Smart Electric Power Alliance

Accelerating Coordinated Utility Programs for Grid-Interactive Efficient Buildings

Practitioners' Perspectives

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Accelerating Coordinated Utility Programs for GEBs

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The Smart Electric Power Alliance (SEPA) is dedicated to helping electric power stakeholders address the most pressing issues they encounter as they pursue the transformation to a carbon-free energy system. We are a trusted partner providing education, research, standards, and collaboration to help utilities, electric customers, and other industry players across three pathways: Regulatory and Business Innovation, Grid Integration, Electrification. Through educational activities, working groups, peer-to-peer engagements and custom projects, SEPA convenes interested parties to facilitate information exchange and knowledge transfer to offer the highest value for our members and partner organizations. For more information, visit www.sepapower.org.

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Executive Summary

Grid-interactive efficient buildings (GEBs) are energy-efficient buildings that use smart technologies and on-site distributed energy resources (DERs) to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences in a continuous and integrated way. The services and other benefits from GEBs have the potential to save up to $18 billion in power system costs and 80 million tons of carbon emissions annually.[1] For this reason, the U.S. Department of Energy (DOE) has a goal to triple the energy efficiency and demand flexibility of residential and commercial buildings by 2030, and is supporting the Biden Administration's goal to achieve a 50-52% reduction (from 2005 levels) in economy-wide net greenhouse gas pollution in 2030.[2]

To help accelerate this GEBs future, building energy programs, which often provide incentives and/or technical assistance for building energy upgrades, will need to transition to better integrate conservation and active management of electricity in buildings for the direct or indirect provision of grid services. This study examined the barriers and potential solutions to this building energy program transition by gathering insights from utilities, other program administrators, technology solution providers, and regulators about energy program business models, regulatory frameworks, and key learnings. A literature review, survey, focus groups, and one-on-one interviews were used to document the industry's current challenges and strategies for success. Key findings are shown below in Table 1.

Study findings on the challenges of transitioning to coordinated energy efficiency (EE) and demand flexibility (DF) programs that are either coupled with or separately offered with demand response (DR) programs ("coordinated EE+DF(+DR) programs"), are detailed within the main body of the report. Solution strategy implementation details, where available, are presented in case studies located in Appendix A. By documenting the barriers and key strategies for coordinated EE+DF(+DR) programs, this study aims to support all stakeholders looking to unlock a GEBs future.

Table 1. Key Study Findings

Section	Key Challenges to Coordinated EE+DF(+DR) Programs
Report	**Accelerating Coordinated Utility Programs for Grid-interactive Efficient Buildings (GEBs)**

Organizational & Structural Silos	- Internal utility organizational silos
	- Traditional regulatory silos
	  - Proceeding-related
	  - Funding-related
	  - Standards-related
	- Separate EE/EE+DF service providers
	- Differing objectives/motivations between program administrators & partners

Existing Regulatory Frameworks	- The absence of regulatory innovation and collaboration frameworks

1 Satchwell, A. et al. (2021). *A National Roadmap for Grid-Interactive Efficient Buildings.* United States. https://doi.org/10.2172/1784302; https://gebroadmap.lbl.gov/A%20National%20Roadmap%20for%20GEBs%20-%20Final.pdf; DOE. (2021, October 13b). *DOE Invests $61 Million for Smart Buildings that Accelerate Renewable Energy Adoption and Grid Resilience.* https://www.energy.gov/articles/doe-invests-61-million-smart-buildings-accelerate-renewable-energy-adoption-and-grid

2 U.S. White House. (April 21, 2021). Fact Sheet: *President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies.* https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/

Accelerating Coordinated Utility Programs for GEBs

Table 1. Key Study Findings	
Section	**Key Challenges to Coordinated EE+DF(+DR) Programs**
Report	**Accelerating Coordinated Utility Programs for Grid-Interactive Efficient Buildings (GEBs)**
Utility Business Models & Valuation	▪ Utility business models which provide inadequate and/or misaligned financial incentives, or use too broad of performance metrics ▪ Limited coordinated program value proposition in jurisdictions without organized wholesale markets ▪ Existing registration frameworks
Program Design & Customers	▪ Challenging quantification/evaluation of cost-effectiveness ▪ Navigating the process of creating, deploying, and refining new program metrics (often to support decarbonization) ▪ Recruiting and retaining customers ▪ Advancing equitable participation
Technical Implementation	▪ Inadequate DF equipment standards and protocols ▪ Real or perceived additional cybersecurity risks
Case Studies	**Successfully Implemented Key Strategies for Coordinated EE+DF(+DR) Programs**
To Help Overcome Utility Organizational Silos	▪ House EE+DF and DR teams under one umbrella ▪ Coordinate with other departments/teams early in the program development process
To Help Overcome Regulatory Silos	▪ Revise regulations and/or statutes ▪ Proactively align proceeding timelines ▪ Encourage regulatory and utility staff to collaborate across separate proceedings, and/or establish/ enhance integrated resource planning (IRP) processes to include EE, DF and DR, as well as relevant experts from separate regulatory teams
To Encourage Pilot and Program Innovation	▪ Increase acknowledgement and acceptance of bounded pilot risk and the need for flexibility ▪ Increase opportunities for discussion/feedback from regulators during pilot and program planning ▪ Enable a more-flexible regulatory structure that allows for pilot and program evolution as learnings emerge ▪ Provide financial support for highlighting pilot successes and customer benefits, as well as research and development (R&D) projects
To Advance Collaboration	▪ Ensure regulatory engagement during program development ▪ Coordinate across all entities that interface with the same customers ▪ Increase data access and process transparency for all stakeholders ▪ Encourage multi-agency/department dialogue within government and program administrators ▪ Leverage different strengths among program administrators and/or stakeholders ▪ Share lessons learned across jurisdictions
To Help Address Limited or Non-Existent Organized Wholesale Markets	▪ Utilize integrated resource planning that includes EE, DF, and DR as procurable resources

Table 1. Key Study Findings	
Section	**Key Challenges to Coordinated EE+DF(+DR) Programs**
Case Studies	**Successfully Implemented Key Strategies for Coordinated EE+DF(+DR) Programs**
To Help Overcome Cost-effectiveness Challenges	▪ Analyze advanced metering infrastructure (AMI) data, when and where available ▪ Collaborate regionally (especially in areas without regional organized wholesale markets) to help assess value ▪ Conduct pilots, which if exempt from the stricter cost-effectiveness requirements that may apply to programs, can help assess cost-effectiveness ▪ Review existing cost-effectiveness requirements for potential enhancements and alignment with national best practices
To Help Successfully Evolve Program Metrics to Support Decarbonization	▪ Carefully consider carbon metric selection, including available data/methods for developing baselines and setting performance goals ▪ Engage internal and external stakeholders in developing new carbon metrics and targets to increase buy-in ▪ Ensure clear, top-down leadership within the organization that provides clarity on how programs are expected to support the organization's overarching carbon goals
To Help Improve Low-to-Moderate Income Customer Participation	▪ Using performance incentive mechanisms (PIMs) tied to low-to-moderate income (LMI) customer benefits ▪ Issuing regulatory directives to publicly track and report relevant metrics ▪ Issuing regulatory directives to hold workshops and otherwise collaborate with experts on LMI customer barriers ▪ Establishing legislative mandates to improve LMI customer engagement and access ▪ Creating utility partnerships with trusted local community-based organizations to identify and engage LMI customers ▪ Working with rental housing market stakeholders (including multi-unit dwellings) to identify and assist LMI customers ▪ Recruiting an income-diverse customer participant pool for pilots to determine strategies to support increased LMI participation in scaled coordinated EE+DF(+DR) program offerings ▪ Designing coordinated EE+DF(+DR) pilots focused on key barriers for LMI customer participation, such as a smart service panel pilot

Source: SEPA, 2022

Glossary

AMI: Advanced Metering Infrastructure

BTM: Behind-The-Meter

BTO: Buildings Technology Office

BYOD: Bring-your-own-device

COS: Cost-of-service

DERs: Distributed Energy Resources

DF: Demand Flexibility

DG: Distributed Generation

DOE: Department of Energy

DR: Demand Response

EE: Energy Efficiency

ES: Energy Storage

EVs: Electric Vehicles

GEBs: Grid-interactive Efficient Buildings

GHG: Greenhouse Gases

IOU: Investor-owned Utility

IRPs: Integrated Resource Plans

ISOs: Independent System Operators

IT: Information Technology

kW: Kilowatt

kWh: Kilowatt-hour

LED: Light-emitting Diode

LMI: Low-to-Moderate Income

PBR: Performance-Based Regulation

PIMs: Performance Incentive Mechanisms

PUC: Public Utilities Commission

PV: Photovoltaic

R&D: Research and Development

RoR: Rate of Return

RTOs: Regional Transmission Organizations

T&C: Testing and Certification

TOU: Time of Use

TVR: Time-varying Rates

Introduction

The U.S. electric power industry is in a transformational era. Declining clean energy costs, technology advancements, a growing policy and societal focus on mitigating climate change, and evolving customer preferences are driving an industry-wide shift toward a more modern and carbon-free energy system. As of April 2022, 81% of U.S. customer accounts were served by an individual utility or a utility owned by a parent company with a carbon-reduction target.[3]

As part of the accelerating industry focus on carbon-reduction targets and strategies, utilities are increasingly embracing innovative demand-side resources and programs, including leveraging energy efficiency (EE), demand flexibility (DF), demand response (DR) and distributed energy resources (DERs) in residential and commercial buildings. These actions are critical because the country's 129 million buildings consume 40% of U.S. energy and 75% of its electricity, and contribute 35% of annual U.S. carbon emissions.[4]

To reduce the building sector's carbon emissions and to leverage buildings as a flexible resource, the U.S. Department of Energy's (DOE) Building Technologies Office (BTO) is advancing the development of its vision for grid-interactive efficient buildings (GEBs), defined as *energy-efficient buildings that use smart technologies and on-site DERs to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences in a continuous and integrated way*.[5] A recent DOE BTO study estimated that by 2030, GEBs could save up to $18 billion in power system costs and 80 million

Definitions

Throughout this report, we will use the following definitions (please see Appendix B, Project Definitions for sources):

- **Energy efficiency (EE):** Energy efficiency is the persistent and maintained reduction in energy and/or demand, as compared to baseline consumption, to provide the same or an improved level of service.[6]
- **Demand flexibility (DF):** The technical capability, associated with a building, to actively lower, increase, shift, or modulate energy usage, compared to a baseline scenario reflecting the passive state of operation, in response to utility grid needs.
- **Demand response (DR):** The active reduction, increase, shift, or modulation of energy and/or demand on a limited time basis, as compared to baseline consumption, in response to a price/incentive payment or command signal, which may result in a lower level of service.
- **Coordinated EE+DF(+DR) Programs:** Coordinated program delivery of EE and DF end-use technologies coupled or integrated with providing some form of electric grid services (i.e., DR programs). Specifically, program types 2 and 3 (see the Program Types & Successes section of this report).

For shorthand, this case study uses the + symbol between EE, DF and/or DR terms to indicate when a program provides more than one of these services (i.e., an EE+DF program provides both energy efficiency and demand flexibility).

3 This includes targets adopted by generation and transmission cooperatives (G&Ts). Additionally, as of April 2022, 69% of U.S. customer accounts were served by an individual utility or a utility owned by a parent company with a 100% carbon-reduction target (including targets adopted by G&Ts). SEPA. (2022). *Utility Carbon Reduction Tracker.* https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/

4 DOE. (2021, October 31a). *Meet DOE's Newest Connected Communities of Grid-interactive Efficient Buildings.* https://www.energy.gov/eere/buildings/articles/meet-does-newest-connected-communities-grid-interactive-efficient-buildings

5 Neukomm, M., Nubbe, V., & Fares, R. (2019). *Grid-interactive Efficient Buildings: Overview. U.S. Department of Energy.* https://www1.eere.energy.gov/buildings/pdfs/75470.pdf

6 Although not explicitly included or excluded from the definition of energy efficiency used in this study, electrification was not a focus for the study's data collection and analysis.

tons of carbon emissions annually.[7] With a goal to triple EE and DF in residential and commercial buildings by 2030, DOE BTO is committed to leveraging the opportunities presented by GEBs.[8]

In order to enable programs that support GEBs, it is important to understand where stakeholders who design, implement, evaluate and regulate energy programs—utilities, program administrators, regulators and policymakers, and technology solution providers—stand today. This study examines how traditional EE, DF, and DR programs are transitioning to integrate energy conservation and active management of electricity in buildings for the direct or indirect provision of grid services, and investigates the degree to which this transition is already occurring as well as barriers to success. By identifying successful programs and their business models, regulatory frameworks, and key learnings, this study investigated how utility-coordinated EE and DF programs that are either coupled with or separately offered with DR programs ("EE+DF(+DR) programs") can support GEBs, and what challenges must be overcome in order to unlock a GEBs future.

Project Framing

Project Scope

To examine the current and future evolution of utility programs[9] that facilitate GEBs, this study focused on the areas in which utility coordinated EE+DF(+DR) programs[10] and GEBs intersect. As illustrated in Figure 1, the project scope includes a focus on residential and commercial utility programs that encourage customer adoption of end-use building technologies including a number of different DERs such as behind-the-meter (BTM) energy storage (ES), electric vehicles (EVs), and distributed generation (DG), and their subsequent use to provide some form of electric grid services.

In order to better understand utility program evolution and to categorize the spectrum of utility programs, this study reviewed a variety of utility coordinated EE+DF program designs along with different types of DR programs.

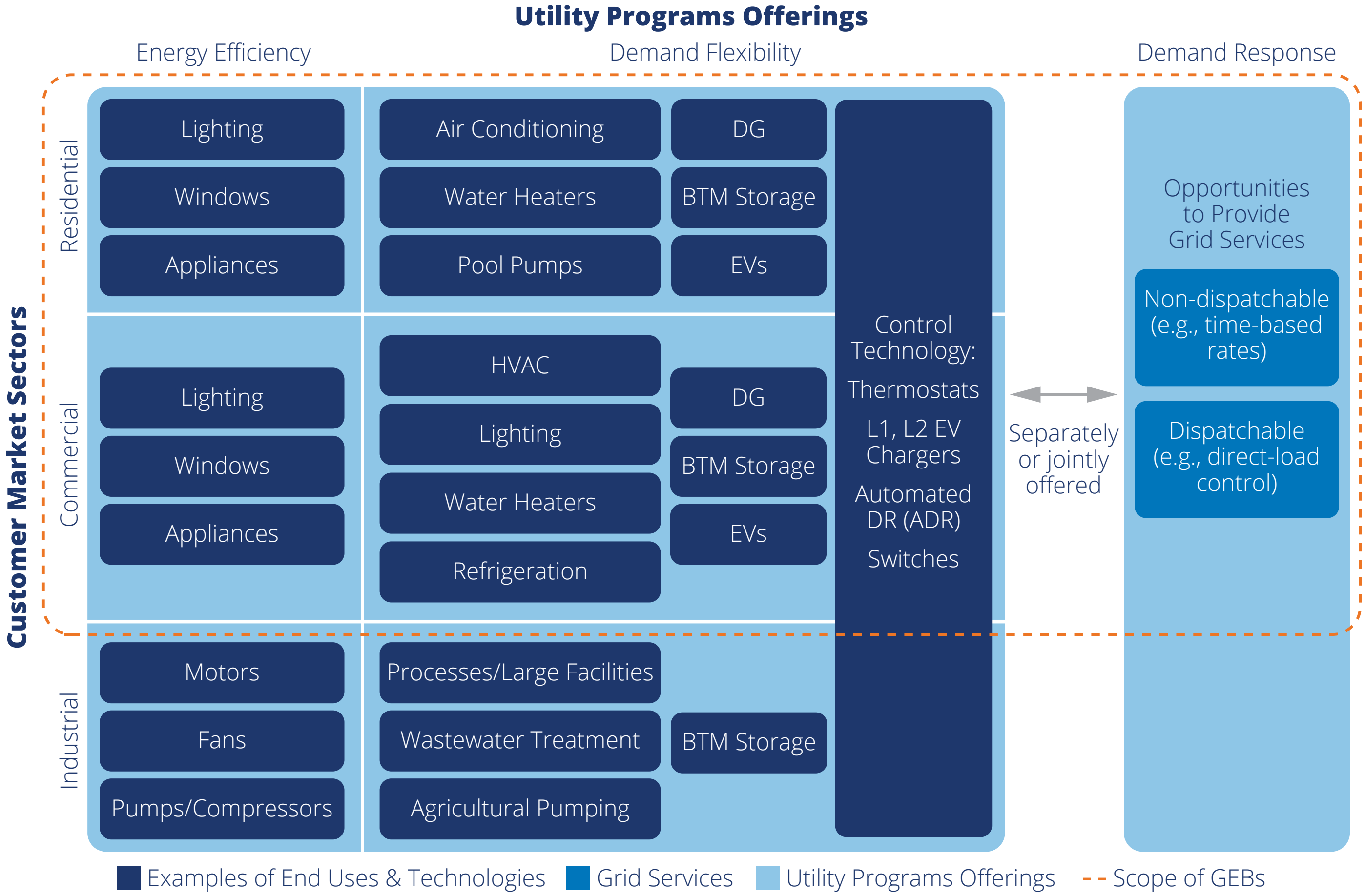
7 The report found that over the next two decades, GEBs could deliver between $100 billion and $200 billion in savings to the U.S. power system. Satchwell, A. et al. (2021) *A National Roadmap for Grid-Interactive Efficient Buildings. United States*. https://doi.org/10.2172/1784302; https://gebroadmap.lbl.gov/A%20National%20Roadmap%20for%20GEBs%20-%20Final.pdf; DOE. (2021, October 13b). *DOE Invests $61 Million for Smart Buildings that Accelerate Renewable Energy Adoption and Grid Resilience*. https://www.energy.gov/articles/doe-invests-61-million-smart-buildings-accelerate-renewable-energy-adoption-and-grid

8 Based on a 2020 baseline. Satchwell et. al. (2021).

9 Throughout this report, we will use the term "utility programs" as a catch-all for opportunities provided to customers to invest in EE and DF technology, which may or may not directly or indirectly include an opportunity to provide some form of grid service (i.e., DR programs). However, we recognize that such EE, DF, and even DR opportunities can be offered by utilities and/or third-party program administrators and/or technology solution providers.

10 Throughout this report, we use the term "coordinated EE+DF(+DR) programs" to refer to the coordinated program delivery of EE and DF end-use technologies coupled or integrated with providing some form of electric grid services (i.e., DR programs). Specifically, program types 2 and 3 (see Program Types & Successes section) are encompassed by the term "coordinated EE+DF(+DR) programs." The term "EE programs" refers to programs with energy efficiency program offerings only, while "EE+DF programs" refers to programs that offer both energy efficiency and demand flexibility technologies and/or offerings.

Figure 1. Project Scope: Utility Coordinated EE+DF(+DR) Programs and GEBs



Source: SEPA, 2022

Project Methodology

This study focused on collecting diverse industry perspectives in order to catalog and understand barriers to and successful strategies for deploying coordinated EE+DF(+DR) utility programs that promote GEBs. Primary study components included:[11]

- A literature review to ensure the study was conducted in parallel with previous and current research, and to identify known barriers and challenges.
- Focus group discussions with diverse utilities, third-party administrators, regulators/policymakers, and technology solution providers to determine existing successes, gaps, and challenges from today's practitioners.
- 1:1 interviews with select focus group participants to investigate barriers/challenges and practitioner experiences to inform future activities in promoting GEBs.

The literature review identified important gaps which informed the study's scope and the development of the focus groups and interviews. These gaps include a lack of information detailing the utility practitioner perspective in successfully deploying coordinated EE+DF(+DR) programs, and the utility vision/role for coordinated EE+DF(+DR) programs in promoting GEBs.

