREL)***

Background: Motivation for Analysis

Barrier

Existing information on technical potential of demand flexibility measures is high level

States needed more granular data to inform state action

Solution

Execute analysis to identify the potential for demand flexibility in large office buildings at the state level

Analysis Design

Measures and metrics identified by GEB WG members:

Measure were designed to address summer peaks driven by **cooling** and **lighting** loads

Metrics focus on impact with respect to: (1) customer bill savings

(2) grid operating cost savings

(3) Carbon dioxide emissions reductions

Goal and Focus of the Analysis

Goal:

Provide actionable information on the potential impact of energy efficiency and demand flexibility investments to inform:

- State or utility incentive design
- Energy efficiency and demand-flexibility program design
- Legislative or regulatory action, including building codes and performance standards
- Target-setting
- Building owner investments

Scope:

- Focus on Lighting & Cooling
- EE & Demand Flexibility
  - Individually & in combination
- Large Office Buildings
- Results for a single building in each state aggregated state-wide, based on building stock data

Metrics:

- Building owner bill savings ($/year)
- Regional grid operating cost savings ($/year)
- Avoided emissions (metric tons CO_2/year)

Measure Definitions

- **Lighting**
  - *Efficiency:* using occupancy controls and improvements in daylighting controls in perimeter zones.
  - *Demand flexibility:* reducing lighting during peak hours while maintaining occupant safety, reducing lighting load on average between 3 – 9 kWh.
- **Cooling**
  - *Efficiency:* upgrading an existing water-cooled centrifugal chiller to a chiller with 7.0 COP.
  - *Load shedding:* increasing the thermostat set point during peak hours.
  - *Precooling measure:* reducing the thermostat set point for the 4 hours preceding the peak period

Overview of Methodology

Modeled office building load before and after implementing efficiency and demand-flexibility measures, for each Electricity Market Module region defined by the Energy Information Administration **(Scout model[1])**

Characterized associated emissions reductions and system cost savings **(Cambium data)**

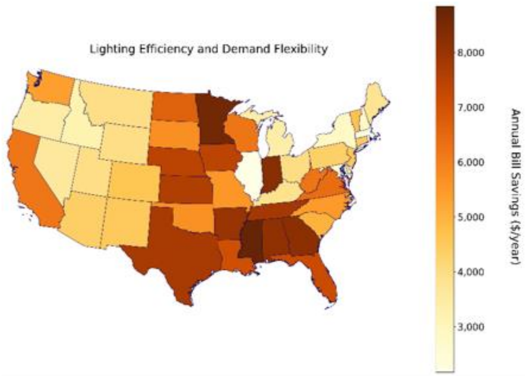
Characterized customer bill savings based on typical demand charges and time-of-use rates **(REopt tool)**

Summarized highest value measures and key locations for implementation **(ComStock U.S. building stock data)**

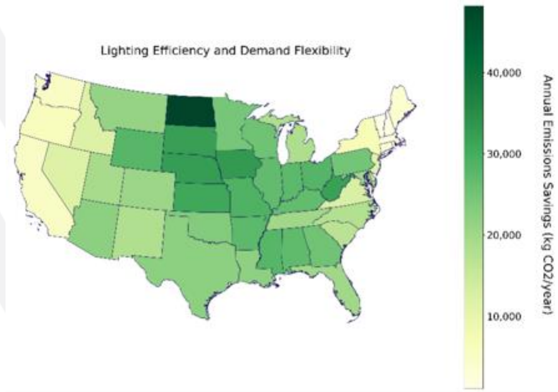
[1] Load shapes from OpenStudio commercial building prototypes with upgrade configuration matching Scout GEB modeling.

Single Building Results: Median Annual Potential for Lighting Efficiency and Demand Flexibility

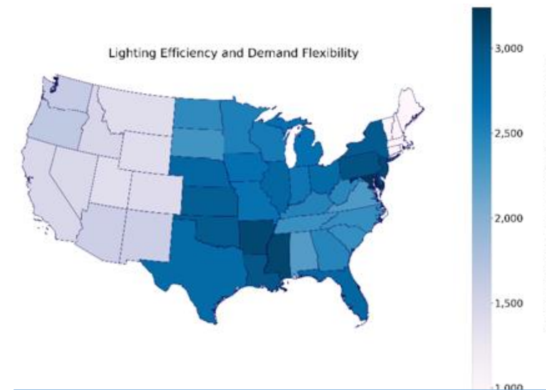
GRID
MODERNIZATION
LABORATORY
CONSORTIUM
U.S. Department of Energy



Annual Customer Bill Savings	
State	**Median**
Mississippi	$8,840
Minnesota	$8,620
Indiana	$8,290
Georgia	$8,200
Alabama	$8,150
Arkansas	$7,990
Tennessee	$7,810
Texas	$7,760
Kansas	$7,630
Nebraska	$7,450



