

WISCONSIN

Environmental & Economic Research and Development Program (EERD)

Load Shaping - Illume Advising

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Date: February 2, 2021

Agenda

- Introduction
- Load Shaping Landscape
- Key Findings & Recommendations
- Results Summary
- Questions

Introduction

EERD Background

EERD research projects allow Wisconsin to further its efforts towards reducing energy waste, costs, and environmental impacts.

Call for concepts in 2020 resulted in (5) total projects:

- Load shaping
- ccASHP in single family & multifamily homes
- Dehumidification
- Variable Refrigerant Flow (VRF)
- Building energy management information systems/building automation systems

Load Shaping Research Team



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Load Shaping Project Overview

Objective: provide a broad view into load shaping opportunities that can complement current and emerging energy efficiency (EE) opportunities in WI

Challenge: load shifting and demand response (DR) are not currently eligible for Focus incentives and are utility functions

Approach: staged research with deeper research on a narrower list of measures at each stage*

- Stage 1. Identify potential measures
- Stage 2. Characterize 10 measures from initial list
- Stage 3. Develop case studies on 4 measures

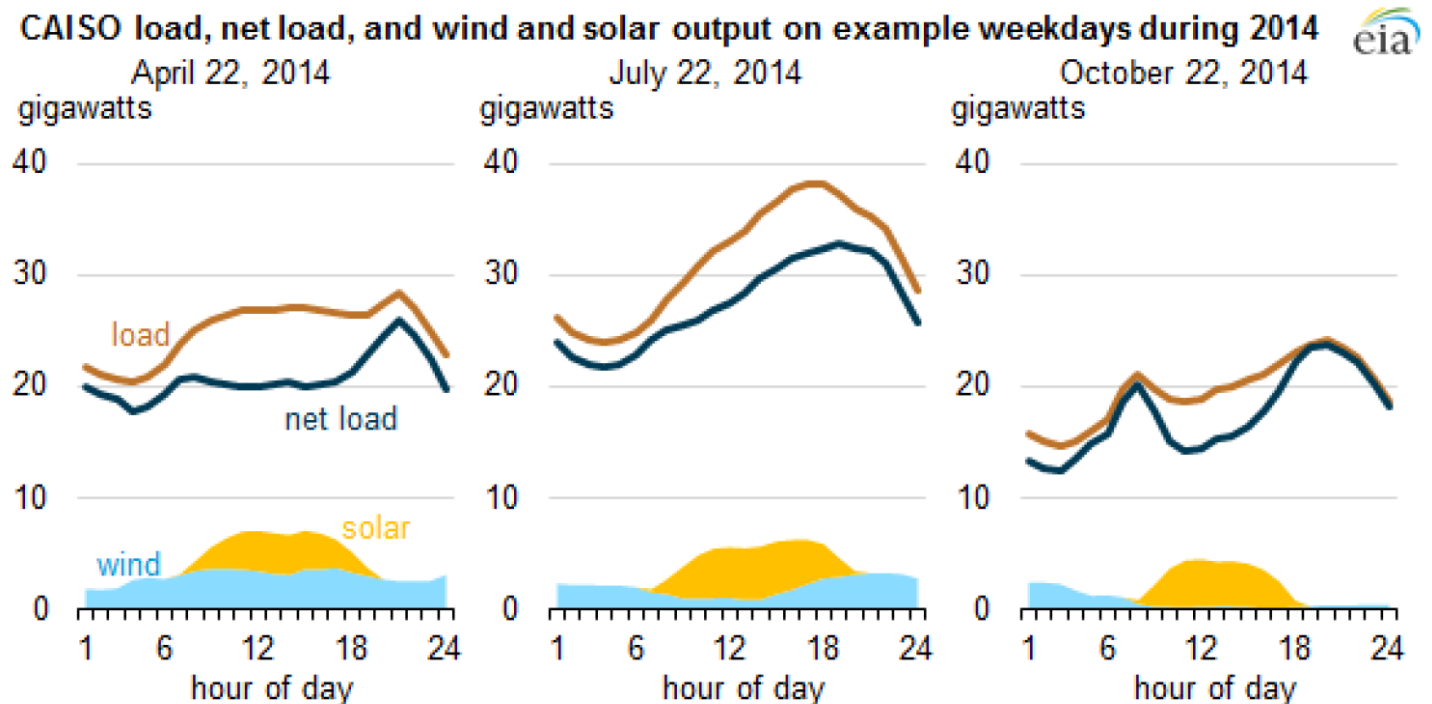
* The research team included stakeholder input to narrow our list at each stage.

