A ROADMAP FOR CLIMATE-FORWARD EFFICIENCY

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Smart Energy. Clean Planet. Better Lives.

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About ACEEE

The American Council for an Energy-Efficient Economy (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

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Executive Summary

KEY FINDINGS

- This report identifies nine strategies to align utility energy efficiency and net-zero goals. These strategies collectively constitute a climate-forward efficiency roadmap.
- Alignment strategies should be developed with equity in mind to ensure that all customers and communities are engaged with and benefit from climate-forward efficiency actions.
- Climate-forward efficiency strategies can be broadly separated into three categories: policy alignment, program delivery, and market preparation.
- The bulk of the actions needed to advance climate-forward efficiency can be taken by legislators, utilities, and their regulators, though roles exist for other stakeholders as well, including efficiency service providers and state agencies.
- The numerous existing examples of climate-forward efficiency actions taken by legislators, regulators, utilities, and others can serve as early models for others.
- Specific climate-forward efficiency solutions will depend on a region's unique characteristics (e.g., policy needs, grid mix).

All sectors of our economy have an imperative to reduce their greenhouse gas (GHG) emissions and adapt to the impacts of a changing climate, but few sectors are as pivotal as the power sector. Utilities and power providers have been gradually decarbonizing the *supply* of energy, mostly by expanding clean, low-cost solar and wind resources.

But utilities also have a significant opportunity to decarbonize through *demand-side* measures such as energy efficiency (EE). However, most current utility EE programs are designed to reduce energy consumption (often on an annual basis) rather than to reduce GHG emissions. This is the case despite the fact that wind and solar variability can greatly affect how much renewable energy—and therefore how much GHG—is produced. Utilities need to reexamine the ways they design, operate, and evaluate their EE programs to ensure that they are on track to achieve an affordable, equitable, clean energy future.

This recognition motivated ACEEE to develop an updated *climate-forward efficiency* framework that balances and aligns our need for net-zero emissions with other benefits that customers and communities seek from EE. This framework first appeared in a companion report, *The Need for Climate-Forward Efficiency: Early Experience and Principles for Evolution*, which proposed that an effective response to climate change requires that we use all the tools at our disposal. Demand-side measures, including EE, are no exception. Moreover, we expect EE to deliver many co-benefits like healthier indoor environments, market transformation, and resilience, and to do so with equity in mind.

The Need for Climate-Forward Efficiency established a *climate-forward efficiency* framework for equitably aligning EE and decarbonization goals in state and utility EE portfolios. It defined *climate-forward* efforts as those that do the following:

- Treat EE as an intentional driver of GHG reductions
- Scale to meet the magnitude of the decarbonization goals in policy and utility corporate commitments
- Leverage EE as a tool to mitigate and adapt to the impacts of climate change on customers by advancing equity, enhancing resilience, and improving health outcomes
- Prioritize EE investments based on their temporal, seasonal, and geographic impacts on GHG
- Enable prioritization of investments — particularly in electrification — across fuels, systems, and sectors.

This report builds on *The Need for Climate-Forward Efficiency* by introducing a roadmap consisting of nine strategies to advance climate-forward efficiency. These strategies, which are visualized in Figure 2, are high level and must be adapted for each region’s unique circumstances (e.g., policy, environmental, economy, grid mix).

The Need for Climate-Forward Efficiency

Climate change remains one of the defining global challenges of our time. Countries have committed to limiting average global warming to “well below” 2°C—and ideally, to 1.5°C—as part of the 2015 Paris Agreement (IPCC 2021, 2018; Schiermeier 2016). Reaching these targets will help us avert the worst impacts of climate change, but some negative outcomes are already upon us. For example, the number of billion-dollar disaster events attributed to extreme weather has trended upward, with ongoing climate change projected to increase the frequency and magnitude of those events (NCEI 2022; Silverstein et al. 2018).

The electric sector has a huge role to play in both mitigating emissions and helping us adapt to climate change impacts. One component of this sector—utility energy efficiency (EE) programs—has a track record of saving customers energy and money, yet the vast majority of these programs are not meeting their potential for addressing climate change (Romankiewicz, Bottorff, and Stokes 2020). While more than 50 U.S. utilities have announced carbon-free or net-zero targets, few are on the path to meet them—and even fewer have EE program goals aligned with these climate commitments (Relf et al. 2020).

In a companion report, *The Need for Climate-Forward Efficiency: Early Experience and Principles for Evolution*, we detail why utilities need to move beyond traditional EE and toward a framework that places formerly secondary goals (e.g., environmental protection, equity, market transformation) near the forefront (Specian and Gold 2021). We summarize these findings as follows:

- With the growth of renewable energy, EE is becoming a more time-sensitive resource with respect to GHG emissions.
- Electrifying technologies—such as space heating, water heating, and transportation—that have been conventionally powered by natural gas and delivered fuels will maximize energy savings and emissions reductions.
- Most utility EE offerings are not currently well positioned to scale to meet climate targets.
- Decarbonization goals can motivate and accelerate the adoption of grid-interactive efficient building (GEB) technologies.[1]
- Working across traditional utility silos can unlock integrated, cost-effective whole-building energy solutions, such as EE, demand response (DR), and renewable energy.
- Fuel-neutral savings constructs are better equipped than resource-specific ones to maintain secure, low-cost grid systems amid a changing building technology landscape.
- Climate change poses a disproportionately large risk to underserved, energy burdened, and otherwise marginalized communities.[2]
- New approaches are needed to animate local markets for EE technologies and services to achieve results at scale.