State	Annual Emissions Savings (kg CO_2/year)
North Dakota	48,200
Iowa	33,100
Nebraska	32,700
South Dakota	32,400
West Virginia	31,900
Kansas	30,900
Missouri	28,900
Ohio	28,200
Wyoming	28,100
Mississippi	28,100



State	Annual Grid Operating Costs Savings ($/year)
Maryland	$ 3,240
Mississippi	$ 3,120
Arkansas	$ 3,100
New Jersey	$ 3,080
Delaware	$ 3,040
Pennsylvania	$ 3,000
Louisiana	$ 2,980
Oklahoma	$ 2,940
New York	$ 2,930
Kansas	$ 2,890

Potential from Implementing Lighting Measures (1)

Bill Savings:

- Central and Southeastern states show the greatest potential for bill savings from lighting efficiency and demand flexibility, with annual bill savings of $7000-8000 for a single 500,000 ft^2 large office building.
- Rate structure has a large impact on the amount of savings achieved. Switching to a different rate in conjunction with installing measures may yield additional savings, so building energy managers should investigate different rate options for their building when implementing lighting measures.

Grid Operational Cost Savings:

- States in the South and Northeast show the greatest potential for grid cost savings, with savings in the top ten states ranging between $2,900-3,200 for a single 500,000 ft^2 large office building.
- Energy efficiency is responsible for most of the grid operating cost savings across the country.
- Regional variation is largely a result of grid operating costs, which are higher in the Eastern Interconnection.

Potential from Implement Lighting Measures (2)

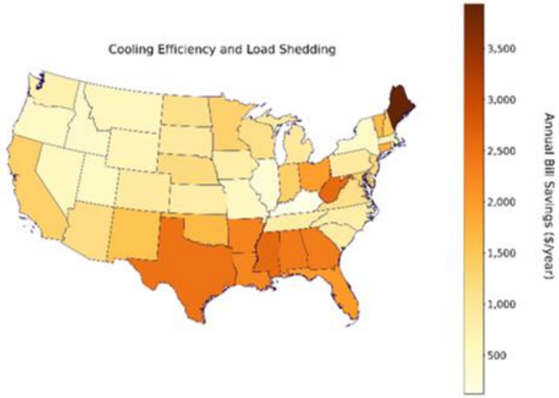
CO_2 Savings:

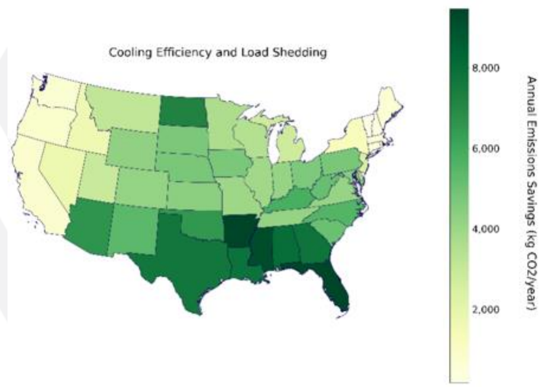
- North-Central and Midwest states, as well as in West Virginia and Mississippi show the greatest potential for carbon-dioxide savings.
- States that have high emitting sources *on the margin* during load reduction have highest potential for savings; these are not *necessarily* the states with the highest annual emissions. States with low annual emissions may have savings potential if periods with high marginal emissions overlap with possible load reductions.

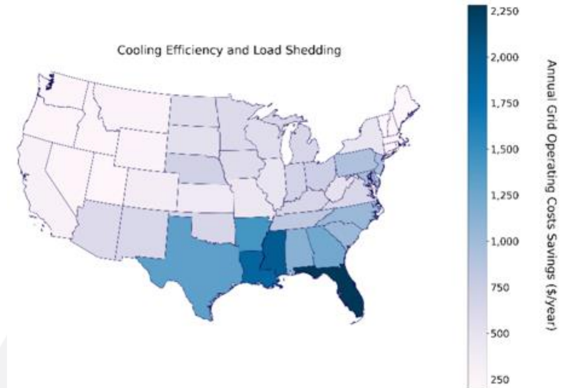
General Finding:

- Both lighting efficiency and lighting demand flexibility measures result in net reduction in lighting load, which always reduces costs and emissions. There is no load shifting or rebound effects.

Single Building Results: Median Annual Potential for Cooling Efficiency and Load Shedding