11 For more information, see: Appendix C, List of Study Participants.

Findings & Discussion

Current State & The Transition Underway

Utilities are actively engaging in a broad spectrum of activities in the coordinated EE+DF(+DR) program and GEBs space. The SEPA 2020 Utility Transformation Challenge survey found that 80% of utility respondents were exploring GEBs opportunities, with nearly half assessing the potential of DF for residential and commercial buildings, among other activities (see Figure 2).[12] Furthermore, federal support for GEBs is expanding, as illustrated by recently-funded DOE Connected Communities pilot projects, which aim to demonstrate how energy-efficient and grid-interactive technologies can transform homes and workplaces into connected communities that can support the electric grid.[13]

As recent literature has highlighted, many utility programs today are in a state of transition, with shifts toward integrating program offerings, providing DF, and approaching customers from a holistic "whole home/building" approach.[14] However, fully-optimized coordinated EE+DF(+DR) programs and GEBs are still nascent. Key literature review findings highlighted that, while a few utilities have achieved some success, most face substantial challenges in evolving towards full-scale deployment. Promoting GEBs through successful full-scale utility programs, as detailed in DOE's *A National Roadmap for Grid-Interactive Efficient Buildings* report, requires overcoming a number of barriers, including significant implementation barriers for utilities and system operators to leverage DF's capabilities and value.[15] By identifying the key levers and barriers to utility implementation and deployment of coordinated EE+DF(+DR) programs that promote GEBs, this study aims to enhance industry understanding of the challenges that need to be addressed to accelerate GEBs deployment, and to identify strategies and solutions that address those challenges.

Figure 2. SEPA Utility Transformation Challenge Profile and Survey Results: GEB Potential

42%
Assessing achievable potential of demand flexibility for residential and commercial buildings and most cost-effective opportunities

18%
Developing partnerships around GEBs with other organizations (e.g., U.S. Department of Energy, national labs, universities, developers, building owners)

18%
Working with residential, commercial and industrial customers to leverage their assets (e.g., microgrids, EV fleets, whole buildings) in aggregate

12%
Investigating measurement and verification of GEBs

38%
Tracking ongoing research and policies that enable GEBs

20%
Conducting pilot programs with smart and connected equipment at building sites

9%
Testing incentive and rate design approaches with building operators

15%
Working with building owners to upgrade IT departments and energy management systems

Respondents

Source: SEPA, published 2020, re-designed 2022

12 The SEPA *Utility Transformation Challenge* survey included over 130 utilities (covering 63% of customer accounts) and addressed multiple dimensions of transformation. See the *SEPA 2020 Utility Transformation Challenge Profile* for data and analysis: https://sepapower.org/utility-transformation-challenge/profile

13 DOE. (2021, October 13b).; DOE. (2021, October 13a).

14 Perry, C. et al. (2019), p. 6., and SEPA. (2019a), p. 34.

15 Satchwell et. al. (2021).

Program Types & Successes

Although fully optimized and coordinated EE+DF(+DR) programs are still nascent, study participants discussed a continuum of current program activity stages, including the investigation, piloting, and full deployment of coordinated EE+DF(+DR) programs. Study participants discussed three types of programs:

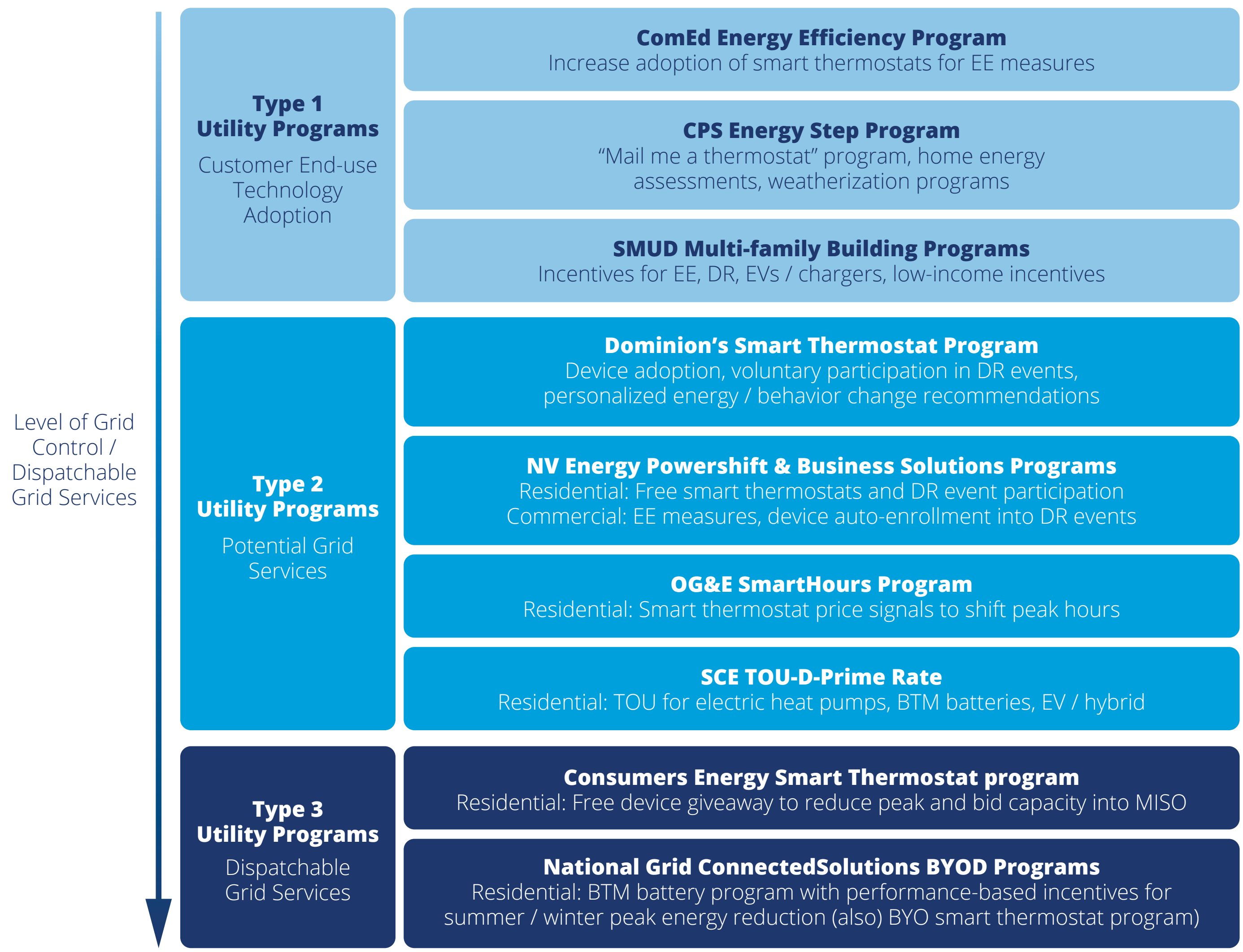
- **Type 1 EE+DF[16]:** Programs promoting customer end-use technology adoption.
- **Type 2 Integrated EE+DF(+DR):** Programs promoting customer end-use adoption with the potential to provide grid services (e.g., if paired with time-varying rates (TVR)).
- **Type 3 Coupled EE+DF(+DR):** Programs promoting customer end-use adoption linked to dispatchable grid services.

A representation of how examples of the three program types fit into the program typology is provided in Figure 3.

This typology categorizes the continuum of utility programs that are integrating EE, DF, and DR, and identifies how programs promote GEBs, as illustrated in Table 2.

Programs solely promoting customer end-use technology adoption (Type 1) represented the majority of activity, while programs promoting customer end-use adoption

Figure 3. Examples of Utility Coordinated EE+DF(+DR) Program Framing Across Project Typology



Source: SEPA, 2022

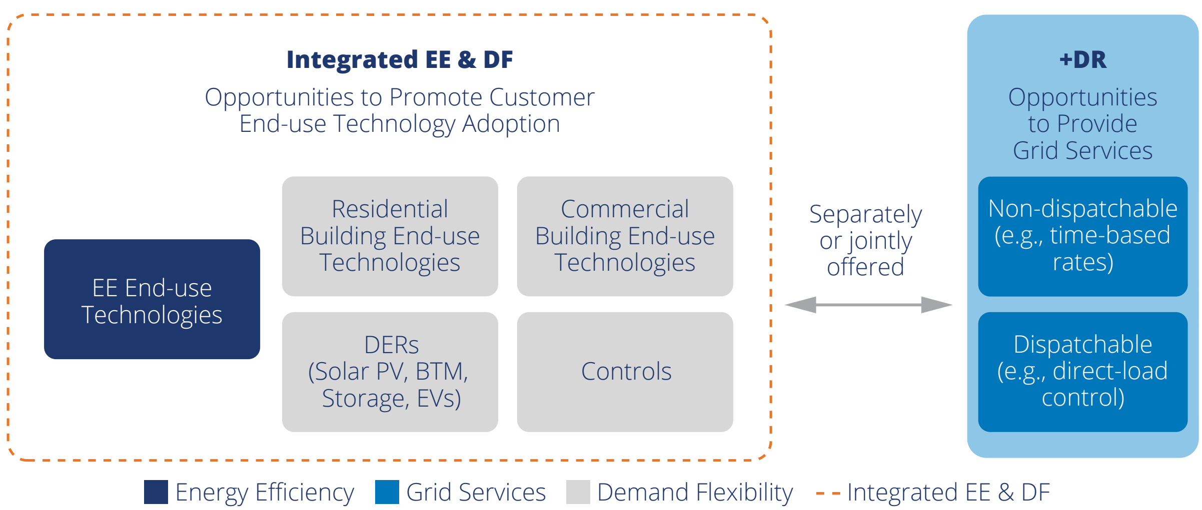
16 See Appendix B for project definitions.

Table 2. Program Types & Characteristics

Characteristics	Program Types		
	Type 1 EE+DF: Programs Promoting Customer End-use Technology Adoption	**Type 2 Integrated EE+DF(+DR): Programs Promoting Customer End-use Adoption with Potential to Provide Grid Services**	**Type 3 Coupled EE+DF(+DR): Programs Promoting Customer End-use Adoption Linked to Dispatchable Grid Services**
EE & DF Approach	Integrates EE and DF program offerings to customers		
DR Approach	Not coupled with DR (i.e., not tied to grid services)	Integrates with non-dispatchable DR (e.g., includes the potential to provide grid services by pairing with time-varying rates)	Couples with dispatchable DR (i.e., includes the potential to provide grid services through dispatchable programs)
GEBs Promotion	Promotes GEBs by increasing the efficiency and adoption of EE+DF technologies in buildings		
		Promotes GEBs by offering opportunities to co-optimize across energy cost, grid services, and customer preferences	

Source: SEPA, 2022

Figure 4. Utility Coordinated EE+DF(+DR) Program Types (Types 1 - 3 Combined)



Source: SEPA, 2022

with potential to provide grid services (Type 2) and programs promoting customer end-use adoption linked to dispatchable grid services (Type 3) were also represented. Figure 4 illustrates the three program types combined.

Study participants described the current state of coordinated EE+DF(+DR) utility programs as follows:

Utilities

The majority of study participants currently operate traditional EE and DR programs, with a few also providing DF offerings. Early successes in program integration primarily have been due to supportive regulatory environments combined with internal drivers, but fully deployed coordinated EE+DF(+DR) programs are the exception. Most utility study participants are in the first stages of operating coordinated program pilots and/or developing plans to integrate program offerings to customers.

Regulatory/Policy Staff

Overall, regulatory / policy staff view DF as key to meeting carbon-reduction targets and achieving the clean energy transition. With the exception of a few states (e.g., CA, HI, AZ), a transition to coordinated EE+DF(+DR) programs is still in the early stages. Many state regulators support accelerated coordinated EE+DF(+DR) program deployment by utilities and program administrators. Some regulators identified rate design and incentive structures as key to successfully developing and implementing coordinated EE+DF(+DR) programs.

Solution Providers

Solution provider study participants are developing the technology and tools to enable customer participation in coordinated EE+DF(+DR) programs and aggregate grid benefits. For example, this may include an online customer "marketplace" that can combine an EE/EE+DF rebate with DR program enrollment at the point-of-purchase. Solution providers expressed general consensus that existing customer devices are not fully optimized to enable coordinated EE+DF(+DR) programs (e.g., because advanced metering infrastructure (AMI) is not fully deployed). A key future opportunity for increased coordinated EE+DF(+DR) program deployment is the emergence of the smart home / smart building ecosystem.

Critical Challenges to Address

In order to accelerate the transition to coordinated EE+DF(+DR) programs and enable GEBs, study participants identified critical challenges to address. The following sections outline key barriers and provide examples of programs and models that have been successful in addressing the challenge. Additionally, individual case studies further investigate some of these challenges and provide recommendations to overcome them.

Organizational & Structural Silos

Key Findings

- *Internal utility organizational silos limit a utility's ability to develop / deploy coordinated EE+DF(+DR) programs and maximize grid services.*
- *The prevalence of traditional EE/EE+DF vs DR regulatory procedural silos limits the industry's ability to develop / deploy coordinated EE+DF(+DR) programs and maximize grid services.*

Coordinated EE+DF(+DR) programs often face organizational and structural silos within and between the entities that administer, implement, and regulate them. These silos can hinder effective collaboration, planning and design, funding, implementation, and evaluation. Although silos such as a utility's operation of separate EE/EE+DF and DR teams (or the existence of external program administrators) are common, solutions to these challenges have been implemented slowly for a myriad of reasons. The following section details the types of silos that pose challenges to coordinated EE+DF(+DR) programs and, where applicable, presents solutions that have been successfully implemented.

Utility Internal Silos

Within utilities, the development and/or implementation of coordinated EE+DF(+DR) programs can be challenging due to the presence of siloed departments or groups. Since coordinated EE+DF(+DR) programs require multiple teams from across the organization to work together, disparate or even competing priorities, goals, and/or budgets between utility departments can hinder program development, implementation, continuation, and evaluation.

This study found that it is still common for utilities to operate separate EE/EE+DF and DR teams, and that this approach hinders coordinated EE+DF(+DR) program development. The presence of separate EE/EE+DF and DR departments can stem from disconnected EE/EE+DF and DR governing statutes, regulatory processes, and/or funding streams. It can also be due to how the utility viewed the purpose of the programs: utilities historically housed DR within a broader grid operations or grid planning team, while EE/EE+DF may have been located in a department such as customer service. In either case, separate EE/EE+DF and DR departments can struggle to coordinate and cooperate, which diminishes a utility's ability to develop and implement a successful coordinated EE+DF(+DR) program. For example, during this study, multiple utilities referenced internal company views that frame EE as a direct competitor to DR because EE improvements can reduce demand. For instance, an energy-efficient building may offer fewer kilowatts (kW) or kilowatt-hours (kWh) for DR to reduce or shift during peak periods, compared to a less-efficient building. Therefore, rather than focusing on EE and DR synergies which can benefit both participating customers and grid operators, there are, in some organizations, obstructive perceptions that energy savings negatively reduce load availability for shedding or shifting.

Table 3. Organizational & Structural Silos Summary Table

Challenge	Potential Solution Strategy	Use
Utility Internal Silos ▪ Separate goals and missions for EE/EE+DF and DR programs and/or teams ▪ Skepticism or inadequate knowledge regarding the value of integration and/or the need for innovation ▪ Misaligned objectives for pilot and full-program development teams ▪ Siloed information technology (IT) systems that hinder interdepartmental billing capabilities or energy data-sharing ▪ Difficulties with motivating different teams to dedicate resources to collaborate	▪ House EE/EE+DF and DR teams under one umbrella	●
	▪ Coordinate with other departments/teams early in the program development process	●
Regulatory Silos ▪ Uncertainty surrounding where to address coordinated EE+DF(+DR) programs among various proceedings ▪ Limitations or an inability to link funding streams together ▪ Misaligned timelines among related proceedings ▪ Difficulties with implementing differing cost-effectiveness requirements ▪ Siloed or limited expertise in GEBs and/or limited staff capacity	▪ Revise regulations and/or statutes	◐
	▪ Proactively align proceeding timelines	○
	▪ Encourage regulatory and utility staff to collaborate across separate proceedings, and/or establish/enhance IRP processes to include EE, DF and DR, as well as relevant experts from separate regulatory teams	◐
	▪ Align benefit-cost tests across proceedings to better support comparability	○
Separate Program Administrators ▪ Differing regulations/ standards among separate administrators ▪ Discrete funding streams ▪ Misaligned objectives and/or motivations among program administrators ▪ Siloed knowledge, data, and expertise ▪ Customer participation fatigue driven by multiple programs and/or building visits	▪ Organize and/or mandate coordination meetings between program administrators with state officials	●
	▪ Establish data-sharing platforms that help automate useful information sharing	○
	▪ Revise existing policies to establish program integration as a priority and potentially a part of determining program success	●
Differing Objectives Between Program Partners ▪ Ownership of the customer relationship not specified or agreed to upfront ▪ Misaligned program objectives with performance metrics or contract obligations	▪ Review all program partner business models and potential contract structures	●
	▪ Proactive planning and discussions among program partners to clarify customer relationship ownership	○

● Strategy successfully implemented by one or more study participants
◐ Strategy partially or beginning to be implemented by one or more study participants
○ Limited to no implementation of strategy by study participants

Source: SEPA, 2022

When the value of a coordinated EE+DF(+DR) program has not been fully demonstrated within a utility, motivating different departments to collaborate can be difficult. For example, a DR/grid operations team may question the scale of grid benefits that a coordinated EE+DF(+DR) program can provide. That team therefore might limit staff time and resources supporting the new program. Planning departments might also hesitate to include planned coordinated EE+DF(+DR) program outcomes in system forecasts if confidence in the program has not been fostered during the pilot, design, and implementation phases. Moreover, launching a coordinated EE+DF(+DR) program often requires combining datasets and sophisticated customer support from a utility's information technology (IT) and customer service departments. If IT and customer service departments are not bought into the new coordinated EE+DF(+DR) program, or if their priorities are not aligned with supporting the program's launch, the program may not succeed.

This study also found that differing objectives between utilities' pilot teams and long-term program implementation teams can slow progress toward sustained coordinated EE+DF(+DR) programs.[17] For example, in one jurisdiction, cost-effectiveness standards are applied to full programs but not to pilots. (For additional discussion, see Cost-effectiveness Challenges.) Although this approach can encourage innovative pilot designs, such as coordinated EE+DF(+DR) programs, it can also encourage misaligned objectives between the pilot team and long-term program implementation team. Specifically, the pilot team might be focused on demonstrating customer interest and equipment performance without equally considering program cost. Under this structure, significant modifications between pilot and program stages might be required. For long-term program implementation teams, these modifications can result in reduced customer satisfaction and participation, and concerns that a program's pilot stage sets unrealistic expectations for the performance of a full program.

Non-coordinated EE/EE+DF and DR teams (as well as poorly linked EE/EE+DF and DR funding) can also place additional burdens on third-party solution providers and/or utility customers. By requiring solution providers, customers, and program implementers to communicate across multiple utility teams and navigate different EE/EE+DF and DR program rules and processes, a utility may exacerbate program delivery inefficiencies and confusion.

Although there are numerous utility silos that act as barriers to programs that support GEBs, there are also successful models that help address these silos. For example, National Grid moved its DR department into its EE/EE+DF department to ensure close coordination and objective alignment.[18] To learn more about these and other solutions, see the Internal Utility Silo Case Study.

Regulatory Silos

Utility regulators and regulatory staff often work within established, siloed procedures and/or processes that can act as barriers to coordinated EE+DF(+DR) programs. The most prevalent regulatory silos identified in this study were proceeding-related, funding-related, and standards-related.

One type of proceeding-related silo occurs when a regulatory body addresses EE/EE+DF and DR in separate dockets (such as in Indiana). This disconnected regulatory approach can raise questions for utilities and regulatory staff regarding where and how to propose a coordinated EE+DF(+DR) program, and what standard of review should be applied. This uncertainty adds risk to the party proposing a coordinated EE+DF(+DR) program and may deter innovative ideas. The use of separate EE/EE+DF and DR dockets can also lead to "expertise silos" among utility and regulatory staff, which can hinder coordinated EE+DF(+DR) program development and review.[19] Additional factors include a potential lack of expertise in GEBs by both utility and regulatory staff, and limited staff capacity. Likewise, when programmatic dockets are separated from resource planning/forecasting dockets, the impacts of newer programs (such as coordinated EE+DF(+DR) programs) may not be fully understood or incorporated into resource forecasts, which can diminish forecasting accuracy.