[1] Also known as smart buildings, GEBs are grid-connected buildings that rely on communication signals to reduce building energy consumption (Perry, Bastian, and York 2019).

[2] A household experiences a high energy burden if it spends more than 6% of total household income on energy bills (Drehobl, Ross, and Ayala 2020).

TOWARD CLIMATE-FORWARD EFFICIENCY

The Need for Climate-Forward Efficiency report establishes a new *climate-forward efficiency* framework for equitably aligning EE and decarbonization goals in state and utility EE portfolios. It defines *climate-forward* efforts as those that do the following:

- Treat EE as an intentional driver of GHG reductions
- Scale to meet the magnitude of the decarbonization goals in state and local policy and utility corporate commitments
- Leverage EE as a tool to mitigate and adapt to the impacts of climate change on customers by advancing equity, enhancing resilience, and improving health outcomes
- Prioritize EE investments based on their temporal, seasonal, and geographic impacts
- Enable prioritization of investments—particularly in electrification—across fuels, systems, and sectors

In these ways, climate-forward efficiency represents a balance between achieving GHG reductions and intentionally pursuing EE's many other benefits.

EARLY PROGRESS IN LEADING STATES

As figure 1 shows, states are currently taking various policy actions to better align EE, decarbonization, utility business model reform, and equity goals. Some have built on annual resource-specific goals that specify how much electricity, natural gas, or peak savings utilities must achieve by establishing multiple goals that reflect expanded policy objectives and/or fuel-neutral goals that establish primary energy (in British thermal units, or Btus) or GHG reduction targets. This empowers program administrators to prioritize the highest-potential GHG mitigation measures across fuels and eligible sectors.

Leading states and utilities are taking action to reform their energy efficiency portfolios to unlock climate-forward efficiency