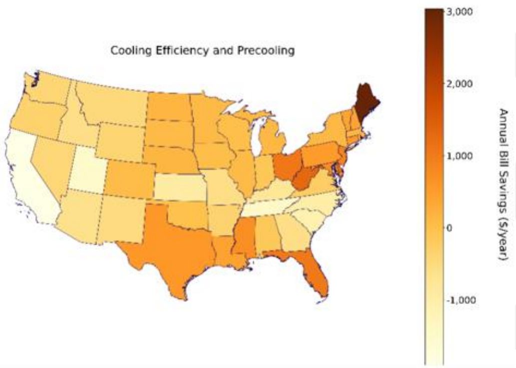


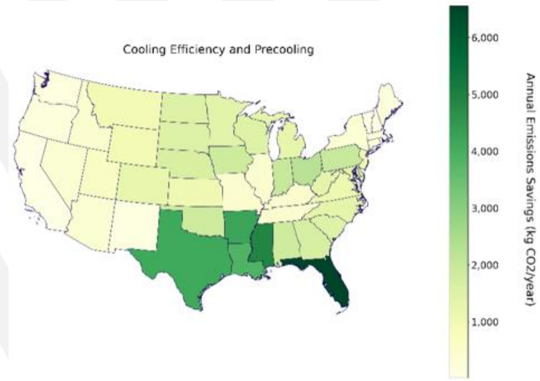
Annual Customer Bill Savings	
State	**Median**
Maine	$3,940
Mississippi	$2,580
West Virginia	$2,580
Texas	$2,460
Alabama	$2,380
Georgia	$2,360
Arkansas	$2,280
Louisiana	$2,250
Florida	$2,020
Ohio	$1,980

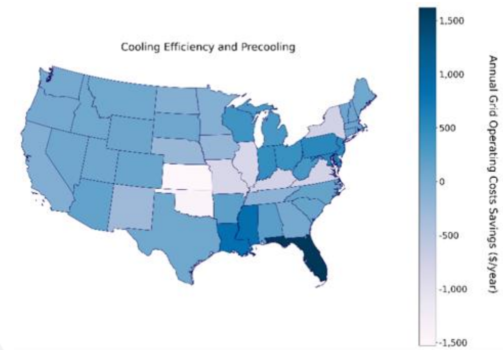
State	Annual Emissions Savings ($kg\ CO_2$/year/building)
Arkansas	9,500
Florida	9,400
Mississippi	9,200
Alabama	8,100
Louisiana	7,900
Georgia	7,800
Texas	7,700
North Dakota	7,200
Arizona	6,700

State	Annual Grid Operating Cost Savings ($/year/building)
Florida	$ 2,280
Mississippi	$ 2,000
Louisiana	$ 1,880
Arkansas	$ 1,440
Texas	$ 1,330
Georgia	$ 1,240
Alabama	$ 1,130
North Carolina	$ 1,030
South Carolina	$ 1,030
Maryland	$ 970

Single Building Results: Median Annual Potential for Cooling Efficiency and Load Shedding with Precool







State	Annual Customer Bill Savings (Median)
Maine	$3,040
West Virginia	$1,320
Delaware	$1,200
Ohio	$1,060
Florida	$1,040
New Jersey	$890
Maryland	$730
Mississippi	$710
Texas	$580
Connecticut	$560

State	CO_2 reduction (kg per building/year)
Florida	6,600
Mississippi	4,900
Arkansas	4,200
Texas	4,100
Louisiana	3,800
Ohio	2,300
Indiana	2,000
Pennsylvania	1,900
Iowa	1,900
Alabama	1,900

State	Annual Grid Operating Costs Savings ($/year/building)
Florida	$ 1,620
Mississippi	$ 870
Louisiana	$ 840
Maryland	$ 560
Delaware	$ 540
New Jersey	$ 540
Pennsylvania	$ 540
Indiana	$ 450
Ohio	$ 420
Wisconsin	$ 370

Potential from Implementing Cooling Measures (1)

Bill Savings:

EE+Load shedding

- The efficiency and loadshedding measures show the most savings potential in Southeastern states (where summer cooling loads are high) and, notably, in West Virginia and Maine.
- Median annual bill savings in top ten states is between $2000 - 4,000, with savings of over $5,000 possible for some rates structures.
- Tariff structures are a key driving factor in savings.

EE+Precooling

- Lower overall savings potential and less pronounced regional pattern
- Median annual savings in top ten states is between about $560 - $3000
- Some states see bill increases up to $2000

Potential from Implementing Cooling Measures (2)

Grid Operational Cost Savings:

- There are clear regional patterns in grid cost savings
- Southeastern states show the highest potential for grid cost savings from the efficiency and load shedding measures, due to the ability to shed significant loads during shed periods
- Some states see grid operating cost *increases* when pre-cooling is applied

CO_2 Savings:

- Southeastern states show the highest potential for carbon savings as well.
- North Dakota and Arizona also show good potential for emissions savings due to relatively high long run marginal emissions rates throughout the year

General Findings:

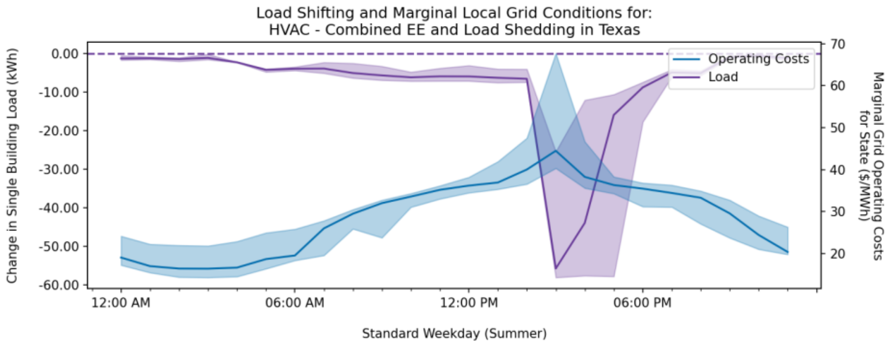
- Load reduction strategies (efficiency and sheds) achieve savings in all cases
- Pre-cooling requires alignment with relevant signal (cost or emissions) to achieve savings because no load savings are achieved. Lack of alignment results in negative savings.