Funding silos—especially misaligned budget and program cycles, and separate EE/EE+DF and DR funding streams—also add risk for coordinated EE+DF(+DR) program administrators and/or participants. When a budget approval cycle is shorter than a program cycle (such as when a three-year budget approval cycle is used for a five-to-10-year bring-your-own-device (BYOD) DR program offering), either the customer or the program

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17 This report broadly uses the term "pilot" to encompass both pilot and demonstration projects; for additional discussion on distinctions, see Fairbrother, C., Guccione, L., Henchen, M., & Teixeira, A. (2017). *Pathways for Innovation: The Role of Pilots and Demonstrations in Reinventing the Utility Business Model.* Rocky Mountain Institute. www.rmi.org/insights/reports/pathwaysforinnovation

18 Based on study focus group discussion.

19 Examples of "expertise silos" include, but are not limited to, separate regulatory and/or utility staff being knowledgeable about DR program offerings and challenges versus EE program offerings and challenges.

administrator is at risk of financial loss and/or reduced program benefits. Conversely, when a budget cycle is longer than an ideal standard program review cycle, it can delay program innovation. This is because some program administrators will wait for the next budget filing deadline rather than reopen a previously-approved program plan to implement recent lessons learned.

Linking together separate funding streams (e.g., different EE/EE+DF and DR funds) can also be difficult for program participants and/or the program implementer. Integrating different funding eligibility rules, application forms/ processes, and reporting/accounting requirements can increase the time and resource burden of a program. Whether the burden is placed on the program administrator or the program participant, it can diminish coordinated EE+DF(+DR) program efficiency and net benefits compared to coordinated programs in jurisdictions with easier-to-blend funding streams.

Lastly, standards-related silos occur where EE/EE+DF and DR programs are required to pass different cost-effectiveness standards. This may originate from differing statutes or regulations, and/or from the presence of separate EE/EE+DF and DR program administrators (e.g., when the utility does not provide both EE/EE+DF and DR programs). (For more information about the specific challenges of separate EE/EE+DF and DR program administrators, see Separate Program Administrators.) When screening requirements differ among programs, determining the overall cost-effectiveness of a coordinated EE+DF(+DR) program can be challenging. Analysis details (e.g., input assumptions) and, therefore, benefit-cost ratio findings may not be agreed upon by parties, which can elevate the perceived risk of regulatory rejection of a proposed program. To learn more, see about the challenges of cost-effectiveness screenings for coordinated EE+DF(+DR) programs, see Cost-Effectiveness Challenges.

Siloed standards also occur when pilot programs are subject to different (often more flexible and/or less stringent) cost-effectiveness screenings than full programs. Although this approach can help support pilot innovation and general idea testing, it can also result in a negative customer experience if a pilot offering must be adjusted when converted to a full program.

Overall, certain proceeding-, funding-, and standards-related regulatory requirements can be siloed and burdensome to coordinated EE+DF(+DR) program administrators, solution providers, and customers.

However, this study also explored proposed solutions within participant focus groups and interviews. Recommended solutions from study participants include revising regulations and/or statutes, altering proceeding timelines to better align DR and EE/EE+DF funding and program reviews, enhancing regulatory staff collaboration across proceedings, aligning benefit-cost frameworks across proceedings, and better integration of all resources (including EE/EE+DF and DR) and resource-specific regulatory teams within integrated grid planning processes. To learn more about where these solutions are being implemented, see the Regulatory Silo Case Study.

Separate Program Administrators

In certain jurisdictions, EE/EE+DF programs are implemented separately from DR or other beneficial grid programs by an independent administrator. Examples of states with a separate EE/EE+DF program administrator include Hawaii, Oregon, Vermont, and Wisconsin. Separate program delivery—typically authorized or required by state law—can create barriers to coordinated EE+DF(+DR) programs. Common barriers include differing regulations/ standards for EE/EE+DF and DR, discrete EE/EE+DF and DR funding streams, separate tracking and reporting software and datasets, and misaligned objectives and/or motivations among program administrators. Focus group participants in states with separate EE/EE+DF program administrators often indicated that utility interest in exploring and implementing coordinated EE+DF(+DR) programs is limited, and that the formal separation of EE/EE+DF programs from utility programs can create hesitancy among utilities and EE/EE+DF program administrators with respect to the development of coordinated EE+DF(+DR) programs.

Similarly, misaligned program performance metrics for separate EE/EE+DF program administrators and utility DR program administrators can reduce incentives for collaboration. For example, this study documented perceptions of EE as diminishing DR load-shifting capabilities, while separate DR program administrators were primarily focused on directly or indirectly providing grid services.[20]

A formal separation between EE/EE+DF and DR program administrators also can result in siloed knowledge, data, and expertise. For example, a utility operating in a state with a separate EE/EE+DF program administrator may lack institutional knowledge of EE technologies and programs. Likewise, the EE/EE+DF program administrator may lack institutional knowledge of DR technologies and

20 While EE reduces electric demand, it does not inhibit the ability of technologies to shift when they use electricity. Therefore, it is a misperception that EE and DR must compete for available kW.

Gerke et al. (2020). *Modeling the Interaction Between Energy Efficiency and Demand Response on Regional Grid Scales.* 2020 ACEEE Summer Study on Energy Efficiency in Buildings Proceedings. August. https://www.nrel.gov/docs/fy20osti/77423.pdf

Potential Approaches to Mitigating this Challenge

1. For states with separate EE/EE+DF program administrators, a shared data platform for utilities and the state's program administrator could be an initial step to support coordinated EE+DF(+DR) programs and bring available data together.
2. In Hawaii, Public Utilities Commission (PUC) staff, Hawaiian Electric, and Hawaii Energy hold monthly collaborative meetings to identify more opportunities to leverage each other's resources. Learn more about Hawaii's approach in this report's Regulatory Collaboration Framework Case Study.

programs delivered by the utility. Furthermore, separate administrators may not share relevant customer data with each other.

When there are limited incentives to coordinate EE/EE+DF and DR programs, opportunities to improve a building's energy consumption patterns may be missed, which can require future retrofits that could have been avoided. Customers are also likely to experience higher levels of participation fatigue and confusion when multiple programs and/or building visits are involved or required.

Potential solutions to this type of silo include organizing and/or mandating coordination meetings between EE/EE+DF and DR program administrators with state officials, establishing data-sharing platforms that help automate useful information sharing; and/or revising existing policies to establish program integration as a priority and potentially a component of determining success of one or both of the coordinated programs.

Differing Objectives Between Program Partners

Even in locations without separate EE/EE+DF and DR program administrators, multiple partners often must work together to provide successful coordinated EE+DF(+DR) programs. Collaborators can include implementation and installation vendors/contractors, solution providers, evaluators, marketing firms/departments, and EE/EE+DF and DR groups within designated program administrators.

If the objectives (and/or performance metrics) of these collaborating parties are misaligned, coordinated EE+DF(+DR) program success may be hindered. Common areas of misalignment include ownership of the customer relationship and potentially conflicting performance metrics.

When ownership of the customer relationship is not specified or agreed upfront, partners for coordinated EE+DF(+DR) programs may compete to own the relationship, or conversely, no one may seek to own the relationship because they assume that someone else will.[21] In either case, the participant experience can suffer.

In other cases, performance metrics or contract obligations may be misaligned with high-level coordinated EE+DF(+DR) program objectives. For example, one utility participant's coordinated EE+DF(+DR) program rollout was negatively impacted by the utility's direct-install vendor's contract incentives. Originally, the vendor's contract prioritized the installation of measures with short payback periods. Therefore, smart thermostat installations were lower than expected, while LED lighting installations were robust. To address this incentive misalignment, the utility revised the contract incentive structure, which increased smart thermostat installations and subsequent DR enrollments.

As this example highlights, a careful review of all program partner business models and potential contract structures may help support coordinated EE+DF(+DR) program success. In addition, proactive planning and upfront discussions among coordinated EE+DF(+DR) program partners can help to clarify customer relationship ownership.

Existing Regulatory Frameworks

Key Findings

- *Many regulatory frameworks and practices do not support program innovation that can meaningfully advance coordinated EE+DF(+DR) programs.*
- *Absent regulatory innovation and collaboration frameworks, successful coordinated EE+DF(+DR) programs proposals are unlikely to be achieved.*

Early learnings from utility efforts to pursue coordinated EE+DF(+DR) programs point to the need to revise existing regulatory frameworks and specific rules to avoid inhibiting innovation and flexibility in utility programs. The following section details existing barriers created by currently implemented regulatory frameworks and rules, and presents solutions that have been successfully implemented to overcome these barriers.

21 Owning a customer relationship is often synonymous with being a customer's primary contact or touch point for a program. The owner of a customer relationship often provides or is an entry-point to program sales and customer support.

Challenge Examples—Regulatory Frameworks & Coordinated EE+DF(+DR) Programs

- In Massachusetts, regulatory rules in place in 2018 prevented National Grid from implementing aspects of its pilot BYOD program. The program sought to use residential batteries to lower system peak. However, existing regulatory rules prevented interconnected residential batteries from being able to export to the grid thereby limiting the potential grid benefits from customer investment in energy storage (ES). After the first year of the program, regulations changed, enabling export of power from participating customer ES resources under certain configurations.[22]
- Xcel Energy noted programmatic challenges in keeping pace with technology within existing regulatory frameworks. These challenges were manifested in the rejection of Xcel's proposed DR program in 2018 because the proposed program did not reduce overall energy consumption.[23]

Table 4. Existing Regulatory Frameworks Summary Table

Challenge	Potential Solution Strategy	Use
Regulatory Innovation Frameworks ▪ Regulatory hesitancy related to pilot risk and newer technologies ▪ Limited opportunities for regulatory feedback during pilot and program planning and design phases ▪ A lack of regulatory flexibility to allow for program and pilot changes after funding has been approved but actionable key learnings have developed ▪ Limited support for highlighting pilot successes and supporting research and development projects	▪ Increase acknowledgement and acceptance of bounded pilot risk and the need for flexibility	●
	▪ Increase opportunities for discussion/feedback from regulators during pilot and program planning	●
	▪ Enable a more-flexible regulatory structure that allows for pilot and program evolution as learnings emerge	●
	▪ Provide financial support for highlighting pilot successes and customer benefits, as well as research and development (R&D) projects	●
Regulatory Collaboration Frameworks ▪ Differing objectives between utilities and partners for delivering coordinated EE+DF(+DR) programs ▪ A lack of data access and process transparency for all stakeholders ▪ An inability to leverage different strengths among program administrators and/or stakeholders ▪ A lack of opportunities to share lessons learned across entities (and jurisdictions)	▪ Regulatory engagement during program development (e.g., staff briefings, technical sessions)	●
	▪ Coordination across all entities that interface with the same customers	◐
	▪ Increase data access and process transparency for all stakeholders	◐
	▪ Multi-agency/department collaboration within governments and program administrators	●
	▪ Leverage different strengths among program administrators and/or stakeholders	●
	▪ Share lessons learned across jurisdictions	●

● Strategy successfully implemented by one or more study participants
◐ Strategy partially or beginning to be implemented by one or more study participants
○ Limited to no implementation of strategy by study participants

Source: SEPA, 2022

22 PLMA. (2020a). p. 25. See DPU 17-146-A for regulation details: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/10333338.
23 PLMA. (2020a). p. 30.

Regulatory Innovation Frameworks

Study participants identified common regulatory factors that can inhibit program innovation, such as regulatory hesitancy related to pilot risk and newer technologies, limited funding for highlighting pilot successes and supporting R&D, limited opportunities for regulatory feedback during program planning, and a lack of regulatory flexibility to allow for program changes as key learnings develop.

Given that coordinated EE+DF(+DR) programs are more comprehensive, and often more complex, than traditional EE/EE+DF and DR programs, the development and testing of new program approaches for planning, implementing and evaluating are needed. Piloting is therefore critical to coordinated EE+DF(+DR) program success.[24] However, regulatory support for pilots and R&D is often limited. Specifically, study participants indicated that some regulators are hesitant to authorize the use of ratepayer funds for pilots or demonstrations that may have higher risks due to the use of new technologies or new implementation or evaluation strategies. Regulatory perspectives that frame pilots as having failed when not all original objectives or metrics are met, as opposed to opportunities to find out what worked and what didn't, also stifle program innovation, and minimize the value of experimentation and lessons learned. Many study participants suggested that without increased regulatory acceptance of pilot risk, program innovation will be deterred, and coordinated EE+DF(+DR) program offerings are unlikely to be developed.

Limited feedback from regulators during program planning and rigid program structure approvals also constrain program evolution. As the pace of technology advancements continues to accelerate, key learnings from pilots may necessitate significant changes in full program designs. Understanding and supporting this dynamic is critical for successful coordinated EE+DF(+DR) program deployment. Without program implementation flexibility and clear regulatory feedback processes, implementation of the latest best practices is likely to be delayed. Alignment with jurisdictional requirements and customers' best interests may also be slowed if regulatory feedback is provided only during rulings on final program proposals, rather than during the initial planning process.

To address these challenges, utility regulators in Hawaii and Vermont have supported innovative pilot frameworks, including the flexibility to implement pilots quickly, as well as to learn from less-successful approaches or pilot designs. Green Mountain Power (GMP), a utility in Vermont, uses their established pilot framework to test new concepts and/or technologies over an 18-month period during which regulators receive multiple status reports. If, during the initial period of a pilot, changes are needed to improve outcomes, then GMP is able to seek approval for a pilot amendment.

For investor-owned utilities (IOU), these supportive regulatory innovation frameworks are a critical driver to enable coordinated EE+DF(+DR) program development and flexibility, as well as a transition towards more coordinated EE+DF(+DR) programs. Regulators are key to enabling more-supportive regulatory innovation frameworks, and implementing new approaches and strategies.

To learn more about where these specific solutions are being implemented, see: the [Supportive Regulatory Innovation Frameworks Case Study].

Regulatory Collaboration Frameworks

Due to the complexity of coordinated EE+DF(+DR) programs, multiple partners often must collaborate closely to launch and implement successful pilots and programs. However, entities such as regulators, utilities, third-party EE/EE+DF administrators, and technology solution providers can struggle to align on program objectives, design, development, and implementation, which can impact the overall effectiveness of the program, and/or stymie efforts to prepare coordinated programs for launch. Since each entity likely has different objectives, a program or pilot proposal shaped by one partner with limited input from the others is unlikely to satisfy the needs of all parties. Likewise, missed opportunities for cross-coordination and leveraged resources may also result from inadequate upfront collaboration. For example, a utility might want to promote the installation of efficient air-source heat pumps paired with smart thermostats due to the technologies' potential grid benefits. However, regulators may be particularly concerned about limited low-to-moderate income (LMI) customer access to those technologies. If the regulators' concern is known upfront, the program design could be shaped to better address specific LMI customer barriers to the adoption of these technologies. However, without upfront collaboration, the proposed program's design might fail to satisfy regulators and thus be rejected.

Due to this challenge, study participants identified forums for collaboration with regulators and/or other critical stakeholders as a key strategy to support successful coordinated EE+DF(+DR) program proposals. Components of successful collaboration frameworks can include:

24 For an overview of DOE's Connected Communities GEBs pilot projects, see: https://www.energy.gov/eere/buildings/articles/meet-does-newest-connected-communities-grid-interactive-efficient-buildings

regulatory engagement during program development such as staff feedback and briefings, coordination across all internal and external entities that interface with the same customers, data access and process transparency for all stakeholders, multi-agency/department collaboration within governments and program administrators, leveraging different strengths among program administrators and/or stakeholders, and sharing lessons learned across jurisdictions.

In addition, engaging multiple stakeholders (from a variety of perspectives) early during program development and/or planning processes was also identified as a successful approach. For example, the Hawaii PUC and Vermont PUC have established collaboration frameworks between utilities and third-party EE/EE+DF administrators. In Hawaii, monthly collaborative meetings include regulatory, utility, and third-party EE/EE+DF administration staff, with the objective to identify increased opportunities to coordinate and leverage each other's resources. In Massachusetts, the Energy Efficiency Advisory Council (EEAC) supports public participation in program planning as a means of bringing in more diverse perspectives. The Massachusetts Department of Public Utilities (DPU), also historically has required the state's IOUs (National Grid, Eversource, and Unitil) to align their EE/EE+DF and DR program offerings in order to limit customer confusion.[25] By requiring program alignment across IOUs, the Massachusetts regulators have encouraged the creation of IOU coordination and collaboration forums for program planning.

To learn more about where these specific solutions are being implemented, see: the Regulatory Collaboration Framework Case Study.

Utility Business Models & Valuation

Key Findings

- *Traditional regulatory models can discourage coordinated EE+DF(+DR) program development, planning, and deployment.*
- *The DF value proposition in jurisdictions without organized wholesale markets is limited or difficult to quantify, and can inhibit coordinated EE+DF(+DR) program deployment.*

Without organized wholesale markets and utility business model evolution, it can be difficult for utilities, regulators, and service providers to define the economic value of coordinated EE+DF(+DR) programs. The following section highlights how utility business model constraints and lack of access to an organized wholesale market can create challenges to coordinated EE+DF(+DR) program

Table 5. Utility Business Models & Valuation Summary Table

Challenge	Potential Solution Strategy	Use
Utility Business Model Constraints ▪ Inadequate financial incentives for utilities to prioritize coordinated EE+DF(+DR) programs ▪ Misaligned incentives within performance-based regulation structures (e.g., incentives that discourage coordination) ▪ Too broad metrics in performance incentive mechanism structures	▪ Implement carefully considered performance-based regulations that align a utility's financial incentives with delivering coordinated EE+DF(+DR) programs	●
	▪ Incorporate DF requirements into building codes and appliance standards to increase the GEBs-related technologies deployed in the marke	●
Limited DF Value in Jurisdictions Without Organized Wholesale Markets ▪ Without organized wholesale markets, it can be more difficult to quantify the regional/broader grid benefits of EE, DF, DR and/or coordinated EE+DF(+DR) programs ▪ Without revenue from organized wholesale markets, coordinated EE+DF(+DR) program funding can also be more challenging	▪ Use integrated resource planning that includes EE, DF, and DR as procurable resources	◐

● Strategy successfully implemented by one or more study participants

◐ Strategy partially or beginning to be implemented by one or more study participants

○ Limited to no implementation of strategy by study participants

Source: SEPA, 2022

25 For additional resources, see Massachusetts Energy Efficiency Council Advisory Council.

development and deployment. Potential solutions that emerged during this study are also presented.

Utility Business Model Constraints

Inadequate financial incentives can discourage utilities from supporting and/or prioritizing EE, DF, DR, and coordinated EE+DF(+DR) programs. In jurisdictions where utility revenue is primarily driven by volumetric electricity sales, EE, DF, and DR may lead to revenue loss. Since utilities still incur fixed costs, a reduction in revenue likely will lead to some degree of achieved earnings erosion.[26] In addition, under traditional cost-of-service (COS) regulation, a utility is authorized to include a rate of return (RoR) on infrastructure investments needed to deliver electricity into their rates. Reducing peak and/or overall demand for electricity through DF, DR, and EE may reduce future infrastructure needs.[27] This, in turn, reduces future opportunities for the utility to invest in assets on which it can earn a RoR.[28] In both cases, this potential for lower future earnings creates a disincentive for utilities to implement and/or invest in coordinated EE+DF(+DR) programs that support GEBs.

To address these issues, some jurisdictions have implemented performance-based regulation (PBR), which encompasses a number of different regulatory and policy instruments to align utility business interests with desired customer outcomes. Decoupling mechanisms, one form of PBR, seek to diminish, if not break, the explicit connection between retail sales and collected utility revenue.[29] As of 2017, electric utility decoupling mechanisms had been implemented in 16 states, mainly to support a utility's achievement of energy-savings goals via EE programs administered by the utility or a third party.[30] To offset the lost future earnings opportunity effect, a utility might be authorized to earn a specified financial incentive if it achieves a certain level of kWh savings through one or more EE/EE+DF programs, or if it enrolls a certain level of kW in one or more DR programs.[31] Hawaii, Colorado, Massachusetts,[32] Minnesota, and New York are examples of states that use such performance incentive mechanisms (PIMs) to promote EE, DF and/or DR delivery from their utilities. Study participants noted that their PBR structures have been successful in supporting coordinated EE+DF(+DR) programs.