LOAD SHAPING LANDSCAPE

Increased Concern for Demand

There has been increased interest for demand savings from EE programs due to:

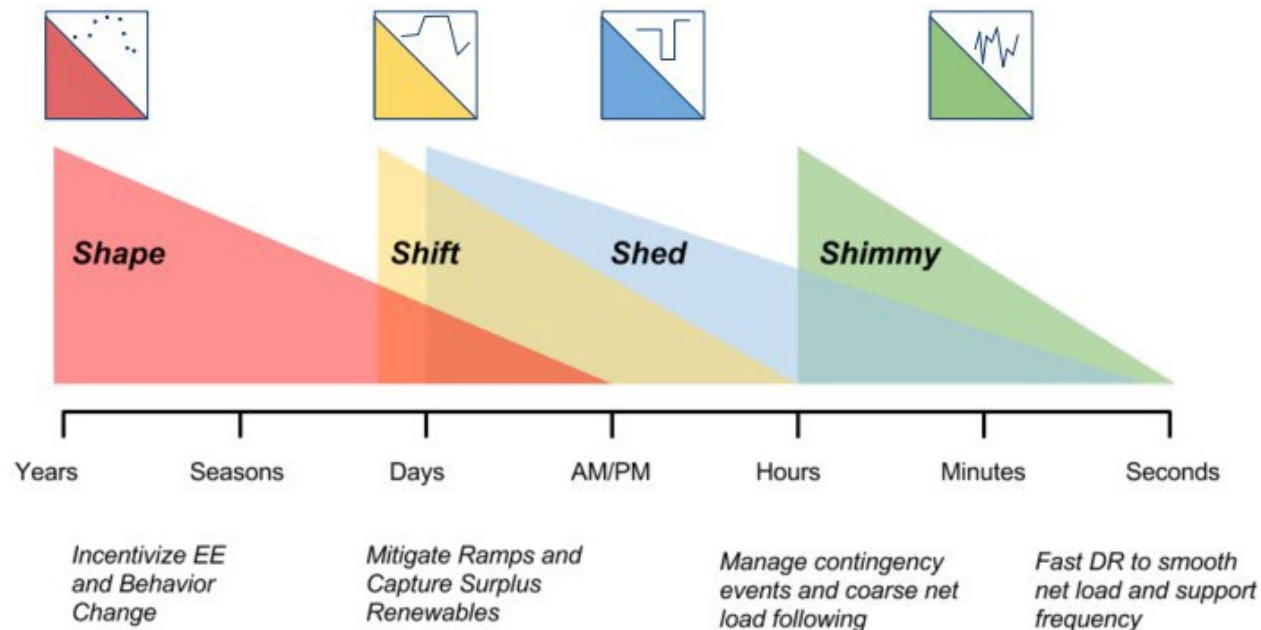
- Intermittent renewable generation
- Electrification of transportation
- Improved markets and technology



Source: <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442451541>

EE Mitigating Demand In Practice

While traditional EE programs help manage peak demand, EE programs are increasingly mitigating load with:



- Load shaping
- Integrated EE and DR
- Non-Wires Alternatives
- Methods to better account for time- and location-value of savings

Source: <https://eta.lbl.gov/sites/default/files/seminars/alstone-seminar-10-9-2017.pdf>

Load Shaping Project Limitations

Focus and ILLUME constrained this specific research task to the following:

- Identifying measure opportunities in context of Wisconsin policies
- Load shaping, and in partnership with utilities, integrated EE and DR opportunities
- Summer peak demand

KEY FINDINGS & RECOMMENDATIONS

Key Findings

- Focus continues to provide incentives for EE measures that save energy at peak summer times in Wisconsin
- Smart thermostats represent the most immediate and least risk opportunity to administer an integrated EE and DR measure
- Wisconsin customers could yield greater benefits from some EE measures already supported by Focus with supplemental funding, education, coordination, and/or support from utilities or entities interested in demand savings
- In other states, regulators and utilities are using EE programs to support initiatives beyond EE