Considerations / Assumptions / Limitations

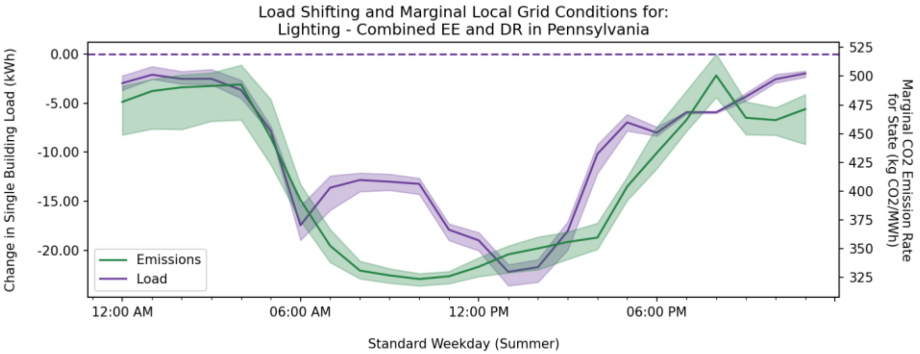
- Measures were deployed in the model based on regional peak loads; with no insight into regional electricity system pricing or carbon emissions.
- Our load profiles assume lighting load drastically reduces at 6pm, limiting the potential for lighting load reductions and savings. Field observation may differ.

Results: Temporal Overlap of Load Change and Grid Conditions Determines Impact of a Measure

In Texas, load reductions from the cooling load shed align well with high grid operating costs.



In Pennsylvania, load reductions from the combined lighting measures are not well aligned with high carbon emissions factors.



Phase 1 Resources

- Phase 1 Report (anticipated May/June publish date): https://nrel.gov/docs/fy23osti/83552.pdf
- Phase 1 Results: https://data.nrel.gov/submissions/205

Energy Efficiency and Demand Flexibility State Level Potential

Phase 2: Expanding the Results

EE-DF Phase 2 Overview

- 3-year project (FY23 – FY25) funded by EERE BTO
- Will extend the GMLC effort to additional building types and energy efficiency and demand flexibility measures

EE-DF Phase 2 Projected Scope

- **New/Updated Measures**
  - Add/modify up to six measures based on feedback from policy makers, building operators, technology vendors, and demand response aggregators
  - Tune measures to better align with specific objectives/metrics (utility bills, grid operational costs, and carbon emissions)
  - Tune measures to reflect real-world system response and equipment performance limitations (operators/vendors/aggregators)
  - ResStock/ComStock model compatibility
  - Leverage End-Use Savings Shape (EUSS) results

- **New Building Types**
  - Select 3-4 new building types (e.g., small office, retail, primary/secondary education)

EE-DF Phase 2 Points of Emphasis

- **Target underserved communities, small businesses, and LMI households**
  - Engage with stakeholders with knowledge of the energy efficiency and demand flexibility challenges faced by these communities
  - Analysis/reporting will address constraints that limit access to energy efficiency and demand response for these communities
  - Produce factsheet/whitepaper highlighting actions to reduce utility bills and maximize carbon emissions reductions for “energy communities” and “low-income communities,” as defined by the Inflation Reduction Act

EE-DF Phase 2 FY23 Scope

- **Stakeholder Engagement**
  - *NASEO/NARUC working group* – to understand goals/challenges/needs from the policy-maker standpoint. Focus on policy development (e.g., state-level carbon goals), program design, and state-level demonstration
  - *BBA renewables integration working group* – to collect insights into portfolio-scale GEB best practices/challenges. What has worked? What hasn't? What outstanding questions need to be answered?

- **Measure Tuning/Validation**
  - Initial focus on alignment with objectives/metrics (utility bills, grid operational costs, and carbon emissions)
  - Additional focus on alignment with real-world response characteristics

EE-DF Phase 2 FY23 Scope

- **Update Workflow and Data Resources**
  - Goal is to leverage internal resources (ResStock, ComStock, OCHRE, URBANopt, etc.) to the extent possible, taking advantage of parallel developments.
  - Migrate to new Scout workflow that will leverage the ComStock capabilities used to create the new End-Use Savings Shapes (EUSS).
  - Identify potential off-the-shelf DF measures that can be applied to this study

EE-DF Phase 2 Preliminary Measure Development Plan

- **Use Available Signal Data to Tune Flexibility Dispatch to Specific Performance Metrics**
  - Hourly weather data
  - Hourly marginal emissions factors
  - Predicted hourly load data (optional)