However, even when various forms of PBR are in place, challenges for coordinated EE+DF(+DR) programs may still arise from incentive misalignment. For example, siloed DR and EE/EE+DF performance metrics may encourage competition rather than collaboration between a utility's EE/EE+DF and DR offerings. If DR program implementation is solely focused on maximizing the number of enrolled kW, then EE/EE+DF programs (which reduce peak demand) may be viewed as an obstacle.

Likewise, if a PIM's goals or metrics are too broad, the PIM may not drive the development of coordinated EE+DF(+DR) programs. For example, peak kW-reduction metrics may ensure that program offerings reduce system peak, but they do not direct how the peak must be reduced. Therefore, a program administrator is likely to deploy the simplest programmatic approach to achieve the peak reduction metric rather than developing/implementing a more-challenging and complex coordinated EE+DF(+DR) program. To address this issue, regulators should carefully consider PIM metrics to ensure specificity.

In addition to PBR, certain types of coordinated EE+DF(+DR) programs are supported by other forms of regulation. In California, the California Energy Commission (CEC) is working to incorporate load flexibility requirements into building codes and appliance standards.[33] These requirements would raise the baseline of new construction and new appliances, and would increase the capability of building-delivered grid services.[34] Although this approach

26 Satchwell, A., Cappers, P., Schwartz, L. and Fadronc, E. M. (2015). *A Framework for Organizing Current and Future Electric Utility Regulatory and Business Models.* Lawrence Berkeley National Laboratory, Berkeley, CA. June 2015. LBNL-181246.

27 For additional discussion, see: NASEO. (2019a). *Grid-interactive Efficient Buildings: State Briefing Paper*. https://naseo.org/data/sites/1/documents/publications/v3-Final-Updated-GEB-Doc-10-30.pdf

28 Satchwell, A., Cappers, P., Schwartz, L. and Fadronc, E. M. (2015).

29 Moskovitz, D. (1989). *Profits and Progress Through Least-Cost Planning*. National Association of Regulatory Utility Commissioners, Washington D.C., November.

30 Berg, W., Vaidyanathan, S., Junga, E., Cooper, E., Perry, C. N., S., Relf, G., Whitlock, A., DiMascio, M., Waters, C. and Cortez, N. (2019). *The 2019 State Energy Efficiency Scorecard. American Council for an Energy-Efficient Economy*. October. Report U1908. https://www.aceee.org/research-report/u1908

31 In addition, unlike standard cost-of-service regulation, authorized financial incentives can encourage utilities to implement non-utility-owned resources and assets.

32 The Massachusetts DPU recently ended electric decoupling. See DPU Order D.P.U. 21-120 through D.P.U. 21-129 issued January 31, 2022: https://www.mass.gov/doc/2022-2024-three-year-energy-efficiency-plans-order/download

33 Beyond building codes and appliance standards, the CEC is also working to develop Load Management Standards through Docket 21-OIR-03. Regulations may require large utilities to provide real-time price and emissions signals for communication with buildings and devices. For more information see https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-OIR-03

34 As a next step, grid planners and operators may then be required to consider this increase in building DF during grid IRP proceedings.

A State PIM Approach that Supports GEBs—Massachusetts

Coordinated EE+DF(+DR) programs in Massachusetts are filed by utilities as part of three-year energy-saving and demand-management plans with the Energy Efficiency Advisory Council (EEAC) and the Department of Public Utilities (DPU). The 2019-2021 plan included an active demand-reduction PIM in addition to historically used energy saving and passive demand reduction metrics. Combined, the metrics quantify and reward program administrators for achieving peak demand reductions (both summer and winter) as well as energy savings, thereby supporting coordinated EE+DF(+DR) program approaches.[35]

does not directly support coordinated EE+DF(+DR) programs that install GEBs-related technologies, it can support programs that leverage existing building technologies and workforce and product development for retrofits.

Limited DF Value in Jurisdictions without Organized Wholesale Markets

Determining the value proposition of DF is critical to supporting coordinated EE+DF(+DR) programs because the quantification of DF value streams is needed in cost-effectiveness analyses. However, determining the value proposition of DF in areas without an organized wholesale market or in a region with limited markets for grid services can be challenging. In particular, quantifying the value of capacity and/or ancillary grid services is greatly simplified in a wholesale market because financial value can be estimated through historical pricing and/or market forecasting. However, without wholesale markets and/or grid service markets, the challenge of determining accurate values and/or justifying the ability to monetize a coordinated EE+DF(+DR) program's benefits can be significant. Study participants in states including Colorado, Hawaii, Indiana, and Oregon noted that the absence of or limited access to organized wholesale markets continues to hinder coordinated EE+DF(+DR) program development and deployment.

Although access and/or participation in organized wholesale markets may help alleviate the challenge of quantifying DF value, individual states and/or program administrators may not have the authority to determine participation. One solution is to ensure that EE, DF and DR are incorporated as resources in utilities' integrated resource plans (IRPs), which would help determine the monetary value of these services.

Program Design & Customers

Key Findings

- *Challenging quantification/evaluation of cost-effectiveness for coordinated EE+DF(+DR) programs hinders program development and deployment.*
- *Navigating the process of creating new metrics, deploying them, and refining them (often to support decarbonization) can be challenging and may hinder coordinated EE+DF(+DR) program design and evaluation.*
- *Recruiting customers into coordinated EE+DF(+DR) programs is more challenging and complex than for traditional programs.*
- *Retaining customers in coordinated EE+DF(+DR) programs requires additional consideration and potentially effort.*
- *Ensuring equitable participation in coordinated. EE+DF(+DR) programs poses additional challenges.*

Cost-effectiveness Challenges

This study reaffirmed previous literature observations by finding that evaluating the cost-effectiveness of coordinated EE+DF(+DR) programs can be challenging and likely acts as a barrier to coordinated EE+DF(+DR) program approval. Specifically, limited data availability, forecasting uncertainty, and program complexity pose problems for program administrators looking to calculate the value proposition of coordinated EE+DF(+DR) programs. When these challenges are coupled with strict cost-effectiveness standards, regulatory approval for coordinated EE+DF(+DR) programs may be difficult to achieve.

To conduct cost-effectiveness analyses, program impacts (benefits) are calculated relative to a reference case or baseline and then compared to program costs. Coordinated EE+DF(+DR) programs provide value by enabling grid services such as load shifting to pursue goals such as aligning consumption with periods of peak resource availability, reducing it at times of system constraint, or others. Demonstrating the cost-effectiveness of coordinated EE+DF(+DR) programs therefore requires data indicating how customer- or device-level electricity consumption responds to program interventions. AMI and certain other devices, such as smart electric panels or device-specific sensors, are capable of providing the hourly or 15-minute interval data needed for these analyses. However, AMI and these other devices are not widely

35 Gold, R., Myers, A., O'Boyle, M. (2020). *Performance Incentive Mechanisms for Strategic Demand Reduction Report.* U2003, 24. https://energyinnovation.org/wp-content/uploads/2020/02/Performance-Incentive-Mechanisms-for-Strategic-Demand-Reduction.pdf

installed in all jurisdictions. Moreover, even when such devices are installed, program administrators may struggle to access their data because the data may be owned by a third party or require sharing permissions from individual customers.

Multiple utilities in this study specifically noted that the lack of AMI in their service territories created challenges for coordinated EE+DF(+DR) program evaluation.[36] Without granular data, a program administrator may need to rely on heuristics and/or generalized load patterns to estimate coordinated EE+DF(+DR) program grid benefits. While these estimates may be precise enough to screen a coordinated EE+DF(+DR) program proposal in some jurisdictions, they do not allow a program administrator to determine the specific grid benefits achieved. As one state regulatory commission noted, it is not always clear which resources are dispatched in a coordinated EE+DF(+DR) program, which can complicate measuring program value.

In addition to baseline data, forecasting information can play a critical role in cost-effectiveness analyses. In particular, some coordinated EE+DF(+DR) programs may leverage buildings' heating and cooling systems to provide system benefits during certain temperature extremes. In recent years, program administrators have proposed coordinated EE+DF(+DR) programs on the basis of impact forecasts that often leverage historical data (e.g., weather and end-use adoption rates). However, regulators and grid operators perceive this method as increasingly risky as weather patterns shift due to climate change, and as the industry's understanding of customer adoption rates and use of newer technologies (such as EVs and heat pumps) continues to evolve. Together, both

Table 6. Program Design & Customers Summary Table

Challenge	Potential Solution Strategy	Use
Cost-effectiveness Challenges ▪ Lack of sufficiently granular baseline data from which to develop a reference case ▪ Forecast uncertainties ▪ Access to the necessary resources and expertise for more complex modeling and analysis techniques ▪ Stringent or narrow cost-effectiveness test requirements	▪ Support AMI deployment and data analysis, when and where possible, to help utilities, regulators, customers, and solution providers better understand program or measure program value & cost-effectiveness	●
	▪ Collaborate regionally (especially in areas without regional organized wholesale markets) to help utilities and participants assess value	●
	▪ Conduct pilots, which if exempt from stricter cost-effectiveness requirements that may apply to programs, can help assess cost-effectiveness	●
	▪ Review existing cost-effectiveness requirements for potential enhancements and alignment with national best practices	◐

Challenges with Evolving and/or Changing Program Metrics (often to support decarbonization targets)
▪ A lack of clear and consistent program goals and success metrics can erode program objective clarity
▪ A lack of regulatory clarity on program objectives can hinder metric evolution
▪ Shifting to new program metrics can be hindered by:
  ▪ New metric quantification challenges
  ▪ Siloed EE/EE+DF and DR program objectives
  ▪ Traditional utility planning processes
  ▪ The existing financial incentives of the program administrator
	▪ Collaborative discussions with internal and external stakeholders can help increase buy-in and align metric changes with regulatory/policy objectives, program administrator objectives, and other stakeholder objectives	●

	▪ Clear direction from regulators and internal leadership on program objectives	●
	▪ Thoughtful selection of new metrics - considering data availability, methods for developing baselines and setting performance goals	●

36 According to the U.S. Energy Information Administration (EIA), in 2020, U.S. electric utilities had about 102.9 million AMI installations, with approximately 88% residential customer installations. U.S. EIA (2021, November 2). *FAQ.* https://www.eia.gov/tools/faqs/faq.php?id=108&t=3 For additional information on historical AMI deployment, also see: https://www.eia.gov/todayinenergy/detail.php?id=34012

<table>
<tr><th colspan="3">Table 6. Program Design & Customers Summary Table</th></tr>
<tr><th>Challenge</th><th>Potential Solution Strategy</th><th>Use</th></tr>
<tr><td rowspan="6">Customer Recruitment and Retention Challenges, including LMI Participation Challenges
▪ Customers' lack of familiarity with DF
▪ Customer confusion about offerings and more-complex enrollment
▪ Difficulties communicating the value proposition
▪ Customer concerns over external control of devices
▪ Utility concerns about the reliability of customer-sited demand-side resources
▪ Traditional DR program challenges such as attrition rates due to a high number of call events or events during extreme temperatures are also relevant for coordinated EE+DF(+DR) programs
In addition to above, several additional challenges are especially prominent among LMI and underserved communities:
▪ Limited LMI access to enabling technologies (e.g., broadband, WiFi, smartphones)
▪ High upfront costs for certain DERs
▪ Lower rates of premise and equipment ownership by LMI customers
▪ Lack of data for identifying eligible LMI customers
▪ Customer distrust of the utility/program administrator
▪ Heightened concerns from regulators and program administrators about unintentionally raising LMI customer bills due to program participation
▪ A lack of statutory authority for addressing broader equity issues that can impact LMI customer participation</td><td>▪ Customize and communicate the primary value proposition for each customer segment/class for program recruitment and retention (e.g., cost savings, adoption of new products, carbon reduction, helping the community/grid)</td><td>◐</td></tr>
<tr><td>▪ Consider offering upfront incentives (e.g., rebates) to encourage program recruitment and/or ongoing incentives (e.g., rate discounts) to encourage program retention, as relevant to program objectives</td><td>●</td></tr>
<tr><td>▪ Recruit an income-diverse customer participant pool for pilots to determine strategies to support increased LMI participation in scaled coordinated EE+DF(+DR) program offerings</td><td>○</td></tr>
<tr><td>▪ Partner with trusted local community-based organizations to design programs and identify and engage LMI customers</td><td>◐</td></tr>
<tr><td>▪ Work with rental housing market stakeholders to identify and assist LMI customers</td><td>◐</td></tr>
<tr><td>▪ Consider implementing a form of PBR that incentivizes utilities to prioritize serving LMI customers and/or establish a legislative directive to focus on equity</td><td>●</td></tr>
</table>

● Strategy successfully implemented by one or more study participants

◐ Strategy partially or beginning to be implemented by one or more study participants

○ Limited to no implementation of strategy by study participants

Source: SEPA, 2022

baseline and forecasting uncertainties can add to the perceived risk of coordinated EE+DF(+DR) programs for regulators and grid operators. Grid operators may worry that estimated grid impacts are unreliable. Regulators may share similar concerns, in addition to concerns that approved investments of ratepayer funds may not be as cost-effective or prudent as initially estimated. Overall, input uncertainty (e.g., uncertainty in weather data, customer technology adoption rates, etc.) can be a barrier for proposed coordinated EE+DF(+DR) programs to pass stringent cost-effectiveness tests. This is especially true for initial program proposals, when the data used for mandatory cost-effectiveness inputs may be unavailable.

Lastly, coordinated EE+DF(+DR) programs are complex and require the use of more advanced cost-effectiveness methods than traditional programs. Specifically, technology interactions must be accounted for when calculating a program's benefit-cost ratio. However, accounting for technology interactions often requires more complex modeling and additional staff expertise, and can be viewed as a resource challenge for program administrators.

To help overcome these cost-effectiveness barriers, study participants suggested the following solutions:

1. Support AMI deployment and data analysis to help utilities, customers, and solution providers better understand the value and cost-effectiveness of a coordinated EE+DF(+DR) program and program measures.
2. Encourage regional collaboration (especially where regional transmission organizations (RTOs) / independent system operators (ISOs) exist) where data-sharing may

help program administrators understand potential coordinated EE+DF(+DR) program value.

3. Exempt coordinated EE+DF(+DR) program pilots from cost-effectiveness requirements so that such pilots can help improve the data used for later cost-effectiveness screenings for full programs.
4. Review existing cost-effectiveness requirements for alignment with national best practices.

To learn more about how some of these proposed solutions have been implemented in specific jurisdictions, see the [Approaching Coordinated EE+DF(+DR) Program Cost-effectiveness Case Study](#).

Challenges with Evolving and/or Changing Program Metrics

Traditionally, EE and DR programs have been evaluated using metrics that include kWh and kW savings. However, as coordinated EE+DF(+DR) programs evolve to include multiple technologies and complex interactive effects, metrics must also evolve to both align with and measure desired program outcomes. This is especially true for carbon-reduction objectives. Not all coordinated EE+DF(+DR) program designs automatically yield carbon reductions, but many have the potential to support the clean energy transition if thoughtfully deployed. For this reason, multiple study participants cited revisions to program performance metrics as critical to coordinated EE+DF(+DR) program success. However, the process of evolving and/or deploying non-traditional metrics (i.e., creating new metrics, deploying them, and refining them) can be difficult, and may hinder coordinated EE+DF(+DR) program design and evaluation.

Utilities and regulators identified a lack of clear and consistent program goals and success metrics as an overall barrier to coordinated EE+DF(+DR) program deployment. Challenges surrounding new metric quantification, siloed EE and DR program objectives, traditional planning processes, and utilities' financial incentives can obstruct the shift away from traditional program metrics and goal frameworks. A lengthy and turbulent shift can impact overall uncertainty about potential changes to existing program metrics, potentially further reducing program objective clarity. Multiple utility participants voiced a need for greater regulatory clarity on coordinated EE+DF(+DR) program objectives. The Hawaii PUC aims to provide that clarity to Hawaiian Electric (HECO) by leveraging the PUC's PBR framework and working group to consider the development of additional metrics, building on the currently required utility metric reporting (e.g., DERs, grid services, etc.).[37]

Changing Metric/Objective Examples

- National Grid noted that traditional DR programs that may have been originally motivated by cost-mitigation opportunities (via regional capacity costs) are now also driven by carbon reduction and resilience goals.
- Regulatory commissions in states such as Minnesota and Vermont are expanding traditional EE programs by shifting from a historic focus on kWh goals towards demand flexibility.
- The California Energy Commission is exploring evolving EE/EE+DF goals to focus on greenhouse gas (GHG) reductions.
- Hawaii is updating its Energy Efficiency Resource Standard (EERS), which could evolve to include a broad GHG-reduction metric.

Furthermore, as many utilities adopt decarbonization goals or targets,[38] some utilities, program administrators and regulators are considering developing and prioritizing non-traditional metrics, such as avoided GHG/carbon emissions or flexible kW metrics, over traditional program metrics (e.g., kWh and kW).[39] Some study participants noted that such a shift could further support coordinated EE+DF(+DR) programs and overall alignment between individual program and organizational objectives.[40]

This study found that municipal utilities may be better positioned than IOUs to achieve a shift towards non-traditional metrics, due to municipal utilities' relatively flexible operating models and decision-making ability. Several IOUs that participated in the study are awaiting state-level action to adjust program metrics, and some state regulatory commissions are indeed considering revised metrics. Collaborative discussions are one potential

37 Hawaii PUC's *Decision and Order 37787* also approves a portfolio of Scorecards and Reported Metrics, which will track and measure utility performance across a wide spectrum of categories to provide valuable data that can inform future planning and development efforts. Hawaii Public Utilities Commission. (2021, May 17). *Decision and Order No. 37787*. Docket No. 2018-0088: Instituting a Proceeding. https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A21E17B53226E00118

38 Utility decarbonization goals can be either voluntarily or due to state or local policy requirements. For additional information, see: SEPA. (2022). *Utility Carbon Reduction Tracker.*

39 Efforts to quantify and track location and time-specific GHG metrics as well as "grid friendliness" metrics are being pursued.

40 It should also be noted that GHG metrics or goals may not always align with least-cost or least-energy intensive program goals or requirements.

solution to help determine how traditional metrics should evolve to align regulatory/policy objectives with program administrators' objectives, and to increase buy-in.

To learn more about how coordinated EE+DF(+DR) programs are shifting away from traditional to non-traditional metrics, see: the Coordinated EE+DF(+DR) Programs, Evolving Metrics and Adopting Decarbonization Targets Case Study.

Customer Recruitment and Retention Challenges, including LMI Participation Challenges

Like traditional EE and DR programs, coordinated EE+DF(+DR) programs face customer recruitment and retention challenges. However, coordinated EE+DF(+DR) program recruitment and retention require additional consideration and potential effort, due to added technology complexity, program complexity, and program nascence. Moreover, many utilities, program administrators, regulators, and technology solution providers share the common priority of ensuring LMI customer participation and benefits in coordinated EE+DF(+DR) programs, and recognize the need to pay special attention to and engage community members during program design and implementation to address the unique barriers these customers face.

Utilities, program administrators, and technology solution providers face steeper barriers to engagement and recruitment for coordinated EE+DF(+DR) programs. Key challenge areas identified include program education, messaging, and communications. Study participants cited the need for new educational and communication strategies to address such foundational issues as customers' lack of familiarity with DF, including DF technologies, use, and value proposition (for customers, utilities, and the grid). Additionally, the coordination of programs with different terms/rules and contractual obligations may cause (or increase) customer confusion about offerings, and more-complex enrollment processes/steps may deter customer participation, unless thoughtfully designed. Furthermore, utilities and technology solutions providers highlighted the challenge of identifying and communicating coordinated EE+DF(+DR) programs' value proposition to all stakeholders, especially because these programs are nascent and complex. Utilities also cited customer concerns over external control of on-site technologies, such as smart thermostats, and utilities' own concerns regarding the reliability of customer-sited demand-side resources.