Recommendations

- Provide stakeholders with information on existing Focus programs and technologies that provide summer demand savings
- Collect feedback on the following from utility partners, regulators and other stakeholders through interviews or focus groups:
 - A straw proposal for administering an integrated EE and DR smart thermostat measure in Wisconsin
 - Options for Focus to support targeted initiatives driven by utilities or other entities
- Pending feedback from stakeholders:
 - Launch an integrated EE and DR smart thermostat offering
 - Consider research to better understand the financial value in achieving greater demand savings
 - Consider further research into demand savings for existing measures (e.g., estimating demand savings for other critical times)
- Pending the progress of an integrated EE and DR smart thermostat measure and stakeholder feedback on potential demand-based offerings, revisit the market readiness of other opportunities

RESULTS SUMMARY

Results

While our research and the report provide deep investigations into the selected measures, the following slides present a summary of our findings:

- Measure and market characterization for 10 measures
- Four case studies

The appendix of this deck includes detailed results for the four case studies.

Measure and Market Characterization



MEASURE	POTENTIAL	SELECT FOR CASE STUDY	LOAD SHAPING VALUE PROPOSITION
Smart Thermostats	High	Yes	Integrated EE/DR
Energy Recovery Ventilator (ERV)	High	No	Traditional EE with load shaping
Variable Frequency Drive (VFD) High Speed Ventilation/ Circulation Fan	High	No	Traditional EE with load shaping Potential for integrated EE/DR
Heat Pump Water Heater (HPWH)	Moderate to High	Yes	Traditional EE with load shaping Potential for integrated EE/DR Potential to pilot load management for electrifying end-uses
Strategic Energy Management (SEM) for Water and Wastewater Treatment Plants	Moderate to High	Yes	Potential for traditional EE with load shaping Potential for integrated EE/DR
Energy Management Information Systems (EMIS)	Moderate	NA – see other Focus research	Emerging EE measure with potential for load shaping Potential for integrated EE/DR
Efficient Compressed Air Nozzles	Moderate	No	Traditional EE with load shaping
Customer Sited Battery Storage	Moderate	Yes	Potential future offering warranting further research and monitoring
Efficient Clothes Washers	Moderate	No	Traditional EE with load shaping Potential for integrated EE/DR
High Frequency (HF) Battery Chargers for Lift-Trucks	Low	No	Potential to pilot load management for electrifying end-uses

High Potential

MEASURE	POTENTIAL	SELECT FOR CASE STUDY	LOAD SHAPING VALUE PROPOSITION
Smart Thermostats	High	Yes	Integrated EE/DR
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Variable Frequency Drive (VFD) High Speed Ventilation/ Circulation Fan	High	No	Traditional EE with load shaping Potential for integrated EE/DR
Heat Pump Water Heater (HPWH)	Moderate to High	Yes	Traditional EE with load shaping Potential for integrated EE/DR Potential to pilot load management for electrifying end-uses
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Traditional EE Load Shaping Opportunities



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Integrated EE/DR Opportunities



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Electrifying End-Uses

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Strategic Energy Management (SEM) for Water and Wastewater Treatment Plants	Moderate to High	Yes	Potential for traditional EE with load shaping Potential for integrated EE/DR
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Efficient Clothes Washers	Moderate	No	Traditional EE with load shaping Potential for integrated EE/DR
High Frequency (HF) Battery Chargers for Lift-Trucks	Low	No	Potential to pilot load management for electrifying end-uses

Four Case Studies

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Smart Thermostats – Next Steps

- Offer an integrated EE/DR measure in partnership with utilities
 - Use as a test case for future EE/DR offerings
 - Consider starting conversations with MG&E and Xcel, as they already offer smart thermostat DR programs
- Research questions to address with pilot
 - What are the challenges of an integrated EE and DR offering (e.g., added staff demands, reduced program flexibility)?
 - Could an integrated EE and DR offering enable Focus's smaller utility partners to offer their customers DR?
 - Does the additional incentive change the participant demographics for smart thermostats?