- **Develop Relevant ComStock Measures in Q1/Q2 FY24**

- **Upcoming Milestones**
  - Presentation of external feedback/plan (5/31/23)
  - Summary of off-the-shelf DF measures (8/11/23)
  - Memo summarizing DF validation (12/1/23)

Collecting stakeholder feedback

- **What additional building types would you like to see analyzed?**
  - Small/medium office, schools (primary/secondary), multifamily, retail, other.
- **What performance metrics are most important to you?**
  - Utility cost (retail consumer rate), energy consumption, grid cost (real price of electricity), carbon emissions, other.
- **What type of strategies are you most interested in?**
  - General efficiency (energy reducing) measures, load shaping measures that reduce peak/demand charges, load shaping measures that align energy consumption with renewable generation, whatever reduces the most carbon, other.
- **What project outcomes would be most useful to you?**
  - Expanding to additional building types, expanding to additional demand flexibility strategies, deeper dive into tradeoffs between cost and emissions, other

Collecting stakeholder feedback

- **What factors will weigh most heavily in your planning/goal setting process?**
  - Minimizing first costs, minimizing long-term utility costs, maximizing carbon reductions, maximizing renewable generation usage factor, balancing near and long-term costs with emissions reductions, other

- **What do you see as the biggest barriers to retrofitting underserved communities?**
  - Raising funds to cover first costs, ensuring that long-term utility costs remain reasonable, community motivation/awareness, ensuring quality of life/level of service (comfort, grid constraints, etc.), other

Demand Flexibility Work at NREL

A brief summary of other relevant work happening at NREL

Wells Fargo IN2 Project with Stratis: Load Flexibility in Multifamily Buildings

- **Study Evaluates Cost and Energy Savings from Demand Flexibility Measures in Multifamily Buildings**
  - Space temperature floating
  - Water heater temperature floating
  - Light dimming
  - Automatic window shading

- **Key Conclusions**
  - Results showed potential for 8% energy costs savings
  - Careful consideration of dispatch strategies (including staging/ramping to avoid severe rebounding) and tenant buy-in (considering potential comfort tradeoffs) are critical to maximizing savings
  - Occupant awareness and corresponding behavior changes are important

- **Paper Reference:** https://asmedigitalcollection.asme.org/ES/proceedings/ES2021/84881/V001T08A001/1114920

Dallas Fort Worth Airport Project: Campus Load Flexibility

- **Study Leverages Model Predictive Control (MPC) to Reduce Energy Costs During Peak Periods**
  - Central plant sequencing (chiller/pump staging, chilled water tank storage)
  - Simulation results show 8% cost savings during summer
  - Next phase will expand to account for charging/discharging potential of electric vehicle fleet
  - Project also leverages digital twin capabilities and automated fault detection and diagnostic analytics

- **Project Impact**
  - Lessons learned could be applied to other airports and campuses, including hospitals, universities, corporate campuses, connected communities, and light industrial parks

NREL – Emerson Refrigeration Research

- **Experimental Evaluation of Shed and Shift Events Using Advanced Controls**
  - Store energy for shed periods by reducing average product temperature
  - Defrost management: defrost 1 hour prior to event, and skip cycle after event
  - Reduce condenser temperature difference setpoint during shed event
  - Turn off case lights during shed event

- **Key Conclusions**
  - 30-minute demand reduction is achievable with fully-loaded case
  - 120-minute demand reduction is possible with fully-loaded case and pre-cooling
  - Can achieve 40% shed during 30-minute event and nearly 30% during 120-minute event
  - An alternate building-wide approach to demand response using a prototype supervisory controller to coordinate HVAC and refrigeration operation reduced peak demand by 10%

Questions?

Thank you for your time. If you have questions or feedback, please reach out to me at:

matt.leach@nrel.gov

Backup Slides

Approach: EE and Demand Flexibility Measures

Measure(s)	Definition
Lighting EE	Lighting efficiency measures follow ASHRAE's Advanced Energy Design Guidelines. Lighting power density is reduced by an additional 15% from the base lighting schedule as a proxy for occupancy controls (per AEDG modeling guidance). Daylighting controls in the perimeter zones are set at 300 lux setpoint.
Lighting DF	Reduces lighting load during peak hours by 30% for occupied spaces and 60% for unoccupied spaces. Thresholds maintain comfort and safety (e.g.. stairwells, hallways).
Cooling EE	This measure makes upgrades the existing water-cooled centrifugal chiller with 5.5 COP (coefficient of performance) to a chiller of the same type with 7.0 COP.
Cooling Load Shedding	A global temperature adjustment (GTA) measure that adjusts zone temperatures during the peak hours. In summer the set point temperature increases from 75ºF to 80ºF GTA during the peak period, maintaining a comfort range of 73ºF–80ºF based on ASHRAE Standard 55-2017. In winter the set point temperature decreases from 70ºF to 68ºF GTA during the peak period to maintain a comfort range of 68ºF–78ºF based on ASHRAE Standard 55-2017.
Pre-cooling	Adjusts zone cooling temperatures downwards for the 4 hours preceding the peak period. (No pre-heating is assumed in winter since the risk of discomfort at 68ºF is low, particularly given that the peak period begins in the evening hours, when most commercial buildings have low occupancy.)