Study participants also noted the distinction between challenges related to initial engagement and program recruitment, versus program participant retention. Utilities noted that traditional DR program concerns also exist for coordinated EE+DF(+DR) programs (e.g., that a high number of called events, a large increase in called events, or events called during extreme temperatures could yield program attrition, as well as impact participants' overall trust and confidence in programs). Additionally, utilities noted that customer perceptions of increased program complexity (or perceived inconvenience) could lead to higher attrition rates.

Finally, most study participants confirmed that ensuring LMI participation in coordinated EE+DF(+DR) programs is a key priority, but achieving this outcome is challenging. Key barriers contributing to the added complexity of extending coordinated EE+DF(+DR) programs to LMI customers include the inaccessibility of certain enabling technologies (e.g., broadband, wi-fi, smart phones), high upfront costs of many DERs (e.g., solar photovoltaics (PV), ES, EVs), and lower rates of premises and/or equipment ownership. Program administrators may also lack the data needed to identify eligible LMI customers, LMI customers may distrust the utility/program administrator, and regulators and program administrators may have greater concerns about unintentionally raising LMI customers' bills due to program participation. Lastly, there may be a lack of statutory authority for program administrators to address broader equity issues that impact LMI customers and their ability to participate in coordinated EE+DF(+DR) programs (e.g., health and safety improvements needed in a building). To learn more about strategies to ensure LMI participation in coordinated EE+DF(+DR) program offerings, see the Advancing Equitable Participation in Coordinated EE+DF(+DR) Programs Case Study.

To help overcome these barriers to customer recruitment, retention, and LMI participation, study participants suggested the following solutions:

1. Customize and communicate the primary value proposition for each customer segment/class for program recruitment and retention (e.g., cost savings, adoption of new products, carbon reduction, helping the community/grid).
2. Consider offering upfront incentives (e.g., rebates) to encourage program recruitment and/or ongoing incentives (e.g., rate discounts) to encourage program retention, as relevant to program objectives.
3. Recruit an income-diverse customer participant pool for pilots to determine strategies to support increased LMI participation in at-scale coordinated EE+DF(+DR) program offerings.
4. Partner with trusted local community-based organizations to design programs and identify and engage LMI customers.

5. Work with rental housing market stakeholders to identify and assist LMI customers.
6. Consider implementing a form of PBR that incentivizes utilities to prioritize serving LMI customers and/or establish a legislative directive to focus on equity.

Technical Implementation

Key Findings

- *Inadequate DF equipment standards and protocols challenge interoperability and negatively impact coordinated EE+DF(+DR) programs and GEBs deployment.*
- *Real or perceived additional cybersecurity risks of DF equipment can limit coordinated EE+DF(+DR) program development.*
- *A wide variety of study participants cited broader, system-level technical implementation challenges as key barriers for coordinated EE+DF(+DR) programs. These include interoperability challenges due to inadequate equipment standards and protocols, and cybersecurity risks.*

Inadequate Equipment Standards & Protocols

Utilities and technology solution providers in particular cited interoperability and inadequate equipment standards and protocols as barriers to coordinated programs. Interoperability is critical to coordinate different types of systems, equipment, and products within the utility.

Utilities noted the operational difficulties of product / equipment optimization or utilization due to inadequate standards and protocols (i.e., communications and management) in the industry,[41] while solution providers are often hampered by the challenge of integrating multiple products and equipment with different communication and management systems.

Additionally, regulators noted that some technologies cannot keep pace or evolve with the rapidly evolving

Key National Institute of Standards and Technology (NIST) Resources for Interoperability Standards & Cybersecurity

- NIST Framework and Roadmap of Smart Grid Interoperability Standards, Release 4.0 (Draft): Key sections include: Smart Grid Conceptual Model, Communication Pathways Scenarios, A Common Language for the Smart Grid, Testing and Certification (T&C) for Smart Grid Standards, and Interoperability Profiles.
- NISTIR 7628 Guidelines for Smart Grid Cybersecurity Rev. 1: a framework to develop effective cybersecurity strategies tailored to particular combinations of Smart Grid-related characteristics, risks, and vulnerabilities.

Table 7. Technical Implementation Summary Table

Challenge	Potential Solution Strategy	Use
Inadequate Equipment Standards & Protocols ▪ A lack of interoperability to coordinate different types of systems, equipment and products ▪ Differing communication and management systems that are not easily integrated ▪ Aligning technical requirements and capabilities with rapid technology and market advancements	▪ Establishing standards and protocols that allow for easy integration of plug-and-play products by supporting the continued identification of interoperability requirements and their inclusion in open standards and protocols	◐
Cybersecurity ▪ Potential harm to utilities, the broader electricity system, and/or participating "connected" customers due to software attacks	▪ Adoption of Cybersecurity industry standards and best practices	◐

● Strategy successfully implemented by one or more study participants
◐ Strategy partially or beginning to be implemented by one or more study participants
○ Limited to no implementation of strategy by study participants

Source: SEPA, 2022

41 Utility programmatic benefits from enabling technology and grid investments to fully deploy coordinated EE+DF(+DR) programs, such as interoperability via equipment standards and protocols, are often indirect and difficult to account for in utility business cases or regulatory filings.

market and customer needs, making regulatory approval of coordinated EE+DF(+DR) programs featuring newer technologies challenging. According to study participants, this barrier significantly undermines marketplace efficiency and increases confusion and challenges to program deployment. This study also found that the challenge of standards and protocols can be exacerbated by other challenges, such as utility organizational silos and markets with separate third-party EE/EE+DF administrators, which can impact internal and external communications standardization. Study participants agreed that standards and protocols are a ubiquitous, fundamental barrier that is inhibiting market efficiency and deployment. There is broad support for accelerated industry alignment to establish standards and protocols, including those that allow easy integration of plug-and-play products.[42]

Cybersecurity

This study found that utilities—and potentially their customers—could be reluctant to pursue new technologies and coordinated EE+DF(+DR) programs in general, due to the perception of additional risk related to potential cybersecurity breaches. Perceived risk includes concerns that cybersecurity incidents could harm utilities and participating "connected" customers (e.g., GEBs customers) significantly, while industry concerns as a whole about grid cybersecurity are elevated when considering coordinated EE+DF(+DR) programs and GEBs. Coordinated EE+DF(+DR) programs and GEBs deployment would benefit from improved grid cybersecurity at the federal, state, and individual utility levels. Study participants generally supported the adoption and implementation of federal cybersecurity standards in order to address this system-level challenge.[43]

Areas for Future Research

Throughout this study, areas for future research were noted and discussed among participants and researchers. The following topic areas would likely benefit from further pilots, experiments, and/or studies in order to further advance GEBs.

First, re-visiting what it means for regulated utilities to pilot a program could further support coordinated EE+DF(DR) programs. New strategies and approaches could include developing pilots with more diverse use cases, using a larger sample size of pilot participants, expanding the demographic diversity of pilot participants, and allowing utilities to test ideas or program designs that may or may not succeed in order to promote novel and potentially more impactful approaches. New methods for more easily sharing and collaborating on pilots across jurisdictions and/or service territories also merit exploration.

Additional research into location-specific demographics that may impact LMI customer participation and engagement could support energy equity objectives. Disparities between and within rural and urban areas may also be important to study, as well as other underserved customer groups such as minority-owned small businesses. Methods for improving the collaboration and coordination with multi-family affordable housing facilities may also support a more equitable transition to GEBs.

The publishing of additional coordinated EE+DF(+DR) program case studies with transparent data and new ways of overcoming the issues documented in this report could promote more rapid coordinated EE+DF(+DR) program development and GEBs investments in other jurisdictions. Support for sharing lessons learned (such as pilot results) in peer-to-peer forums may also encourage more rapid ideation and implementation.

Lastly, innovative methods for monetizing hard-to-quantify impact streams and new techniques for eliminating double-counting across impact streams are needed to support coordinated EE+DF(+DR) program benefit-cost analyses. Strategies for improving forecast inputs and data access/granularity would also benefit the development and deployment of coordinated EE+DF(+DR) programs.

42 For additional information, see SEPA and Grid Modernization Laboratory Consortium (GMLC) work, including the Plug & Play Challenge, and *OpenFMB for Resiliency*, a case study on how a control system integrated with the Open Field Message Bus (OpenFMB) architecture can increase system flexibility and resiliency.

43 For additional information, see the Biden Administration's Industrial Control Systems (ICS) Cybersecurity Initiative and Electricity Subsector Action Plan, and U.S. DOE's Cybersecurity Capability Maturity Model.

Conclusion

As the U.S. electric power industry transitions towards a more modern and carbon-free energy system, coordinated EE+DF(+DR) programs and GEBs are a key component. In order to realize the DOE goal to triple EE and DF in residential and commercial buildings by 2030, it is critical for diverse industry stakeholders to address key challenges that are limiting coordinated EE+DF(+DR) program development and deployment.

Key to enabling GEBs is transitioning traditional EE/EE+DF and DR programs towards programs that increase the efficiency and adoption of EE+DF technologies in buildings, and optimize energy costs, grid services, and customer preferences. Today, many utility programs are in a state of transition, but fully-optimized coordinated EE+DF(+DR) programs and GEBs are still nascent. While utilities have achieved some success, they face challenges in keeping pace with evolving technologies and overcoming programmatic and regulatory silos. The continuing prevalence of utility organizational and regulatory procedural silos are limiting the ability to develop and deploy coordinated EE+DF(+DR) programs and maximize DF and grid services. However, supportive regulatory innovation and collaboration frameworks, such as a more flexible regulatory framework for pilot programs or strategies to enhance collaborative work across multiple entities, can enable coordinated EE+DF(+DR) program development and flexibility. Additionally, alternative regulatory models can encourage coordinated EE+DF(+DR) program development, planning, and deployment, though cost-effectiveness and evolving metrics for program design and evaluation remain challenging. Customer recruitment and retention in coordinated EE+DF(+DR) programs is often more challenging and complex than for traditional programs, and ensuring equitable participation poses additional considerations. Finally, broader system-level barriers such as inadequate standards and protocols, and cybersecurity concerns, are also limiting coordinated EE+DF(+DR) program development.

To fully unlock a GEBs future, strategies to address key barriers will require coordinated efforts across the industry, including utilities, program administrators, regulators and policy makers, technology solution providers, and others. Eight (8) case studies listed in Appendix A further highlight the critical challenges, including key factors, examples, and proposed solutions:

1. *Internal Utility Silos*
2. *Regulatory Silos*
3. *Supportive Regulatory Innovation Frameworks*
4. *Regulatory Collaboration Frameworks*
5. *Approaching Coordinated EE+DF(+DR) Program Cost-effectiveness*
6. *Advancing Equitable Participation in Coordinated EE+DF(+DR) Programs*
7. *Coordinated EE+DF(+DR) Programs, Evolving Metrics and Adopting Decarbonization Targets*
8. *Demand Flexibility Value Proposition without an Organized Wholesale Market*

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Appendix A. Links to Case Studies

- *Case Study: Internal Utility Silos*
- *Case Study: Regulatory Silos*
- *Case Study: Supportive Regulatory Innovation Frameworks*
- *Case Study: Regulatory Collaboration Frameworks*
- *Case Study: Approaching Coordinated EE+DF(+DR) Program Cost-effectiveness*
- *Case Study: Advancing Equitable Participation in Coordinated EE+DF(+DR) Programs*
- *Case Study: Coordinated EE+DF(+DR) Programs, Evolving Metrics and Adopting Decarbonization Targets*
- *Case Study: Demand Flexibility Value Proposition without an Organized Wholesale Market*

Case Study: Internal Utility Silos

Introduction

Programs that support grid-interactive efficient buildings (GEBs) typically need to integrate or allow for the integration of a variety of building technologies and services that building owners and/or operators can use. For example, insulation improvements might be bundled with one or more smart thermostats to reduce a building's overall heating and/or cooling needs, which improves energy efficiency (EE), while also providing demand flexibility (DF). However, integrating these technologies and services can require collaboration between multiple teams and/or departments within a utility, especially when a utility is solely responsible for administering programs that promote the adoption of measures that enhance EE and DF, as well as programs that directly or indirectly provide grid services, including demand response (DR). Under this type of program administration structure, a utility's internal organization can play a critical role in supporting or hindering coordinated EE+DF(+DR) program development, and implementation.

Findings

Factors

To effectively design and implement a coordinated EE+DF(+DR) program, several different utility departments or teams, such as program administration, evaluation, grid operation, call centers, and information technology (IT), must align and collaborate. However, siloed departments or teams can challenge coordination. The separation of EE/EE+DF teams from DR teams presents a particularly difficult challenge to coordinated EE+DF(+DR) programs. Not only do utilities themselves face internal hurdles under this structure, but third-party solution providers describe the structure as a serious barrier to providing integrated incentives and a positive customer experience.

Examples

Within utilities, organizational barriers for coordinated EE+DF(+DR) programs can include:

- The existence of separate goals and missions for EE/EE+DF and DR programs and/or teams.
- Skepticism or inadequate knowledge regarding the value of integration and/or the need for innovation.
- Siloed IT systems that hinder interdepartmental billing capabilities or energy data-sharing.
- Difficulties with motivating different teams to dedicate resources to collaborate.

To address these barriers, Eversource and National Grid (both investor-owned utilities (IOUs) operating in the U.S. Northeast) have made strategic, organizational changes to facilitate internal coordination and collaboration.

Eversource and National Grid both leverage a strategic organizational structure by housing the DR team within the EE+DF team. Under this structure, the DR and EE+DF teams use the same stakeholder feedback groups during program planning, and use the same marketing and invoice payment strategies. According to National Grid, the integration of these two teams under one umbrella within the company has been relatively seamless, and has avoided the confusion and different focuses that launching a DR team within a separate group (e.g., research and development) might have caused. This approach has also enabled DR to utilize existing EE+DF marketing avenues, and encouraged both the EE+DF and DR teams to collaborate on device priorities and offerings.

For Eversource, a primary benefit of this organizational structure has been the ability for the DR programs to leverage the more extensive customer relationships and marketing channels established under the EE+DF programs. This helps to ensure that the operational goal of demand reduction is met while providing a good customer experience to motivate continued participation. Additionally, the long-standing sales and marketing expertise within the EE+DF team was essential to recruiting substantially more customers to enroll and, as a necessary first step, adopt the devices and technologies that allow for DR program participation.

However, both utilities still experience internal silos. Eversource is still challenged by coordinating its programs, system operations, system planning, and call center teams. National Grid also experiences internal silos, especially between (or among) programs, grid operations, system planning, and distribution management systems. National Grid indicated that overcoming these silos is critical to further enabling coordinated EE+DF(+DR) program benefits, and doing so is still a work in progress. For example, National Grid's recent solar inverter offering to improve the power factor behind customers' meters, in order to save energy, required considerable input and coordination with the distribution system management and grid operations teams to decide on inverter settings. The EE+DF+DR teams focused on customer marketing, distributed energy resource (DER) coordination, and regulatory approval.[44]

While neither Eversource nor National Grid has fully overcome the internal silos that can act as barriers to coordinated EE+DF(+DR) programs, there is strong evidence that their efforts have been successful; both utilities offer coordinated EE+DF(+DR) programs that support the advancement of GEBs.[45]

Strategies

By housing their DR teams within the existing EE+DF team, both Eversource and National Grid have enhanced their internal coordination and their ability to implement coordinated EE+DF(+DR) programs.

When asked to share additional advice with other utilities, Eversource encouraged utilities to work with operations and system planning teams early in the program-development phase to ensure that coordinated EE+DF(+DR) programs align with the wider grid of the future. By using this approach, the coordinated EE+DF(+DR) team can gain buy-in from other internal departments.

Successful Strategies for Eversource and National Grid

- House EE+DF and DR teams under one umbrella
- Coordinate with other departments/teams early in the program development process.

Conclusion

Although internal utility silos are commonly cited as a barrier to various types of energy programs, the challenges are particularly acute for coordinated EE+DF(+DR) programs, which require the coordination and alignment of multiple teams and departments. Internal organizational silos can hinder the development and implementation of coordinated EE+DF(+DR) programs. They can also inhibit the coordination of grid planning and grid operations. However, some utilities have succeeded in mitigating this challenge by integrating DR departments with EE+DF departments, and by working with grid operations and system planning departments to ensure that coordinated EE+DF(+DR) programs align with the future grid.

44 National Grid's EE+DF+DR offerings, such as the solar inverter offering described here, are proposed to regulators through the Company's EE plan filings.

45 To learn more about National Grid's programs including the ConnectedSolutions Bring-Your-Own-Device DR program, visit https://www.nationalgridus.com/energy-saving-programs. For more information on Eversource's programs, visit https://www.eversource.com/content/ema-c/about/sustainability/focus-areas/energy-efficiency-demand-response (Note that some programs are only offered in certain jurisdictions.)

Case Study: Regulatory Silos

Introduction

Regulatory silos can act as barriers to the efficient adoption of grid-interactive efficient buildings (GEBs) by limiting the development and deployment of coordinated energy efficiency (EE), demand flexibility (DF), and implicit or explicit demand response (DR) (EE+DF+(DR)) programs that can assist customers with funding and technical assistance. Common regulatory silos fall under three categories: proceedings, funding, and standards.

- Proceeding-related silos arise when regulatory authorities separate the regulatory review of complementary topics, such as EE/EE+DF and DR, distributed energy resources (DERs) and system operations and planning, or programs and pilots. Regulators often address such complementary topics in different proceedings, which may utilize different standards of review, and can raise questions about where and how utilities should propose coordinated EE+DF(+DR) programs.
- Funding-related silos primarily take the form of non-concurrent budget and program cycles, and/or separate funding streams for coordinated EE+DF(+DR) programs or the different components of a coordinated EE+DF(+DR) program.
- Standards-related silos stem from differing cost-effectiveness requirements between coordinated EE+DF(+DR) programs and pilots, or between different program types.[46]

Each of these regulatory silos can increase the perceived uncertainty, risk, and/or resource burdens of coordinated EE+DF(+DR) programs for regulatory agencies, program administrators, third-party solution providers, and/or customers.

Findings

Factors

Common challenges stemming from regulatory silos include:

- Uncertainty surrounding where to address coordinated EE+DF(+DR) programs among various proceedings.
- Limitations on the ability, or an inability to link funding streams together.
- Misaligned timelines among related proceedings.
- Difficulties with implementing differing cost-effectiveness requirements.

Examples

A wide variety of third-party solution providers, utilities, and state regulatory commissions agree that these regulatory silos are a major barrier to coordinated EE+DF(+DR) programs that support GEBs.

Proceeding-Related Regulatory Silos

Regulatory agencies in states such as Wisconsin and Minnesota acknowledge that siloed proceedings have hindered coordinated EE+DF(+DR) programs. No formal integrated resource planning (IRP) process currently exists in Wisconsin. Therefore, each proceeding is very "case-specific" and may be, in some staff's opinion, limiting the ability to assess coordinated EE+DF(+DR) programs. The Wisconsin Public Service Commission (WI PSC) reviewed the coordination between EE and DR in early 2022 as part of a general EE policy review, and concluded that ongoing collaboration should be encouraged between Wisconsin's statewide, contractor-administered EE program and utility-administered DR programs, without implementing any formal standards. Staff affirm that collaboration is taking place and note that the statutory division between contractor-run EE programs and utility-run DR programs, as well as the lack of a statewide planning process, can limit opportunities for in-depth coordination. In Minnesota, the topic of DF has been raised in numerous Public

46 To determine cost-effectiveness, many jurisdictions establish benefit-cost analysis standards. For more information on best practices for comprehensive benefit-cost tests see: National Energy Screening Project (NESP). (2020). *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources* (NSPM for DERs). https://www.nationalenergyscreeningproject.org/national-standard-practice-manual/

Utilities Commission (PUC) dockets, including resource planning and vehicle electrification, but coordinated EE+DF(+DR) programs do not currently exist, according to Minnesota Public Utilities Commission (MN PUC) staff. Progress toward developing coordinated programs is especially challenging because of Minnesota's historical regulatory division between EE and DR – the Department of Commerce regulates EE programs while the MN PUC regulates DR/DF programs not associated with overall consumption reduction.