HPWH – Next Steps

- Because adoption has been low, Focus may consider whether HPWH in a beneficial electrification (BE) context or integrated EE/DR context could improve participation
- Research questions to address with a pilot related to BE:
 - What are the customer economics of fuel switching?
 - How is the customer experience different?
 - How is the installation process and experience different?
 - What are the non-energy benefits, if any?
 - What are the emissions impacts?
- Research questions to address with a pilot related to integrated EE/DR:
 - What are the DR savings?
 - How do the DR savings change by hour or seasonally?
 - What is the customer experience with DR events?
 - Does the combination of EE/DR incentives impact participation rates?
 - Is it feasible to limit EE incentives to models that are DR-ready?

SEM for Water/Wastewater Treatment

– Next Steps

- Consider more ready opportunities to pilot integrated EE and DR
- Consider beginning to engage utility partners to better understand their appetite for aligning on goals and expanding the SEM offering to include DR and demand specific savings
- Conduct additional research, such as interviews with utilities, energy service companies, and industrial engineering firms in Wisconsin to better understand their reactions to and feedback for SEM at water/wastewater treatment facilities to meet specific demand reduction goals

Residential Customer-Sited Batteries

– Next Steps



- Consider more ready opportunities to pilot load shaping
- Consider various potential roles for Focus with regards to battery storage with utility partners and other stakeholders

Questions

Recommendations

- Provide stakeholders with information on existing Focus programs and technologies that provide summer demand savings
- Collect feedback on the following from utility partners, regulators and other stakeholders through interviews or focus groups:
 - A straw proposal for administering an integrated EE and DR smart thermostat measure in WI
 - Options for Focus to support targeted initiatives driven by utilities or other entities
- Pending feedback from stakeholders:
 - Launch an integrated EE and DR smart thermostat offering
 - Consider research to better understand the financial value in achieving greater demand savings
 - Consider further research into demand savings for existing measures (e.g., estimating demand savings for other critical times)
- Pending the progress of an integrated EE and DR smart thermostat measure and stakeholder feedback on potential demand-based offerings:
 - Revisit the market readiness of other opportunities identified in this report no later than late 2021/early 2022

Thank you

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Potential Research to Better Inform Focus to Support Load Mitigation



- Three key areas of targeted future research are:
 - Assessing different strategies for enhancing programs to achieve greater demand savings
 - Better understanding the value of achieving additional demand savings
 - Expanding the list of potential demand saving opportunities.
- Seven potential research studies designed could help address these target areas:
 - Utility, regulator, and other stakeholder interviews or focus groups
 - WI customer survey on awareness and knowledge of demand issues and savings
 - Summary of WI and utility partner demand issues
 - Cost of acquisition for demand savings
 - Full database review of Spectrum
 - Prioritized EE measure list for winter demand savings opportunities
 - Reviewed/revised demand and coincident demand savings for key measures

Potential Research Tasks

- Utility, regulatory, and other stakeholder interviews or focus groups
 - Objectives: inform assessment of load shifting program designs, processes, and strategies for Wisconsin
- WI customer survey on awareness and knowledge of demand issues and savings
 - Objectives: inform assessment of load shifting program designs, processes, and strategies for Wisconsin
- Summarize WI demand issues and characterize utility partners
 - Objectives: inform assessment of load shifting program designs, processes, and strategies for Wisconsin; and assess load shaping value for Wisconsin

Potential Research Tasks (continued)

- Cost of Acquisition for demand savings
 - Objectives: assess load shaping value for Wisconsin
- Full database review of SPECTRUM
 - Objectives: expand the list of potential demand saving opportunities
- Prioritize EE Measures with winter demand savings opportunities
 - Objectives: expand the list of potential demand saving opportunities
- Review and revise demand and coincident demand savings
 - Objectives: expand the list of potential demand saving opportunities

Policy Considerations

Due to the current Focus on Energy Policy Manual, our research indicates that Focus's most immediate and actionable opportunities for supporting demand mitigation include:

- Emphasizing EE measures that both save demand at critical times and meet the necessary EE screening criteria
- Partnering with utilities for integrated EE and DR offerings

Our research also indicates that in other states, regulators and utilities are exploring using EE programs to support initiatives beyond EE. However, the success of these initiatives is unclear and there is not yet a playbook to follow for implementing this type of transition.