Tools: Data Sets & Models

Tool / Dataset	General Use	Analytical Outputs Used in this Study	Geographic Resolution
Scout	Models the impact of implementing a variety of Energy Conservation Measures[a] in residential and commercial buildings.	Building load profiles before and after Energy Conservation Measures[a]	EIA Energy Market Module (EMM) Region[b]
REopt	Optimizes energy systems for buildings, campuses, communities, microgrids, and other load centers. Recommends the optimal mix of renewable energy, conventional generation, and energy storage technologies to meet cost savings, resilience, and energy performance goals.	Processing of electricity bills based on a sample large office building location, tariff and load patterns associated with given measures.	100 km^2
Cambium	Data sets of simulated grid hourly cost and operational data for a variety of U.S. electricity sector futures (aligned with NREL's Standard Scenarios)	Data on the marginal conditions of the power system in each region, including: • Short-run marginal operating costs and capacity costs • Long-run marginal emissions rates	ReEDs Balancing Areas

[a] Energy conservation measure is a term used in the Scout energy modeling tool to refer to all upgrades that modify a building's load and is equivalent to the "energy efficiency and demand flexibility measures" term used throughout the rest of the report.

[b] Scout can provide results at multiple regional resolutions and aggregations, however, the EIA Energy Market Module (EMM) regions were used in this analysis.

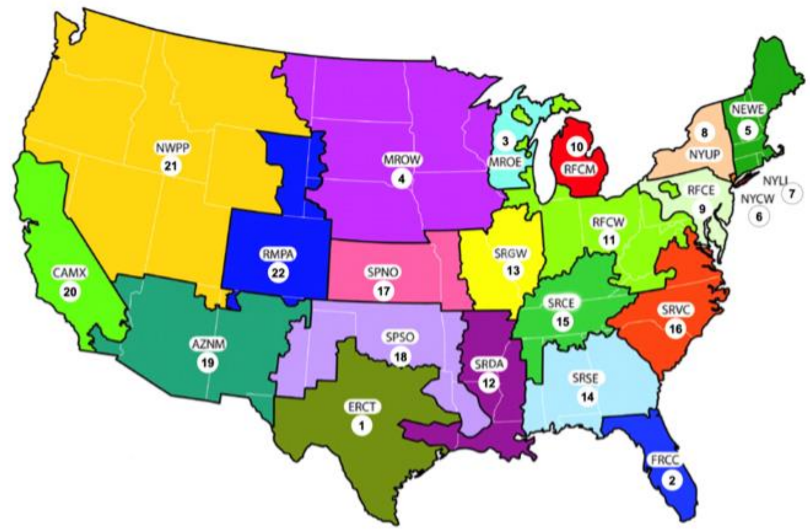
Factors Influencing State-Level Results

► 3 factors influence whether a measure has a large impact at a state level:

1. The extent of load reduction building load (as evidenced in single-building results)
2. The alignment between load reductions and cost/emissions of the regional power system
   - There are ~40 hours in a year in which system prices are very high, if the measure reduces load in one of those 40 hours, then the cost reduction impact will be greater.
3. The number of large office buildings in the state
   - Because we do not make assumptions about the level of adoption of any measures, the potential impact of a measure at the state level is dependent on how many buildings exist, according to our building data.

How is a Large Office defined in the load modeling? Large Office floor area (10^6 ft^2) for EMM regions 1–22

1. 547
2. 474
3. 81
4. 293
5. 408
6. 662
7. 164
8. 486
9. 1381
10. 268
11. 1179
12. 169
13. 210
14. 331
15. 217
16. 591
17. 120
18. 203
19. 223
20. 916
21. 494
22. 114



1.	ERCT	TRE All
2.	FRCC	FRCC All
3.	MROE	MRO East
4.	MROW	MRO West
5.	NEWE	NPCC New England
6.	NYCW	NPCC NYC/Westchester
7.	NYLI	NPCC Long Island
8.	NYUP	NPCC Upstate NY
9.	RFCE	RFC East
10.	RFCM	RFC Michigan
11.	RFCW	RFC West
12.	SRDA	SERC Delta
13.	SRGW	SERC Gateway
14.	SRSE	SERC Southeastern
15.	SRCE	SERC Central
16.	SRVC	SERC VACAR
17.	SPNO	SPP North
18.	SPSO	SPP South
19.	AZNM	WECC Southwest
20.	CAMX	WECC California
21.	NWPP	WECC Northwest
22.	RMPA	WECC Rockies

Fig. 13 Map of U.S. EIA Electricity Market Module (EMM) regions in the 2019 Annual Energy Outlook.