Another form of proceeding-related regulatory silo stems from misaligned timelines between programs. Southern California Edison (SCE), an investor-owned utility (IOU), receives regulatory authorization for its EE and DR programs on budgeting and rate-case cycles that can range from three to six years, often with different start dates. This means coordinating EE+DF(+DR) program flexibility and innovation can often be restricted, if not hindered.

Funding-Related Regulatory Silos

Funding-related regulatory silos also create challenges for utilities, third-party solution providers, and regulatory agencies. For regulatory staff at the Washington Utilities and Transportation Commission (WA UTC), it is not clear whether utilities may use EE bill rider funds to support DF and DR program administration and incentive costs. Although Washington utilities have operated DR pilots with EE funds, no utility has moved a DR pilot into a full program, in part because of the potential, but yet untested, limits on the use of EE funds. Colorado Energy Office staff believe that energy storage and distributed generation have historically been difficult to integrate, primarily because the planning and funding for those technologies were addressed in separate proceedings.

For third-party solution providers, separate program funding streams can create inefficiencies by not comprehensively valuing DF resources and reducing grid visibility of flexible load resources. Thermostat optimization platforms that offer personalized EE, time-based retail rates and DR optimization, such as ecobee's eco+,[47] can be hindered in some jurisdictions because their capabilities are not fully valued by either existing EE or DR programs. In states that have transitioned all customers to time-of-use (TOU) rates, load shifting through thermostat optimization can be significant.[48] But absent some opportunity to formally connect smart thermostat installations which are often driven by EE/EE+DF programs with DR administrators such as utilities and/or bulk power system operators, the resulting load shifting will not be visible. The existence of coordinated EE+DF(+DR) programs could create such an opportunity, but for the separation of program funding streams.

For Consumers Energy and SCE, separate funding streams have created reporting and accounting challenges for coordinated EE+DF(+DR) programs. In Michigan, Consumers Energy, an IOU, has succeeded in combining EE and DR incentives for smart thermostats; but the separate EE and DR funding streams and regulatory constructs require additional tracking and management efforts that have been cumbersome. Similarly, in California, EE service providers operate separately from utility DR providers. Although separate EE and DR incentive funds have been successfully paired to support the deployment of smart thermostats, there still exists significant barriers to integrating EE and DR on a larger program level due to differences in program delivery models, different cost effectiveness methodologies, and joint EE+DR measurement and evaluation challenges.

Standards-Related Regulatory Silos

A number of entities offer examples of regulatory silos related to cost-effectiveness requirements (i.e., standards-related regulatory silos). In Wisconsin, cost-effectiveness requirements apply to Focus on Energy, the state's third-party EE program administrator, but those same requirements do not apply to utilities, which administer the DR programs, as a result of separate governing statutes and regulations. According to WI PSC staff, these distinct program structures and requirements can make it more difficult to pursue in-depth planning and implementation of coordinated EE+DF(+DR) programs. In California, SCE conducted several "integrated demand-side management" (IDSM)[49] pilots to integrate DR measures and technologies with new construction incentives and upstream EE HVAC and lighting programs. However, the next step to develop integrated DR and EE programs failed, primarily because the process for determining cost-effectiveness and benefits for a joint program was too complicated, given the different California regulatory requirements at the time. While an economic study to develop a joint EE+DR cost-effectiveness framework was eventually completed, there were then changes in the regulatory focus in California for pursuing these efforts, and the policies were eventually set aside.

47 For additional information, see: https://www.ecobee.com/en-us/eco-plus/

48 Michigan and Colorado will also be transitioning all customers to TOU rates.

49 SCE utilizes IDSM terminology to refer to its programs.

Strategies

In Minnesota, solutions to these regulatory silos are being pursued as part the 2021 Energy Conservation and Optimization Act (ECO Act),[50] that allows utilities participating in the state's Conservation Improvement Programs to include DR and DF in an integrated fashion with EE. The ECO Act was the result of multiple years of stakeholder discussion and development, was passed in a bipartisan manner, and received overwhelming support from the state's electric and natural gas utilities and EE stakeholders. Technical guidance was issued by the Minnesota Department of Commerce on March 15, 2022, allowing utilities to develop and implement integrated EE, DF, and DR programs[51] with immediate effect. The guidance and statute address funding-related and standards-related silos by establishing clear guidelines (including limitations) for the use of utility spending on efficient fuel-switching measures, and by establishing load management cost-effectiveness methodologies. Future IRPs considered by the MN PUC will also evaluate EE, DF and DR, thereby ensuring that these resources are considered within one proceeding.

Strategies to Overcome Regulatory Silos

To overcome regulatory silos, jurisdictions could consider the following strategies:

- Revise regulations and/or statutes.
- Proactively align proceeding timelines.
- Encourage regulatory and utility staff to collaborate across separate proceedings, and/or establish/ enhance IRP processes to include EE, DF and DR, as well as relevant experts from separate regulatory teams.

Conclusion

Existing regulatory structures often act as barriers to coordinated EE+DF(+DR) programs. In particular, regulatory silos related to proceedings, funding, and standards have negatively impacted the ability of utilities, third-party solution providers, and regulators to support coordinated EE+DF(+DR) program development in numerous jurisdictions. Regulators and legislators could surmount these challenges by statutory or regulatory revisions, through proactive coordination and procedural changes, such as timeline alignment, and/or through broader participation in IRP processes. Scaling coordinated EE+DF(+DR) programs will likely require the de-siloing of policy frameworks to support the future scalability of GEBs.

50 As codified in Minnesota Statutes sections 216B.241, 216B.2402, and 216B.2403.

51 MN PUC utilizes integrated EE, DR, and DF terminology to refer to its programs.

Case Study: Supportive Regulatory Innovation Frameworks

Introduction

For investor-owned utilities (IOUs), existing regulatory frameworks that limit flexibility in utility programs and pilots can challenge coordinated energy efficiency (EE), demand flexibility (DF), and implicit or explicit demand response (DR) (EE+DF(+DR)) program development, and the deployment of grid-interactive efficient buildings (GEBs). Pilots, in particular, are an important step in enabling the development of more comprehensive (and often complex) programs. By highlighting practitioner experiences with successful alternative regulatory approaches for pilots, this case study aims to encourage regulators to consider strategies that better support program evolution.

Findings

Factors

Common regulatory factors that can inhibit program innovation include:

- Regulatory hesitancy in regards to pilot risk and newer technologies.[52]
- Limited opportunities for regulatory feedback during pilot and program planning and design phases.
- A lack of regulatory flexibility to allow for program and pilot changes post regulatory funding authorization.
- Limited financial support for highlighting pilot successes and supporting research and development projects.

Examples

A wide variety of utility study participants agree that regulatory frameworks and actions that support program innovation can enable coordinated EE+DF(+DR) program development and GEBs deployment. Utilities and regulators highlighted diverse examples of regulatory frameworks and actions that allow for greater pilot and program innovation throughout SEPA's Accelerating Coordinated Utility Programs for GEBs Report.

Many utilities noted the challenge of overall regulatory hesitancy in regards to the risk of unsuccessful pilots and implementation/integration of newer technologies. In contrast, Green Mountain Power (GMP), an IOU in Vermont, operates with a regulatory pilot structure that allows it to develop targeted pilots with an objective of rapid experimentation to enable accelerated potential full-scale deployment.[53] GMP can develop pilots that test new technologies and business models, especially those related to DF, with a streamlined regulatory review period. These pilots run for 18 months and sometimes set enrollment numbers for customers. Pilots serve as the basis for more permanent tariff programs and allow GMP to validate assumptions, gauge customer response, and ensure integration with other utility systems. GMP's Integrated Resource Plan (IRP)[54] provides more information on the design framework and evaluation criteria for pilots. Specifically, the Vermont Public Utility Commission (VT PUC) has authorized GMP to deploy pilots such as a residential battery lease and an all-you-can-charge electric vehicle (EV) subscription plan.[55] As part of the development process, GMP engages with stakeholders to incorporate their feedback to make the pilot a success. GMP creates a detailed financial model that lays out the expected costs

52 SEPA's 2020 Renovate Initiative, which sought to innovate regulatory processes also highlighted "managing risk and uncertainty" as a critical issue within utility regulation. For more information on this issue and the solutions proposed through the Renovate Initiative see: SEPA. (2020). Renovate Solution Set: Identifying Promising Practices, Processes and Structures to Enable Innovation.

53 The full framework is available as Attachment 2 of GMP's 2020 Multi-Year Regulation Plan, which explains the context for innovative pilots, the types of offerings that are eligible for pilot treatment, and the format of reporting and cost tracking.

54 Green Mountain Power. (2021). Integrated Resource Plan. Sections 1-7 and 1-8. https://greenmountainpower.com/wp-content/uploads/2021/12/2021-Integrated-Resource-Plan.pdf

55 For additional information on the GMP battery lease program, see: https://www.greentechmedia.com/articles/read/from-pilot-to-permanent-green-mountain-powers-home-battery-network-is-sticking-around; For additional information on the GMP charging pilot, see: https://cdn2.hubspot.net/hubfs/5496199/VP_gmp_case_study_2019.pdf

and benefits of the pilot as part of the initial filing letter; updated financials are included in status update reports. This flexibility within a structured pilot framework allows GMP to develop new ideas and opportunities, implement them rapidly on a small scale, and quickly apply lessons learned.

Vermont's approach to regulatory innovation and flexibility also extends to Efficiency Vermont, one of the state's regulated, third-party EE administrators, which is authorized to install EE measures with DF, allowing customers to enroll in utility DR programs. After exploring the merits of DF measures with a modest Research & Development (R&D) budget during the 2018-2020 performance period, Efficiency Vermont proposed and received regulatory authorization to implement Flexible Load Management programs and services in its Demand Resource Plan (DRP) proceeding.[56] Efficiency Vermont collaborates closely with its distribution utility partners to develop and execute DF programs. Recent collaborations include PowerShift,[57] a residential program for water heater and electric vehicle supply equipment with Washington Electric Co-op, and a Flexible Load Management (FLM)[58] pilot focusing on commercial building controls with GMP.

At this time, Efficiency Vermont does not earn a performance incentive for its Flexible Load programs and services, which may help limit perceived regulatory risk. However, the existing performance metric framework could accommodate the application of a future performance incentive. For GMP, pilots that include capital investment are treated no differently from other capital investments that are able to earn a return on investment (ROI). This approach may help to further motivate GMP pilot proposals, although not all pilots involve capital spending by the utility.

Additional successful regulatory strategies to encourage pilot and program innovation include exempting pilots from the cost-effectiveness requirements, and authorizing dedicated pilot funding. (For additional discussion of cost-effectiveness, see the Approaching Coordinated EE+DF(+DR) Program Cost-effectiveness Case Study) For example, the Washington Utilities and Transportation Commission (WA UTC) affirmed the success of dedicated pilot funding to help enable coordinated EE+DF(+DR) program development, via conservation cost-recovery riders.[59]

Some utilities indicated they are under increasing pressure from regulators to rapidly bring innovative ideas to full-scale programs. Utilities also note that a pilot's first design or structure may not be successful, however documented pilot success is critical for regulatory approval of a pilot-to-full program transition. Therefore, the ability to significantly and quickly change pilot offerings and/or designs within an approved budget period has played an important role in GMP's pilot successes. For example, GMP's original "Bring Your Own Device" (BYOD) pilot received very low-uptake with a design that provided only ongoing monthly participation payments. Within 12 months of bringing this pilot online, they amended the design to include an upfront additional incentive that allowed GMP to dispatch a customer's battery system during peak events. As a result, GMP saw a large increase in signups. In other cases, GMP will make a design change after the pilot concludes, when designing a tariff based on the pilot experience. GMP took this approach for its residential EV rates, switching from a flat monthly subscription to a per-kWh discount for off-peak charging. In the case of GMP's Flexible Load Management (FLM) pilot, which compensated commercial and industrial customers for reducing demand during peak times, GMP determined more testing was needed before a tariff could be proposed for review by regulators. GMP then launched a second iteration of the pilot with an updated compensation model that provides a more reliable payment to participants. Overall, by allowing a more flexible pilot design structure that enables managed experimentation, the VT PUC has helped ensure that foundational challenges or gaps have been identified and addressed prior to scaling a pilot to a full program.

In some jurisdictions, utilities noted limited opportunities for regulatory feedback during program and pilot planning. However, Consumers Energy offered a successful example of regulatory engagement for more complex coordinated EE+DF(+DR) offerings. During the development of its Smart Thermostat Program, Consumers Energy engaged in regular discussions with Michigan Public Service Commission (MPSC) staff, enabling constructive program refinement and revisions. Regulatory staff feedback was especially helpful in developing the program's capacity bid into Midcontinent Independent System Operator

56 Efficiency Vermont received regulatory authorization from the VT PUC to implement Flexible Load Management programs in Case No.19-3272-PET: Petition of Vermont Department of Public Service to initiate an EEU Demand Resources Plan proceeding for the 2021-2023 performance period.

57 For more information, see: https://www.efficiencyvermont.com/powershift

58 For more information, see: https://greenmountainpower.com/new-program-helps-vermont-businesses-save-money-improve-efficiency/

59 For additional information on Washington state utility conservation cost-recovery riders, see: https://www.utc.wa.gov/consumers/energy/company-conservation-programs

(MISO).[60] Specifically, Consumers met with MPSC staff at specific touch points throughout the year to review major milestones for the program. Consumers would send pre-reading materials and offer in-person time to discuss any questions. This process yielded constructive feedback and included a substantial coordinated effort between Consumers Energy (plus its technology solution providers) and the MPSC.

Utilities also cited limited regulatory financial support for highlighting pilot successes and benefits to customers as a barrier to coordinated EE+DF(+DR) programs. Limited funding for research and development (R&D) projects has also worked to slow innovation. In order to address these challenges, the California Energy Commission (CEC) authorizes funding for education and outreach as well as R&D.[61] The R&D funding continues to support new scientific and technology solutions such as vehicle-to-grid integration and technologies that enable a more decentralized electric grid.[62] Education and outreach programs such as the Appliance Efficiency Program have also helped to raise customer awareness of EE, DF, and DR.

Strategies

As highlighted above, the VT PUC successfully implemented several strategies in GMP's alternative multi-year regulation plan, including a framework for innovative pilots, to overcome common regulatory conditions that can inhibit program innovation.[63] GMP proposed the pilot concept in the 2020-2022 multi-year regulation plan to gain flexibility to experiment with new technologies and business models prior to filing more permanent tariffs. In addition to the PUC supporting the pilot approach, GMP also benefits from Vermont's ratepayer advocate providing feedback on each pilot prior to implementation.

Similarly, in Michigan and Georgia, Consumers Energy and Southern Company program teams instituted a practice to communicate program innovation designs to regulatory staff prior to filing to provide awareness and opportunity for feedback.

In California, funding for education, outreach, and R&D have helped raise customer awareness of the latest technologies. Annually, the CEC provides more than $200 million to accelerate new solutions that support a cleaner, safer, more affordable and more resilient energy system for California. Technical assistance, fact sheets, and training are also provided through a variety of CEC energy programs and initiatives.[64] The funding and programs from the CEC help potential pilot customers as well as regulators to understand the importance and value of implementing the latest technologies.

Pilot and Program Innovation Strategies

Regulators can consider pursuing the following strategies and approaches to help encourage pilot and program innovation:

- Increase acknowledgement and acceptance of bounded pilot risk and the need for flexibility.
- Increase opportunities for discussion/feedback from regulators during pilot and program planning.
- Enable a more-flexible regulatory structure that allows for pilot and program evolution as learnings emerge.
- Provide financial support for highlighting pilot successes and customer benefits, as well as R&D projects.

Conclusion

Regulatory frameworks and actions that support utility pilot and program innovation can advance coordinated EE+DF(+DR) programs. Increased regulatory acceptance of limited program risk and flexibility can also better enable program development and deployment, to the benefit of customers, utilities, and the grid as a whole.

60 Annually, there is a deadline for registering new DR commitments (MWs) with MISO.

61 The CEC is the state's energy policy and planning agency, and does not have regulatory authority over state IOUs, which is the purview of the California Public Utilities Commission.

62 For more information on California Energy Commission's R&D programs, see: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development

63 Green Mountain Power. (2020). *Multi-Year Regulation Plan 2020-2022*. Attachment 2. https://greenmountainpower.com/wp-content/uploads/2020/11/2020-09-03-Amended-Multi-Year-Regulation-Plan-Clean-2.pdf

64 To learn more about the CEC's energy programs visit: https://www.energy.ca.gov/programs-and-topics/programs

Case Study: Regulatory Collaboration Frameworks

Introduction

Due to the complexity of coordinating energy efficiency (EE), demand flexibility (DF), and demand response (DR), multiple partners often must work together to develop, launch and implement coordinated EE+DF(+DR) programs successfully. Establishing a regulatory collaboration framework can support proposed coordinated EE+DF(+DR) programs by engaging partners and other stakeholders early in program development and/or planning processes, working to align objectives, and identifying opportunities to coordinate and leverage resources. This case study provides examples of regulatory collaboration frameworks and strategies to encourage stakeholders to consider their use.

Findings

Factors

Common factors that can hinder effective coordination across entities involved in coordinated EE+DF(+DR) programs include:

- Differing objectives between utilities and partners for delivering coordinated EE+DF(+DR) programs.
- A lack of data access and process transparency for all stakeholders.
- An inability to leverage different strengths among program administrators and/or stakeholders.
- A lack of opportunities to share lessons learned across entities (and jurisdictions).

Examples

A regulatory collaboration framework can help to lay the groundwork to align program and policy objectives. Both the Hawaii Public Utilities Commission (HI PUC) and the Vermont Public Utility Commission (VT PUC) have established collaboration frameworks between utilities and statewide EE administrators to address coordination challenges.

Hawaii's long-standing collaboration framework between the state's investor-owned utility (IOU), Hawaiian Electric (HECO), and the state's third-party EE+DF administrator, Hawaii Energy, encompasses integrated demand-side management, and prioritizes collaborative efforts around energy optimization initiatives, such as providing incentives for grid-service-capable technologies that enable customers to participate in HECO's DR programs. The HI PUC plays a significant role in maintaining and supporting the collaborative framework, and liaises with other states' regulatory commissions on best practices. The collaborative framework was established in 2016 based on an initiative set forth by HECO that had effective collaboration results occurring in periodic stretches through 2020. Further, Hawaii Energy's triennial planning process offered an opportunity to update the collaboration framework, which HECO/Hawaii Energy revised jointly for Hawaii Energy's 2019 triennial supplemental filing.

The Hawaii collaboration framework is also driven by the state's performance-based regulation (PBR) framework.[65] Specifically, the EE performance incentive mechanism (PIM) for low- and moderate-income (LMI) customers (the LMI EE PIM) is designed to deliver energy savings for those customers and promote customer engagement, equity, and affordability by fostering collaboration between HECO and Hawaii Energy.[66] The LMI EE PIM awards HECO based on whether Hawaii Energy exceeds their program year targets (e.g., kW reduction, kWh reduction, customer participation) for the residential portion of Hawaii Energy's LMI programs. HECO works with Hawaii Energy to determine how it can partner with the EE administrator to exceed their targets. To this end, monthly collaborative meetings aim to identify additional opportunities to coordinate and leverage each entity's resources and strengths. For example, HECO enhances Hawaii Energy's community outreach and engagement efforts for its own program and technology offerings, by utilizing HECO's

65 For additional information on Hawaii's PBR framework, see: https://puc.hawaii.gov/energy/pbr/

66 Hawaii Public Utilities Commission, State of Hawaii (HI PUC). (2020). *Summary of Phase 2 Decision & Order Establishing a PBR Framework.* p. 4. https://puc.hawaii.gov/wp-content/uploads/2020/12/PBR-Phase-2-DO-5-Page-Summary.Final_.12-22-2020.pdf

outreach channels, community presence, and expertise as the state's utility. Additional forms of collaboration include an active grid-interactive efficient buildings (GEBs) working group. Hawaii's collaboration framework and PIMs are motivating HECO and Hawaii Energy to work together more actively, with continued focus on developing fully collaborative programming.