Case Studies

- **Methodology:** examine the technological potential, current market, and program design considerations, and “fit” withing the Focus portfolio
- **Sources:** industry literature, program documentation, and Illume team’s experience
- Four measures
 - Smart Thermostats
 - Residential Heat Pump Water Heaters
 - SEM for Wastewater Treatment
 - Residential Customer-Sited Battery Storage

Smart Thermostats – Measure Characterization **focus on energy**[®] Partnering with Wisconsin utilities

Description: Standard programmable thermostats allow customers to adjust temperatures during unoccupied periods to allow for energy savings. Communicating can be programmed remotely through various communication protocols. Smart thermostats have several automatic features to increase energy savings and can be used to control a growing number of residential HVAC types.

CATEGORY	MEASURE DETAILS
Segment	Residential
End Use	HVAC system
Load Shaping Value Proposition	Integrated EE/DR partnership with utilities
Relevance for Load Shaping	<p><i>Recurring:</i> Documented annual energy savings without demand savings in the Focus TRM 2020, but other sources indicate potential demand savings</p> <p><i>Event-based:</i> Strong opportunity for event-based savings with integrated EE and DR</p>

Smart Thermostats – Market Characterization



- Delivery Channels
 - EE programs: retail (online in-store) & utility e-marketplaces
 - DR programs: device/account, utility marketing, point-of-sale
- Market Actors
 - e-marketplace vendors
 - DR providers of BYO programs
- Adoption & Saturation
 - >40,000 units since 2016 (1-2% of homes)
 - National adoption in high growth period: ~350% CAGR predicted through 2020
- Market Barriers
 - Cost, privacy concerns, HVAC system compatibility

Smart Thermostats – Program Design

- Incentives & Marketing themes from national programs
 - Using an implementer that can manage both the DR implementation and e-marketplace for the EE program
 - Having the DR marketing effort piggyback on the e-marketplace managed and paid for by the EE program
- Eligibility Considerations
 - Identical for EE and DR components
 - Specific to offering
- Barriers to Implementation
 - Evaluation risk posed by variation in energy savings of devices
 - Manufacturer & utility cooperation
 - Attribution impact

Smart Thermostats – Next Steps

- Offer an integrated EE/DR measure in partnership with utilities
 - Use as test case for future EE/DR offerings
 - Consider starting conversations with MG&E and Xcel that already offer smart thermostat DR programs
- Research questions to address with pilot
 - What are the challenges of an integrated EE and DR offering (e.g., added staff demands, reduced program flexibility)?
 - Could an integrated EE and DR offering enable Focus's smaller utility partners to offer their customers DR?
 - Does the additional incentive change the participant demographics for smart thermostats?

HPWH – Measure Characterization

Description: In addition to using electricity, HPWHs pull heat from the surrounding air, making them more efficient than traditional electric resistance heating.

CATEGORY	MEASURE DETAILS
Segment	Residential
End Use	Domestic hot water
Load Shaping Value Proposition	Traditional EE measure with potential demand savings Potential for integrated EE/DR partnership with utilities Opportunity to pilot load management for electrifying end-uses
Relevance for Load Shaping	<i>Recurring:</i> Established recurring energy and demand savings <i>Event-based:</i> Potential savings with connected HPWH but the greater EE of HPWH means they provide less benefit to peak demand mitigation and energy shifting.

HPWH – Market Characterization

- Delivery Channels
 - **Trade allies** (dominant mechanism)
 - Direct-to-consumer rebates for DIY installation (less common due to complexity)
- Market Actors
 - Trade allies
 - Retail stores & online marketplaces
 - e-marketplace vendors
 - Distributors (for midstream programs)
 - Manufacturers of DR-enabled HPWH/aftermarket DR controllers
 - DR system providers
- Adoption & Saturation
 - 1% of all electric water heaters nationally
- Market Barriers
 - Cost, customer awareness, prevalence of natural gas DHW, availability, installer expertise, installation constraints, customer experience

HPWH – Program Design

- Incentives & Marketing themes from national programs
 - Often offered to complement state/local beneficial electrification policies
 - Many programs in pilot stage with limited results
- Eligibility Considerations
 - Specified performance requirements
 - Some considering DR capability a requirement to push market transformation
- Barriers to Implementation
 - Low customer demand/fuel switching required (customers prefer like-for like replacements)
 - Nascent market
 - No beneficial electrification policy in WI yet

HPWH – Next Steps

- Consider HPWH as a good test case for beneficial electrification in WI
- Consider limiting HPWH incentives to DR-enabled models if DR is a priority strategy
- Research questions to address before a pilot
 - What are the customer economics?
 - How is the customer experience different?
 - How is the installation process and experience different?
 - What are the non-energy benefits, if any?
 - What are the emissions impacts?
- Research questions to address with a pilot
 - What are the DR savings?
 - How do the DR savings change by hour or seasonally?
 - What is the customer experience with DR events?
 - Does the combination of EE/DR incentives impact participation rates?