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U.S. Department of Energy

Update on Demand Flexibility Technical Assistance

Natalie Mims Frick, Berkeley Lab

NASEO-NARUC Grid-interactive Efficient Buildings Working Group
May 17, 2023

Technical assistance update: Arizona and Indiana

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

Berkeley Lab is assisting the Arizona Corporation Commission (ACC) with a novel tariff for aggregated distributed demand-side resources (including storage, demand response and managed charging) for customers of Arizona Public Service (APS).

The tariff will compensate program participants and aggregators for a wide range of services for the electricity system: energy, capacity, demand reduction, load shifting, locational value, and voltage support. Berkeley Lab reviewed APS’s draft request for proposals (RFP) to improve the final RFP, recommended criteria for ACC’s evaluation of the filed tariff, and assisted with ACC review. We recently reviewed APS’s cost-benefit analysis, proposed evaluation, measurement and verification plan and modeled participant impacts, including reductions in peak load and cost and benefits for reliability and resilience for the ACC. In March 2023 the ACC ordered APS to issue a new RFP and consult with Berkeley Lab on the design and evaluation of responses.

The Indiana Utility Regulatory Commission (IURC) requested technical assistance from Berkeley Lab on economic valuation and assessment of utility-scale and distributed energy storage in the context of integrated resource plans (IRPs). Berkeley Lab reviewed storage technology types; utility-scale and distributed storage inputs and methodologies; cost assumption, grid services, model assumptions and storage adoption outcomes in eight IRPs and summarized the findings in a technical brief. We identified that Indiana utilities could improve their storage analysis and capacity expansion modeling approach as opportunities for the Indiana utilities to improve consideration of storage in IRP.

Technical assistance update: Connecticut and Wisconsin

- **Connecticut** - Berkeley Lab provided technical assistance to the Connecticut Department of Energy and Environmental Protection (DEEP) on the state Conservation and Load Management plan. We reviewed prior plans, identified examples of demand flexibility programs, and interviewed electric investor-owned utilities, the Connecticut Efficiency Board and other stakeholders on opportunities to incorporate demand flexibility into the state's 2022-2024 plan. We summarized demand flexibility opportunities for that plan in a memo to DEEP.

- **Wisconsin**- Berkeley Lab interviewed Wisconsin investor-owned electric utilities and Focus on Energy on demand flexibility opportunities in the state and reviewed the Wisconsin PSC's Roadmap to Zero Carbon investigation framework. Our memo to the Wisconsin PSC identified opportunities to use energy efficiency and demand flexibility to achieve the goals in the state's carbon reduction goal (Executive Order 38), as well as the utilities' carbon reduction goals.

DOE continues to support demand flexibility in buildings

A vision for a net-zero U.S. building sector by 2050

Support rapid decarbonization of the U.S. building stock in line with economy-wide net-zero emissions by 2050 while centering equity and benefits to communities

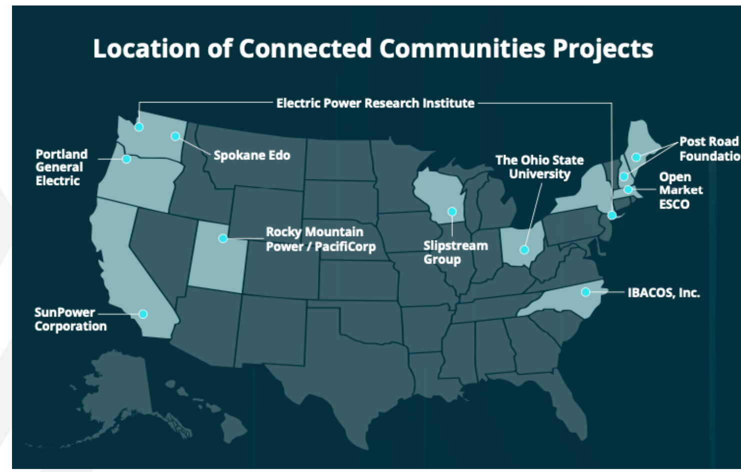
Prioritize equity, affordability, and resilience

- Ensure that 40% of the benefits of federal building decarbonization investments flow to disadvantaged communities
- Reduce the cost of decarbonizing key building segments 50% by 2035 while also reducing consumer energy burdens
- Increase the ability of communities to withstand stress from climate change, extreme weather, and grid disruptions

Increase building energy efficiency
Reduce onsite energy use intensity in buildings 30% by 2035 and 45% by 2050, compared to 2005

Accelerate onsite emissions reductions
Reduce onsite fossil-based CO_2 emissions in buildings 25% by 2035 and 75% by 2050, compared to 2005

Transform the grid edge at buildings
Increase building demand flexibility potential 3X by 2050, compared to 2020, to enable a net-zero grid, reduce grid edge infrastructure costs, and improve resilience.