In Vermont, the coordination framework between Green Mountain Power (GMP), an IOU, and Efficiency Vermont, the state's third-party administrator, enables more effective customer engagement and cross-promotion of programs. GMP and Efficiency Vermont work together to address demand-shifting for customers, with current cross-promotion efforts including a GMP commercial & industrial (C&I) Flexible Load Management (FLM) pilot. Because it can be challenging to work across multiple entities to deliver programs, GMP and Efficiency Vermont have met regularly since the first iteration of the FLM pilot in 2019 to coordinate and share information. The meetings have continued, due to a shared focus on enabling DF and a common mission to help Vermonters shift away from fossil fuels for heating, transportation, and industrial processes. Efficiency Vermont also coordinates a monthly call among all distribution utilities and EE utilities in Vermont. At these meetings, partners discuss topics such as adoption forecasts for technologies like heat pumps and electric vehicles (EVs), and details on new programs in development.

In addition to information-sharing between utilities and program administrators, regulatory commissions such as the Minnesota Public Utilities Commission (MN PUC) and Indiana Utility Regulatory Commission (IURC) highlighted the importance of sharing best practices and peer learning among different jurisdictions and stakeholders. For example, the MN PUC is currently requiring Xcel Energy to share reports and updates with regulators on its Colorado battery storage pilot, and for all Minnesota utilities to give updates in their Transportation Electrification Plans on EV related pilots/projects filed in their other jurisdictions. In addition to monitoring the activities in other states, the IURC has also approved the creation of Demand-Side Management Oversight Boards for each of Indiana's IOUs. Board members include the Office of the Utility Consumer Counselor (OUCC), Citizens Action Coalition (CAC), and industrial representatives. These oversight boards provide a forum for broader input into utility EE, DF and DR program offerings and design, and increasingly, are getting involved in EE, DF and DR market potential study development processes. Having this broad stakeholder participation in EE and DR program planning, as well as in integrated resource plan (IRP) input processes, is important to supporting future coordinated EE+DF(+DR) program development, according to IURC staff.[67] Lastly, in Indiana, the eight utilities required to prepare IRPs regularly attend the stakeholder sessions of other Indiana utilities. IURC staff see the utilities learning from each other through this process and attempt to encourage further knowledge sharing through the IURC's IRP review and critique process.

Strategies

Components of effective regulatory collaboration frameworks can include diverse strategies such as:

- Regulatory engagement during program development.
- Coordination across all entities that interface with the same customers.
- Increased data access and process transparency for all stakeholders.
- Multi-agency/department collaboration within government and program administrators.
- Leveraging different strengths among program administrators and/or stakeholders.
- Sharing lessons learned across jurisdictions.

As highlighted in the examples above, many of these strategies can be implemented through regulatory orders or directives and/or incentives, such as PIMs. Engaging with regional and national organizations may also help entities to stay up-to-date on learnings from other jurisdictions.

Conclusion

Establishing a regulatory collaboration framework that engages multiple stakeholders with a variety of perspectives early during a program's development and/or planning process can support successful coordinated EE+DF(+DR) programs.

67 Other examples of states that have utility program oversight boards include Massachusetts, Connecticut and Rhode Island. More information about their boards can be found at the following links: https://ma-eeac.org/; https://energizect.com/connecticut-energy-efficiency-board; and https://rieermc.ri.gov/

Case Study: Approaching Coordinated EE+DF(+DR) Program Cost-effectiveness

Introduction

Evaluating the cost-effectiveness of planned, coordinated energy efficiency (EE), demand flexibility (DF), and implicit or explicit demand response (DR) (EE+DF(+DR)) programs can be challenging, and can act as a barrier to program development as well as regulatory approval. Specifically, limited data availability, forecasting uncertainty, and challenging cost-effectiveness structures can pose problems for program administrators seeking to calculate the value of a coordinated EE+DF(+DR) program. By highlighting practitioner experiences and desired solutions, this case study aims to help program administrators and regulators overcome this common barrier.

Findings

Factors

An accurate value proposition showing that benefits will exceed costs is needed both internally and externally for a program administrator to successfully develop and deploy a coordinated EE+DF(+DR) program that supports grid-interactive efficient buildings (GEBs). However, regulators and utilities agree that quantifying the cost-effectiveness of coordinated EE+DF(+DR) programs can be challenging. In some cases, the primary barrier is a lack of sufficiently granular and/or trusted baseline and impact data, due in large part to insufficient (or nonexistent) advanced metering infrastructure (AMI) and/or limited pilot data. In other cases, significant forecast uncertainties such as extreme changes in weather patterns or customer behavior can raise concerns over the accuracy of benefit-cost analysis (BCA) results. In addition, stringent or narrow cost-effectiveness test requirements can also prevent coordinated EE+DF(+DR) programs from passing the screening process.

Examples

El Paso Electric provides one example of data limitation challenges that can hinder coordinated EE+DF(+DR) program cost-effectiveness analyses. El Paso Electric, an investor-owned utility (IOU) operating in Texas and New Mexico, is in the process of deploying AMI and looking forward to better utilizing DR after AMI is fully deployed. However, in the meantime, El Paso Electric feels that achieving cost-effectiveness for coordinated programs is difficult because developing baselines without sufficiently granular data (i.e., without AMI) is challenging.

In contrast to El Paso Electric, Consumers Energy, an IOU in Michigan with fully deployed AMI, has solved some problems with respect to developing baselines and trusted savings projections for coordinated EE+DF(+DR) programs, but has not resolved all challenges that might affect the accuracy of cost-effectiveness assessments. In particular, AMI data has been instrumental in revising third-party technology providers' estimates of product benefits and in developing appropriate electricity usage baselines for use in cost-effectiveness screenings. This AMI data has increased utility and regulatory staff confidence in projected savings, which in turn, likely eased state regulatory approval of a smart thermostat coordinated program and allowed Consumers Energy to successfully bid grid services into Midcontinent Independent System Operator (MISO), its regional wholesale market. Nevertheless, in 2021, Consumers Energy found that other forecast uncertainties were not overcome with AMI data. Specifically, Consumers' Smart Thermostat Program fell short of meeting its expected daily MISO delivery of DR resources,[68] due to wide temperature differences across the MISO region. Although Consumers Energy initially assumed that during extreme temperature events, smart thermostats could provide similar grid benefits across the MISO region, the summer of 2021 showed that temperatures are not sufficiently uniform across MISO to support this assumption. Instead, when high temperatures occurred in some MISO regions, mild temperatures in Consumers Energy's service territory limited the scale of achievable load shifting compared to higher temperature locations. This meant that not all of the projected benefits, which were incorporated into the program's cost-

68 Consumers Energy sets their DR target and submits that value to MISO. Accurately forecasting the target is critical to success.

effectiveness screening referenced by regulators in their approval of the program, were achieved.

Beyond these data granularity and input value challenges, El Paso Electric also highlights how challenging cost-effectiveness structures can pose problems for program administrators looking to screen coordinated EE+DF(+DR) programs. In both Texas and New Mexico, where El Paso Electric can provide DR and EE programs, non-energy benefits are excluded from cost-effectiveness calculations, and the estimated useful life of behavior-related DR measures is limited to one year. These factors have made it difficult for DR offerings to pass the screening process.

Strategies

National Grid, like Consumers Energy, is an IOU that has successfully used granular customer data to establish usage baselines and measure program impacts. Although AMI is not widely deployed for residential or small business customers in National Grid's service territories (New York, Massachusetts, and Rhode Island), advanced meters are standard for commercial and industrial (C&I) customers, and this data can provide critical insight into performance for programs associated with these larger customers.

In addition to utilizing granular data when and where it is available, National Grid also leverages the New England Avoided Energy Supply Costs study (AESC study), a regionally-funded analysis that helps to quantify a variety of DR and EE benefits.[69] According to National Grid, this study provides defensible impact values for program cost-effectiveness screenings that have been accepted by its regulators.

Beyond analyzing granular/AMI data and collaborating regionally to measure program value, both Eversource and Green Mountain Power (GMP) (both IOUs) have benefited from regulatory flexibility with pilots. In Eversource's Massachusetts service territory, "demonstration projects" refer to hard-to-measure offerings, including pilots, which are limited in term and scope and provide the information required to assess potential for measurable, cost-effective savings and benefits that can be scaled to be included in programs. These demonstration projects are not required to pass a cost-effectiveness test which has allowed Eversource to use them as a means of generating the necessary data for future program cost-effectiveness screenings. Likewise, the Vermont Public Utilities Commission (VT PUC) recently authorized GMP to use heuristics to estimate the cost-effectiveness of a proposed flexible load pilot for certain use cases beyond traditional peak reduction. This approach allows a utility to collect otherwise unavailable data to more accurately determine a program's cost-effectiveness.

Lastly, Washington Utilities and Transportation Commission (WA UTC) staff recognize that its traditional approach to cost-effectiveness analyses, which has focused on the utility's lens, is a barrier to coordinated EE+DF(+DR) programs. Therefore, with funding from the U.S. Department of Energy and support from E4TheFuture, WA UTC staff plan to open a docket to investigate a potential jurisdiction-specific test for all distributed energy resources (DERs).[70] This approach aims to establish a cost-effectiveness test through which all DER technologies and offerings can be screened and accurately compared.

Potential Solutions to Cost-Effectiveness Challenges

- Program administrators can analyze AMI data, when and where available, to help utilities, regulators, customers, and solution providers better understand or measure program value and cost-effectiveness.
- Regulators and program administrators can collaborate regionally (especially in areas with regional organized wholesale markets) to help utilities and participants assess value.
- Program administrators can conduct pilots, which if exempt from the stricter cost-effectiveness requirements that may apply to programs, can help assess cost-effectiveness.
- Regulators can review existing cost-effectiveness requirements for potential enhancements and alignment with national best practices.

69 For the most recent AESC, see: Synapse Energy Economics Inc., prepared for the AESC Study Group. (2021). *Avoided Energy Supply Costs in New England (AESC)*. https://www.synapse-energy.com/project/avoided-energy-supply-costs-new-england-aesc

70 WA UTC is utilizing the *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources* (NSPM for DERs) in its investigation of a potential jurisdiction-specific test. See: https://www.nationalenergyscreeningproject.org/national-standard-practice-manual/

Conclusion

Many utilities and regulators are struggling to understand and measure the cost-effectiveness of coordinated EE+DF(+DR) programs, due to limited data availability, forecasting uncertainty, and challenging cost-effectiveness structures.[71] However, study participants offer several strategies to begin tackling this challenge. These include leveraging AMI data where available, collaborating regionally to better understand and estimate value, conducting pilots to collect necessary data, and reviewing existing cost-effectiveness requirements for alignment with best practices.

71 In addition to El Paso Electric and Consumers Energy mentioned in this case study, Eversource, Green Mountain Power, and National Grid also noted cost-effectiveness challenges during study data collection.

Case Study: Advancing Equitable Participation in Coordinated EE+DF(+DR) Programs

Introduction

With an increasing industry and policy focus on an equitable clean energy transition,[72] ensuring low-to-moderate income (LMI), otherwise vulnerable, and historically marginalized customer participation in coordinated energy efficiency (EE), demand flexibility (DF), and implicit or explicit demand response (DR) (EE+DF(+DR)) programs is a key priority for utilities, program administrators, regulators, and technology solution providers. Customer recruitment and retention is often challenging for coordinated EE+DF(+DR) programs, due to program complexity and nascency. Ensuring LMI and historically underrepresented customer participation can further require thoughtful program design and outreach. This case study aims to highlight practitioner experiences and desired solutions to help educate program administrators and regulators on how to advance equitable participation in coordinated EE+DF(+DR) programs.

Findings

Factors

Ensuring equitable customer participation in coordinated EE+DF(+DR) programs requires a comprehensive understanding of the barriers, including challenges that impact the customer, utility/program administrator, and regulatory body in different ways. Primary barriers for LMI customers include required investment in new technologies (e.g., solar, electric vehicles (EVs), energy storage (ES)) and supporting technologies (e.g., central air conditioning, broadband, Wi-Fi, smart-phone) generally required for participation in coordinated EE+DF(+DR) programs. Immediate bill savings can be more critical for LMI customers versus other customers that can afford, either with time and/or with money, an investment with a multi-year payback. Furthermore, higher rates of non-ownership of premises and equipment can also fundamentally impact an LMI or historically underserved customer's ability to participate in a coordinated EE+DF(+DR) program by limiting their program eligibility and/or control of relevant technologies. For example, if multi-unit residences are not eligible for a program, or if a program does not account for a customer's potential lack of decision-making authority in investing or controlling enabling technologies such as upgraded service panels or

Common Challenges for LMI Customer Participation

- Limited access to new and supporting technologies, often due to large upfront costs.
- Non-ownership of buildings and/or relevant equipment.
- Difficult or burdensome program eligibility requirements.
- Difficulties for utilities/program administrators in identifying eligible LMI customers.
- LMI customers' distrust of utilities/program administrators.
- Concerns about unintentionally raising LMI customers' bills due to program participation.
- Lack of statutory authority to address broader equity issues that impact LMI customer participation.

72 For additional discussions of energy equity, see: https://www.energy.gov/articles/doe-announces-16-million-support-community-driven-pathways-clean-energy; and Farley, C., Howat, J., Bosco, J., Thakar, N., Wise, J., & and Su, J. (2021). *Advancing Equity in Utility Regulation.* Ed. Schwartz, Lisa C. Vol. FEUR Report No. 12. https://emp.lbl.gov/publications/advancing-equity-utility-regulation

central air conditioning, some customers may be excluded from program participation.

In addition to program-specific barriers, broader factors can inhibit equitable participation in coordinated EE+DF(+DR) programs. First, it can be challenging for utilities to identify eligible LMI customers and specific program opportunities that may benefit them.[73] Additionally, LMI and historically underserved customers may not view a utility/program administrator as a "trusted resource," due to a myriad of factors, thus negatively impacting program recruitment and participation opportunities. The affordability risk for LMI customers may also be higher, as unintentionally raising participating LMI customers' bills may have more serious consequences than for non-LMI participants.[74] Lastly, utilities/program administrators and regulators may lack the necessary statutory authority or direction to meaningfully focus on broader equity issues, such as historic marginalization, which can impact customers' access and participation.

Examples

Utilities are broadly experiencing challenges in ensuring LMI customer participation in coordinated EE+DF(+DR) programs. Holy Cross Energy's (HCE) challenges are reflective of other utility experiences, and provide a good overview of common issues and factors.[75] Notably, HCE (an electric cooperative) has a strong organizational and strategic focus on reaching LMI customers, and offers numerous LMI-focused programs, including a solar program, and a weatherization program that HCE recently expanded to include electrification.[76] These LMI-focused programs attracted stronger LMI participation by tailoring outreach and offerings to LMI customers' needs. However, HCE has not yet developed LMI-focused coordinated EE+DF(+DR) programs. Instead, LMI customers, like all other HCE customers, may participate in the utility's general coordinated EE+DF(+DR) programs. According to HCE staff, a primary reason for not yet developing an LMI-focused coordinated EE+DF(+DR) program is technology cost. HCE aims to incorporate additional technologies, such as ES, into future LMI-focused program offerings as prices decrease.[77] In the meantime, HCE is responding to limited LMI participation in coordinated EE+DF(+DR) programs by increasing marketing and communications staff, and by focusing on overall customer engagement. Communicating the value proposition and benefits of different technologies, both for an individual customer and for HCE's members, is a key strategy.[78]

As noted in the section above, another component of this challenge is the ability of utilities/program administrators to identify and access customers who may be LMI and/or underserved. Because the defining characteristics of LMI or underserved customers may vary by jurisdiction and/or service territory, external data may be needed to identify target customers.[79] In Hawaii, metrics including LMI Energy Burden (average annual residential bill as a percentage of low-income average income), percentage of customers entered into payment arrangements with the utility by zip code, percentage of disconnections for non-payment by customer class by zip code, and LMI participation rates in community solar, time-of-use rates, distributed energy resources (DERs) and DR programs, are being collected and used to help track LMI participation.[80]

Many regulators seem keen to focus on equity, and to expand program access to LMI customers and underserved communities. However, they acknowledge the current challenges of doing so. The Hawaii Public Utilities Commission (HI PUC) noted that coordinated EE+DF(+DR) programs are already challenging to implement, and targeting LMI customers is even more difficult because LMI customers often have other priorities than the identified program objectives. For example, LMI customers may have older homes that are less weatherized and may need to prioritize home comfort, safety, and health over meeting specific program

73 For example, National Grid shared that both traditional DR and coordinated EE+DF(+DR) program offerings may not be applicable to LMI customers, who may not have central air conditioning, EVs, battery storage systems, or solar systems to enroll in DR programs.

74 For example, if customer electric use patterns changed such that a TOU rate no longer saved the customer money but instead increased their monthly bills compared to the previous, fixed rate.

75 Utilities including Austin Energy, BG&E, Consumers Energy, El Paso Electric, Eversource, Fort Collins Utility, Green Mountain Power, National Grid, and SCE also noted this challenge during study data collection.

76 For more information, see: https://www.holycross.com/assistance-programs/

77 HCE noted that encouraging EV adoption for LMI customers is particularly challenging.

78 GMP also noted that they aim to allocate a larger portion of their budget to marketing to reach LMI customers to address this challenge. However, they also do not track customers by income bracket, which can make LMI or underserved customer identification challenging. GMP is committed to conducting LMI outreach and engagement in a sensitive and respectful manner.

79 SMUD is using indicators to identify underrepresented communities where their programs could have the greatest impact. See SMUD's web tool here: https://usage.smud.org/SustainableCommunities/?_ga=2.197682479.1447627763.1649092436-2080546571.1649092436

80 For more information on the affordability tracking metrics, see: Public Utilities Commission of the State of Hawaii (HI PUC). (2018). *Docket No. 2018-0088: Decision and Order No. 37787: Instituting a Proceeding To Investigate Performance-Based Regulation. Appendix A.* https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A21E17B53226E00118

participation requirements such as delivering demand reductions during certain hours. The HI PUC also noted its broader focus on "affordability and accessibility" for customers, which includes small businesses in addition to LMI customers.[81] To address this broader focus, the HI PUC is tracking other metrics, such as energy and peak demand savings and total benefits delivered to hard-to-reach businesses.

Strategies

Although no examples of LMI-specific coordinated programs were documented through this research, strategies employed for specific EE and DR programs are likely applicable and are therefore described here. For example, in order to continue to address LMI customer participation challenges, the HI PUC has established an LMI EE performance incentive mechanism (PIM), which is intended to deliver energy savings for LMI customers and promote customer engagement, equity, and affordability by fostering collaboration among the utility, Hawaiian Electric (HECO), and the third-party EE administrator, Hawaii Energy.[82] The LMI EE PIM provides financial incentives to HECO for delivering energy savings to LMI customers.[83] In order to earn the reward, HECO must take meaningful action to collaborate with Hawaii Energy, and help them surpass their established performance metrics (e.g., kW reduction, kWh reduction, customer participation) for the residential portion of Hawaii Energy's LMI programs. Quantitative results from the PIM are not yet available, as the PIM is still in the first year of implementation. However, the two organizations have begun to develop a new community-based EE program, improved collaboration on data sharing, marketing, and outreach efforts, and HECO has begun to help distribute EE kits to LMI customers, as a part of Hawaii Energy's programs.

Utility regulators in other states are also pursuing new efforts to facilitate LMI participation across utility program offerings. For example, the Wisconsin Public Service Commission (WI PSC) will include energy burden reporting in its annual reports moving forward, in addition to hosting public performance-based regulation (PBR) workshops with a focus on affordability. In rules adopted to implement the state's Clean Energy Transformation Act (CETA), the Washington Utilities and Transportation Commission (WA UTC) has required electric utilities to establish equity advisory groups to ensure participation by "vulnerable populations" and "highly impacted communities," as identified in the statute, in the development of integrated resource plans, and clean energy implementation plans.[84]

Legislative action can also help to increase LMI participation. For example, the Colorado Energy Office highlighted a new state law that established requirements around income-based incentives, as well as the development of a process to identify underserved communities, and to engage underserved communities more in regulatory processes.[85] As previously described, Washington's CETA already supported the engagement of "vulnerable populations and highly impacted communities" in regulatory processes, and a 2021 legislative amendment further required utility funding for stakeholder

Common Challenges for LMI Customer Participation

- Limited access to new and supporting technologies, often due to large upfront costs.
- Non-ownership of buildings and/or relevant equipment.
- Difficult or burdensome program eligibility requirements.
- Difficulties for utilities/program administrators in identifying eligible LMI customers.
- LMI customers' distrust of utilities/program administrators.
- Concerns about unintentionally raising LMI customers' bills due to program participation.
- Lack of statutory authority to address broader equity issues that impact LMI customer participation.