SEM for Water/Wastewater Treatment

– Measure Characterization

Description: SEM takes a holistic approach to managing energy use to continuously improve energy performance by achieving persistent energy and cost savings over the long term. Water and wastewater treatment plants represent facilities with both EE and load shifting opportunities, which are complex and well suited for SEM.

CATEGORY	MEASURE DETAILS
Segment	Industrial
End Use	Controls
Load Shaping Value Proposition	Traditional EE measure with potential demand savings Potential for integrated EE/DR partnership with utilities
Relevance for Load Shaping	<i>Recurring:</i> Established recurring energy savings <i>Event-based:</i> Opportunity for event-based savings with integrated EE and DR

SEM for Water/Wastewater Treatment

– Market Characterization

- Delivery Channels
 - SEM program implementers
 - 3 Program components: customer commitment, planning & implementation; energy use measurement
- Market Actors
 - Plant facility managers & staff
 - Water solution providers
 - Engineers used for capital upgrades
- Participation
 - 3 out of 90 major municipal wastewater treatment plants currently participate in SEM
- Market Barriers
 - Limited available capital, limited staff availability, emphasis on regulatory compliance & water quality

SEM for Water/Wastewater Treatment

– Program Design



- Incentives & Marketing
 - Incentives typically \$0.01-\$0.02/kWh
- Eligibility Considerations
 - Customer size and interest
- Barriers to Implementation
 - Focus' requirement to achieve energy savings and limits on demand savings

SEM for Water/Wastewater Treatment

– Next Steps

- Consider more ready opportunities to pilot integrated EE and DR for other measures
- Consider beginning to engage utility partners to better understand their appetite for aligning on goals and expanding the SEM offering to include DR and demand specific savings
- Conduct additional research, such as interviews with utilities, energy service companies, and industrial engineering firms in WI to better understand their reactions to and feedback for SEM at water/wastewater treatment facilities to meet specific demand reduction goals

Residential Customer-Sited Batteries

– Measure Characterization

Description: Demand side management programs are beginning to leverage customer sited battery storage to provide grid services, such as load shifting.

CATEGORY	MEASURE DETAILS
Segment	Residential
End Use	Storage
Load Shaping Value Proposition	Potential future offering warranting further research and monitoring
Relevance for Load Shaping	<i>Recurring:</i> While not saving energy, batteries can shift load on a recurring basis (e.g., daily) <i>Event-based:</i> Strong opportunity for event-based savings

Residential Customer-Sited Batteries

– Market Characterization

- Delivery Channels
 - Storage-plus-solar equipment suppliers
 - Solar installers
 - Online marketplaces
 - Utilities via community storage or solar-plus-storage
- Market Actors
 - Solar installation contractors and/or battery storage manufacturers
 - Lending partners
 - Trade allies including enrollment service providers and performance data providers
- Adoption & Saturation
 - Low but growing. 1,000-2,000 MW annual capacity expected nationally from 2023-2025
- Market Barriers
 - Cost, awareness & misconceptions of technological capabilities, permitting & regulation

Residential Customer-Sited Batteries – Program Design

- Incentives & Marketing
 - Utility and statewide programs are providing different degrees of support for battery storage, whether directly administering a program, providing incentives for standalone storage devices, supporting battery storage indirectly using solar rebates, or with marketing
- Eligibility Considerations
 - Qualifying battery storage systems and qualified inverters
 - Approved interconnection applications (with the participating utility or co-op)
 - Use of program participating trade allies
- Barriers to Implementation
 - The fact that battery storage does not produce energy savings can be a barrier to their inclusion in EE programs
 - Overcoming the customer barriers of technological awareness and misconceptions

Residential Customer-Sited Batteries

– Next Steps



- Consider more ready opportunities to pilot load shaping
- Consider various potential roles for Focus with regards to battery storage with utility partners and other stakeholders