Source: Building Technologies Office Peer Review 2023

Berkeley Lab provides technical assistance to states on **Integrated Distribution System Planning**. Example topics include objectives and priorities, planning for distributed energy resources and grid modernization, developing utility filing requirements, and reviewing utility filings. Contact Lisa Schwartz: lcschwartz@lbl.gov

Select Berkeley Lab Resources

- Accelerating Decarbonization with the California Load Flexibility Research and Deployment Hub
- Defining and applying an electricity demand flexibility benchmarking metrics framework for grid-interactive efficient commercial buildings
- A Snapshot of EV-Specific Rate Designs Amoung U.S. Investor Owned Electric Utilities

Forthcoming research

- Managing the peak demand impacts of building and transportation electrification through energy efficiency and demand flexibility

Forthcoming: Catalog of State Distribution Planning Requirements

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- Available this spring – Interactive map, detailed state-by-state table, document library
- Later this year — Report updating our 2017 and 2018 publications on state engagement in distribution system planning as well as presentations on regulatory approaches
  - Materials will be posted on Berkeley Lab's IDSP website
- **General information and procedural requirements**
  - Planning goals and objectives, type of plan (e.g., grid mod plan, distribution system plan, integrated grid plan, DER plan, T&D improvement plan), frequency of filing, planning horizon, term of action plan, stakeholder engagement & equity, type of commission action on filed utility plans
  - Links to legislation & regulations, commission proceedings & orders, utility plans
- **Substantive requirements**
  - Baseline information required on current distribution system
  - Load and DER forecasting
  - Reliability and resilience analysis and metrics
  - Grid needs assessment & solution identification, including NWA analysis
  - Hosting capacity analysis
  - Grid modernization strategy and roadmap
  - Coordination with other types of planning

Also: **Berkeley Lab/NASEO brief on state energy office engagement in distribution planning**

Resources for more information

U.S. Department of Energy's (DOE) *Modern Distribution Grid*, Vol. IV, 2021

Berkeley Lab's integrated distribution system planning website: https://emp.lbl.gov/projects/integrated-distribution-system-planning

Berkeley Lab's research on time- and locational-sensitive value of DERs

A. Cooke, J. Homer, L. Schwartz, *Distribution System Planning – State Examples by Topic*, Pacific Northwest National Laboratory and Berkeley Lab, 2018

P. De Martini et al., *The Rising Value of Stakeholder Engagement in Today's High-Stakes Power Landscape*, ICF, 2016

P. De Martini et al., *Integrated Resilience Distribution Planning*, PNNL, 2022

T. Eckman, L. Schwartz and G. Leventis, *Determining Utility System Value of Demand Flexibility From Grid-interactive Efficient Buildings,* Berkeley Lab, 2020

C. Farley et al., *Advancing Equity in Utility Regulation*, Berkeley Lab, 2021

N. Frick, S. Price, L. Schwartz, N. Hanus and B. Shapiro, *Locational Value of Distributed Energy Resources*, Berkeley Lab, 2021

J. Homer, A. Cooke, L. Schwartz, G. Leventis, F. Flores-Espino and M. Coddington, *State Engagement in Electric Distribution Planning*, Pacific Northwest National Laboratory, Berkeley Lab and National Renewable Energy Laboratory, 2017

J.S. Homer, Y. Tang, J.D. Taft, D. Lew, D. Narang, M. Coddington, M. Ingram, A. Hoke, *Electric Distribution System Planning with DERs — Tools and Methods*, Pacific Northwest National Laboratory and National Renewable Energy Laboratory, 2020

ICF, *Integrated Distribution Planning: Utility Practices in Hosting Capacity Analysis and Locational Value Assessment*, 2018

J. McAdams, *Public Utility Commission Stakeholder Engagement: A Decision making Framework*, NARUC, 2021

Smart Electric Power Alliance, *Integrated Distribution Planning: A Framework for the Future*, 2020

N.L. Seidman, J. Shenot, J. Lazar, *Health Benefits by the Kilowatt-Hour: Using EPA Data to Analyze the Cost-Effectiveness of Efficiency and Renewables*, Regulatory Assistance Project, 2021

Y. Tang, J.S. Homer, T.E. McDermott, M. Coddington, B. Sigrin, B. Mather, *Summary of Electric Distribution System Analyses with a Focus on DERs*, Pacific Northwest National Laboratory and National Renewable Energy Laboratory, 2017

T. Woolf, B. Havumaki, D. Bhandari, M. Whited and L. Schwartz, *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges and Considerations*, Berkeley Lab, 2021

Xcel Energy, *2022-2031 Integrated Distribution Plan*, 2021

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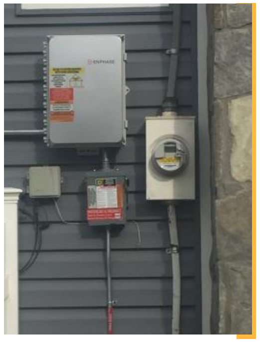

Questions:

- Has your state examined or considered examining EE potential by building or user type? DF potential?
- How might your state use such information to inform—
  - Utility policies and programs? Utility planning?
  - Building policies (e.g., codes, performance standards)?
- What next steps or follow-on work from the NREL study may be of interest to your state?