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81 The HI PUC noted that Hawaii Energy, the state's third-party EE program administrator, is very effective at identifying and focusing on Hawaii's "affordability and accessibility" population.

82 Hawaii Public Utilities Commission. (2020). *Summary of Phase 2 Decision & Order Establishing a PBR Framework*. p. 4.

83 For more information on the LMI EE PIM, see: Hawaii Public Utilities Commission. . (2018). *Docket No. 2018-0088: Decision and Order No. 37787: Instituting a Proceeding To Investigate Performance-Based Regulation*. p. 21. https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A21E17B53226E00118

84 For more information, see: the Clean Energy Transformation Act; and WA UTC Docket UE-191023.

85 For more information, see: Colorado Senate Bill 21-272, and Colorado PUC updates on the rulemaking to incorporate SB 272 into processes.

participation in regulatory proceedings with priority given to "vulnerable populations and highly impacted communities."[86]

To help overcome LMI participation barriers, study participants also suggested the following additional strategies:

- Utilities can partner with trusted local community-based organizations to design programs and identify and engage LMI customers.
- Utilities can work with rental housing market stakeholders (including multi-unit dwellings) to identify and assist LMI customers.
- Utilities can recruit an income-diverse customer participant pool for pilots to determine strategies to support increased LMI participation in scaled coordinated EE+DF(+DR) program offerings.
- Utilities can design coordinated EE+DF(+DR) pilots focused on key barriers for LMI customer participation, such as a smart service panel pilot.
- Policymakers can consider implementing a form of PBR that incentivizes utilities to prioritize serving LMI customers and/or establish a legislative directive to focus on equity.

Successfully Implemented Strategies for Increasing LMI Participation

- The use of performance incentive mechanisms (PIMs) tied to LMI customer benefits.
- Regulatory directives to publicly track and report relevant metrics.
- Regulatory directives to hold workshops and otherwise collaborate with experts on LMI customer barriers.
- Legislative mandates to improve LMI customer engagement and access.

Conclusion

Ensuring that clean-energy programs are equitable, and benefit LMI and historically underserved customers, is a constant challenge for utilities. This is especially true for coordinated EE+DF(+DR) programs, which are newer and less familiar to customers, more complex, and typically involve new equipment or technologies. Facilitating equitable customer participation in coordinated EE+DF(+DR) programs will necessitate collaboration among utilities, regulators, technology solution providers, and policymakers.

86 For more information, see: Washington SB 5295 (sec. 4).

Case Study: Coordinated EE+DF(+DR) Programs, Evolving Metrics and Adopting Decarbonization Targets

Introduction

The process of evolving and/or deploying new metrics for coordinated energy efficiency (EE), demand flexibility (DF), and implicit or explicit demand response (DR) (EE+DF+(DR)) programs can support or hinder program design and evaluation. This case study provides examples of successful transitions of program metrics by a municipal utility and an electric co-operative, and details best practices recommended by study participants. Although the examples directly apply to publicly-owned utilities and cooperatives, many of the strategies for successfully transitioning to carbon-based program metrics may be useful to investor-owned utilities (IOUs) if/when states require or support revisions to program metrics.

Findings

Factors

Establishing measurable, trackable metrics that reflect the desired outcomes of coordinated EE+DF(+DR) programs can be difficult. In particular, unclear program objectives and quantification challenges are significant barriers to evolving program metrics. Uncertainty regarding potential revisions to existing program metrics may also reduce the clarity of a program's objective. However, several municipal utilities and electric co-operatives have successfully navigated these transition challenges.

Examples

Sacramento Municipal Utility District (SMUD), a municipal utility, as well as Holy Cross Energy, an electric cooperative, have adopted robust carbon-reduction commitments that are supported by coordinated EE+DF(+DR) programs. These utilities' approaches to aligning energy programs with climate goals provide examples of how stakeholder engagement, clear leadership direction, and thoughtful metric selection can smooth program metric transitions.

In 2021, SMUD adopted its 2030 Zero Carbon Plan, which strongly prioritizes demand-side management (DSM) and flexible load.[87] According to SMUD staff, a shift in focus toward carbon reduction as an overarching metric for customer programs over the past several years enabled the successful combination of electrification and EE, as a means of growing the utility's business. SMUD is now beginning to move toward incorporating demand response (DR) and virtual power plants (VPPs) that include behind-the-meter (BTM) energy storage (ES) and electric vehicles (EVs), after carefully implementing default time-of-use (TOU) rates. This transition toward coordinated programs was, at least partially, enabled by SMUD's transition to carbon-focused metrics for its programs. SMUD's 2030

SMUD 2030 Zero Carbon Plan and Coordinated Programs

SMUD adopted its 2030 Zero Carbon Plan in April 2021. Year 1 priorities include the following actions relevant to coordinated EE+DF(+DR) programs:

- Perform information technology system upgrades to enable distributed energy resources (DERs) and VPPs.
- Include DERs in operations, distribution and grid planning processes.
- Launch new customer-partner pilot programs for VPPs, involving thermostats, (EVs), rooftop solar and batteries.
- Launch pilots for behavioral DR ("Flex Alert"), EV managed charging and vehicle-to-grid (V2G) demonstrations.

87 SMUD. (2021). *2030 Zero Carbon Plan*. https://www.smud.org/-/media/Documents/Corporate/Environmental-Leadership/ZeroCarbon/2030-Zero-Carbon-Plan-Technical-Report.ashx

Zero Carbon Plan states that by leveraging a carbon metric to help quantify program impact, it is realigning its program portfolio to maximize its climate benefit.[88] According to SMUD staff, the utility's goal of developing at least 165 megawatts (MW) of flexible load programs by 2030 was established based on clear, corporate priorities articulated through the 2030 Zero Carbon Plan. In addition, the transition toward carbon-focused metrics was also facilitated by an internal reorganization that better aligned departments with SMUD's climate goals. Specifically, SMUD's 2030 Zero Carbon Plan was developed over an intensive 6-month period working extensively with community stakeholders and engaging more than 100 staff across all aspects of the organization to contribute.[89] SMUD met with dozens of community groups working to ensure the plan reflected community inputs and could meet the goal of ensuring no part of the community was left behind. The plan catalyzed an internal reorganization effort to ensure efficient delivery and accountability for the plan; specifically, the research & design (R&D), program delivery, power generation and energy trading departments have been combined and/or restructured into a Zero Carbon implementation business unit. This new unit enables all aspects of reaching the 2030 Zero Carbon goal, from an energy supply, customer efficiency, electrification and DF/VPP standpoint, to be coordinated under a single Chief Zero Carbon Officer. SMUD also now tracks lifetime carbon savings as a means of quantifying program performance.

Holy Cross Energy (HCE), an electric distribution cooperative in Colorado, has established a similar goal to provide 100% clean electricity to its members by 2030. HCE is leveraging this goal to direct energy program development. According to HCE staff, coordinated EE+DF(+DR) programs are critical to achieving this goal, and staff and leadership therefore prioritize them. Specifically, HCE realized that a move to a decarbonized future would change not only the way they source power, but how they use and control it. A recent HCE commissioned study with RMI[90] noted that, with decarbonization and a drive to electrification, HCE should expect significant impacts to their system. However, if the new loads from electrification can also be flexible and controllable, HCE can reshape their load and smooth demand. With coordinated EE+DF(+DR) programs, HCE believes they will get past the 85% clean energy hurdle and meet their 100% clean energy goal by 2030.

Strategies

Both SMUD and HCE have benefited from top-down leadership that has prioritized carbon reductions and stakeholder engagement in developing their strategic plans.[91] Not only have clear, public carbon reduction goals been established by both utilities, but leadership has been supportive of reorganizing program planning, implementation, and reporting in support of these goals. The proactive engagement of key stakeholders during strategic plan development has also helped to build broad support for decarbonization commitments.

At SMUD, the specific carbon-based program performance metrics now used are lifetime and cumulative carbon savings. SMUD adopted these metrics in place of a longstanding metric for EE, which used to measure first-year gigawatt hour (GWh) savings converted into a percentage of retail sales. According to SMUD staff, this metric replacement helped significantly shift perspectives toward investing in efforts that save energy during times of day and year where there is the most carbon on the grid. It also shifted thinking to focus on the entire life of a measure, including how carbon savings will change as the grid shifts over time.

Successful Strategies for Evolving Program Metrics to Include Carbon Reduction

- Carefully consider carbon metric selection, including data availability, methods for developing baselines and setting performance goals.
- Engage internal and external stakeholders in developing new carbon metrics and targets to increase buy-in.
- Ensure clear, top-down leadership within the organization. Leadership should provide clarity on how programs are expected to support the organization's overarching carbon goals.

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88 SMUD. (2021). *2030 Zero Carbon Plan*. p.104.

89 SEPA supported facilitation of SMUD's community stakeholder engagement meetings from November 2020 to March 2021.

90 RMI, prepared for Holy Cross Energy. (2022). *Managing and Accelerating Electrification in Holy Cross Energy*. https://www.holycross.com/resources-white-papers/

91 SMUD. (2021). 2030 Zero Carbon Plan. https://www.smud.org/-/media/Documents/Corporate/Environmental-Leadership/ZeroCarbon/2030-Zero-Carbon-Plan-Technical-Report.ashx; Holy Cross Energy (2020). *2020 Strategic Plan*. https://www.holycross.com/wp-content/uploads/2020/12/HCE-Strategic-Plan-121020-FINAL_R2_TOPOST.pdf

The baselines for SMUD's carbon metrics were determined by combining supply-side hourly carbon emissions from SMUD's integrated resource plan (IRP) with demand-side load and savings shapes, as well as avoided emissions from natural gas and transportation fuels. The performance goals were established based on a trajectory consistent with hitting state and regional goals of zero carbon by 2045, which SMUD intends to support from a building and transport standpoint, while accelerating its supply-side goal to reach zero carbon by 2030. According to some SMUD staff, the transition to new metrics (and a new way of thinking) has not been easy, as it has required new levels of modeling and necessary shifts in mindsets and approaches. However, many of SMUD's EE programs were able to serve as good starting points from which to build electrification incentives, and therefore, programs were able to stand up rapidly. Shifting SMUD's reporting practices is still a work in progress, as state requirements for EE reporting still use GWh, and alignment of legacy software reporting has taken time to fully convert over and align to models used to establish carbon goals.

Together, the experiences of SMUD and HCE showcase how thoughtful metric selection, stakeholder engagement, and utility leadership's clarity on program objectives can facilitate coordinated EE+DF(+DR) program development and deployment. They also highlight how revisions to program metrics to prioritize carbon reduction can work to align coordinated EE+DF(+DR) program outcomes with climate goals.

Based on study participant interviews, such revisions require concerted effort and top-down internal leadership. Conducting strategic planning and collaborative discussions with relevant stakeholders also helped these two utilities determine how traditional program metrics should evolve, and gain buy-in for new policy objectives and potential internal reorganization.

Conclusion

Transitioning to measurable, trackable carbon-focused metrics can help to align coordinated EE+DF(+DR) programs with desired climate outcomes. Both municipal utilities and electric distribution cooperatives have demonstrated their ability to succeed with this approach. Their experiences show that this transition is easier when clear policy objectives are established by leadership, often through public-facing commitments. IOUs may also be able to implement these strategies if/when state policies support program metric changes.

Case Study: Demand Flexibility Value Proposition without an Organized Wholesale Market

Introduction

Without an organized wholesale market for grid services, such as an Independent System Operator (ISO) or Regional Transmission Organization (RTO), determining the full value of coordinated energy efficiency (EE), demand flexibility (DF), demand response (DR), and/or coordinated (EE+DF(+DR)) programs can be difficult. This significant economic barrier, which exists in many areas of the country and applies to a variety of program types, was cited by several utilities and state regulators during this study. This case study provides representative examples of this challenge and describes the potential solutions discussed by study participants.

Findings

Factors

In regions without organized wholesale markets for grid services, difficulties with valuing the broad grid impacts of EE, DF, DR, and/or coordinated EE+DF(+DR) programs can be an obstacle for cost-effectiveness screenings and program funding levels. Without revenue from such markets, other funding sources, such as bill riders, must cover a program's full expense. Moreover, benefit-cost analyses (BCA) for programs may become asymmetrical when regional/broader grid benefits cannot be accurately quantified.

Examples

In Washington, utilities have sought to provide coordinated EE+DF(+DR) programs without access to an ISO/RTO. According to study findings, Washington Utilities and Transportation Commission (WA UTC) staff have struggled to develop a model to help determine the appropriate annual program goals for EE savings and DR enrollment in the state. In particular, WA UTC staff find coordinated EE+DF(+DR) valuation to be challenging and shared concerns that utilities might not be able to adequately recover their costs for coordinated EE+DF(+DR) programs. However, an effort is underway to develop a Northwest resource adequacy program that will allow comparisons across utilities to measure the capacity resources (including EE and DR) that utilities bring to the region.[92] In doing so, such a program likely will improve the ability of utilities and regulatory commissions to establish the value of coordinated EE+DF(+DR) capacity grid services.

In Hawaii, the Public Utilities Commission (HI PUC) and Hawaiian Electric (HECO), the state's investor-owned utility (IOU), recognize that the absence of an organized wholesale market makes valuing demand response (DR) difficult, and they specifically describe DR as a resource that requires complex analysis to determine its dynamic value proposition. To help overcome this challenge, the HI PUC directed HECO to provide a value for EE and DR resources in the context of Integrated Grid Planning (IGP) docket proceedings. Proxy values for EE and DR resources are derived from HECO's resource bid process as part of its IGP.[93] Although this solution is "not perfect," according to a HI PUC staff member, it ensures that defensible, publicly-vetted estimated values are available for cost-effectiveness analyses.

Lastly, in Indiana, utilities participate in either the Midcontinent Independent System Operator (MISO) or PJM Interconnection (PJM) regional market. However, these markets differ in their market structures, grid service rules, and capacity needs. According to Indiana Utility Regulatory Commission (IURC) staff, MISO is currently revising pricing structures, capacity valuation and resource accreditation

92 The Northwest Power Pool, now named the Western Power Pool, has an initiative underway to develop a Western Resource Adequacy Program (WRAP).

93 In Hawaii, IGP is a process which includes data collection, plan definition, creating a clean energy marketplace, and plan refinement. The plan is ultimately submitted to the HI PUC for approval with the intent that the approved plan will provide valuation for all resources including EE and DR.

processes, and is working to accommodate more renewable energy—all of which may impact EE, DF and DR value. However, likely due to the two RTOs' historically different capacity market rules, processes, participating utility structures, and capacity prices, IURC staff have observed that utilities operating in PJM have seemed more active in providing DR programs than those operating in MISO. This observed difference underscores the significant impact that wholesale markets may have on coordinated EE+DF(+DR) programs.

Strategies

To address the challenge of limited or non-existent regional markets for grid services, study participants suggested utilizing integrated resource planning (IRP) that includes EE, DF and DR as procurable resources.

IRPs that include EE, DF and DR as procurable resources may directly improve the ability of a program administrator and/or regulator to estimate EE, DF, DR, and/or coordinated EE+DF(+DR) program value. As shown in Hawaii and Washington, IRPs (now called IGPs in Hawaii), whether specific to a utility or region, require comparisons among resource options to meet long-term reliability and resource adequacy requirements. If EE, DF and DR are included in the list of resources that must be considered, then comparable cost estimates and time-sensitive value capabilities will need to be developed. Although challenging, estimating the full value stack from coordinated EE+DF(+DR) programs is critical to their ability for consideration in IRPs, on par with more traditional supply-side resources.

Conclusion

Without a robust wholesale market for grid services, determining the overall value of benefits provided to a system through EE, DF, DR and/or coordinated EE+DF(+DR) programs is difficult. By extension, determining appropriate compensation levels for program administrators and/or participating customers is a challenge that can inhibit coordinated EE+DF(+DR) programs. IRP that includes EE, DF and DR as procurable resources may help to mitigate this challenge. Ongoing research and new collaborations between utilities and/or states to address the valuation of grid services provided may also yield solutions outside of a traditional ISO/RTO market.

Appendix B. Project Definitions

Energy efficiency: Energy efficiency is the persistent and maintained reduction in energy and/or demand, as compared to baseline consumption, to provide the same or an improved level of service.[94]

Demand response: The active reduction, increase, shift, or modulation of energy and/or demand on a limited time basis, as compared to baseline consumption, in response to a price/incentive payment or command signal, which may result in a lower level of service.[95]

Demand-side management (DSM): The modification of energy demand by customers through strategies including energy efficiency, demand response, distributed generation, storage, electric vehicles, and/or time-of-use pricing structures.[96]

Demand flexibility: The technical capability, associated with a building, to actively lower, increase, shift, or modulate energy usage, compared to a baseline scenario reflecting the passive state of operation, and in response to utility grid needs.[97]

Grid-interactive efficient buildings (GEBs): An energy-efficient building that uses smart technologies and on-site DERs to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences in a continuous and integrated way.[98]

Integrated EE+DF Programs: The coordinated or combined program delivery of energy efficiency and demand flexibility end use technologies to customers. Depending on program design, price/incentive payments and available control technologies, the program may or may not be coupled with providing grid services (i.e., DR).

Coupled EE+DF Programs: The program delivery of energy efficiency and demand flexibility end use technologies to customers that is linked to providing grid services (i.e., DR).

Promoting GEBs: The encouragement of building energy efficiency and adoption of smart technologies/on-site DERs to provide demand flexibility and opportunities to optimize across energy cost, grid services, and occupant preferences through integrated and/or coupled utility program delivery.

94 Satchwell, A., Cappers, P., Deason, J., Forrester, S., Frick, N., Gerke, B., & Piette, M. (2020). *A Conceptual Framework to Describe Energy Efficiency and Demand Response Interactions.* Prepared by Berkeley Lab. Washington, DC: DOE. https://eta-publications.lbl.gov/sites/default/files/lbnl_report_ee_and_dr_interactions_framework_final_posted.pdf

95 Satchwell, A. et al. (2020)

96 Satchwell, A. et al. (2021)

97 Satchwell, A. et al. (2020)

98 Neukomm et al., December (2019)

Appendix C. List of Study Participants (Organization-Level)

Utilities and Program Administrators

Arizona Public Service (APS)
Austin Energy
Avangrid (including NYSEG, RG&E)
Baltimore Gas & Electric (BG&E)
Bonneville Power Administration (BPA)
CPS Energy
Consumers Energy
Duke Energy
Efficiency Vermont
El Paso Electric
Eversource
Fort Collins Utilities
Green Mountain Power
Hawaii Energy
Hawaiian Electric (HECO)
Holy Cross Energy
National Grid
New York Power Authority (NYPA)
Oklahoma Gas & Electric (OG&E)
Omaha Public Power District (OPPD)
Pacific Gas and Electric (PG&E)
Portland General Electric (PGE)
Poudre Valley Rural Electric Association
Southern California Edison (SCE)
Sacramento Municipal Utility District (SMUD)
Sterling Electric Cooperative
Southern Company
Xcel Energy

Regulators/Policymakers

California Energy Commission
Colorado Energy Office
Colorado Public Utilities Commission
Hawaii Public Service Commission
Indiana Utility Regulatory Commission
Minnesota Public Utilities Commission
Washington Utilities and Transportation Commission
Public Service Commission of Wisconsin

Solution Providers

Ecobee
Enbala
EnergyHub
Google Nest
Michaels Energy
Oracle
Powerley
Uplight

Smart Electric
Power Alliance

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