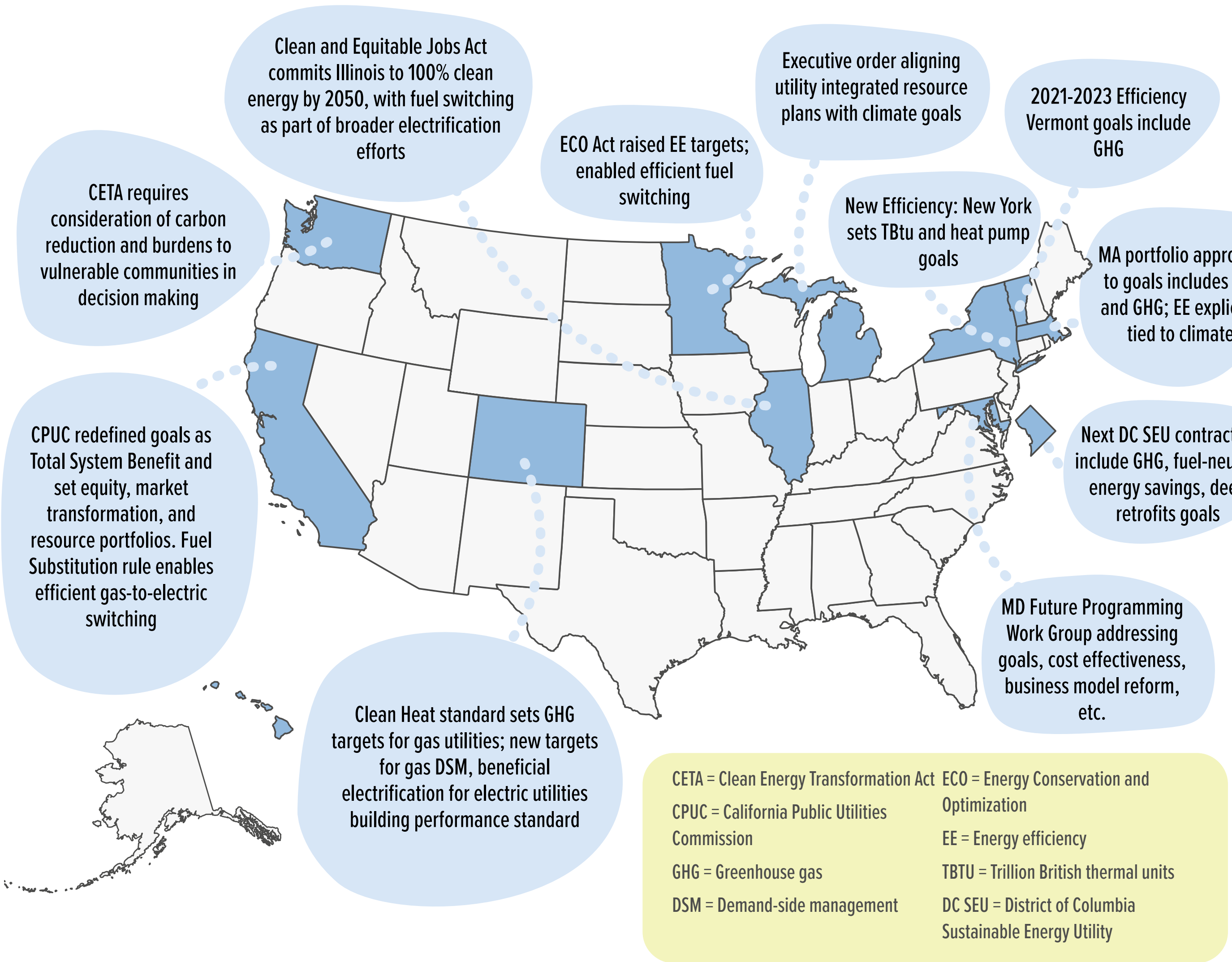


Figure 1. Map of leading states and utilities with recent notable climate-forward efficiency policies

Utility business model reforms are also unlocking the potential for emissions reductions. States with performance incentives for utilities or program administrators show an evolution in metrics to align with climate-forward efficiency by pairing EE with DR to reduce emissions and system costs (Gold et al. 2020). Revenue decoupling mechanisms, which make utilities indifferent to sales volume, are important to ensuring that customers benefit from the extra revenue from electrification and to disincentivizing inefficient electrification (e.g., electric resistance space heating). A total of 31 states have authorized decoupling—11 through legislation, and 20 through public utility commission (PUC) orders and utility rate cases (Cleveland, Dunning, and Heibel 2019).

Some states are reviewing and updating policies to enable EE and DR resources (e.g., grid-interactive electric heat pump water heaters) to participate in integrated programs that deliver both services. Others have lifted fuel-switching restrictions, which prohibit ratepayer funding from supporting electrification that passes environmental and consumer economic screens. Some states have taken steps to align their cost-effectiveness testing with local policy goals, including those motivated by climate change.

ROADMAP OBJECTIVES

These are still early days in terms of states and utilities fully aligning their EE portfolios with net-zero decarbonization goals. Legislators, regulators, utilities, and other policy influencers are hamstrung by the lack of experience with these issues in their sector, as well as by existing policies and regulations that limit utility regulators' ability to address environmental objectives.

Given the imperative to move quickly to address climate change, we present this roadmap report as practical guidance to navigate the evolution to climate-forward efficiency. This report's aims include the following:

- Share a vision of what climate-forward EE looks like for legislators, regulators, utilities, and service providers
- Characterize the strategies needed to address misalignments between current practice and the decarbonization goals being adopted around the country
- Detail policy design options and notable examples for each strategy
- Help stakeholders to determine which set of strategies is right for their particular context and to take the first steps to act and advance those strategies

REPORT STRUCTURE

The following section, "Pathways for Climate-Forward Efficiency," constitutes the bulk of our report and introduces the nine strategies that collectively outline a roadmap for advancing climate-forward efficiency through policy, programs, and markets. Appendix A provides details on the stakeholder engagement process that we used to generate the report's recommendations. This process was part of our three climate-forward efficiency workshops, the agendas of which are presented in Appendix B.

Pathways for Climate-Forward Efficiency

Here, we describe the set of strategies that collectively serve as an introductory roadmap for climate-forward efficiency. These strategies are necessarily high level, as specific solutions depend on a region's unique characteristics (e.g., policy needs, grid mix). These strategies do, however, constitute a solid initial set of considerations, options, and examples that stakeholders can use to construct more bespoke climate-forward efficiency solutions.

The following content began as a preliminary set of internally generated ideas, examples, and recommendations. We subsequently improved on them during the second and third of our three climate-forward efficiency workshops, as described in Appendix A. The participants we engaged in this process reflect the types of key stakeholders needed to effectively implement climate-forward efficiency: legislators, regulators, and utilities.

Figure 2 shows the nine climate-forward efficiency roadmap strategies that we developed through this process. As the figure shows, we divided the strategies into three action categories, each of which can inform the others, and center the three categories around one unifying equity-focused strategy.

Center Equity. This strategy lies at the framework's center as most (if not all) customers and communities must be engaged to deliver on climate commitments and avoid exacerbating existing inequities in the energy and climate mitigation systems. We begin the roadmap with this strategy, but also explore equity connections within the other eight strategies.

Policy Alignment. These strategies explore the set of guidance principles and rules of the road provided to regulated utilities by state regulators and legislators.

Market Preparation. These strategies represent the funding, data, and workforce approaches that offer climate-forward activities the greatest chance of success.

Program Delivery. These strategies focus on evolving customer offerings, including programs that deliver easy-to-access, whole-building decarbonization solutions.

Figure 2. Nine roadmap strategies to accelerate climate-forward efficiency

The primary barriers to climate-forward efficiency relate to issues such as funding gaps, policy and politics, and program delivery. Energy-efficient technology is not a barrier itself, but existing economic and political constraints can prevent effective distribution and installment of new technology. So, while there is certainly a role for, say, higher-performing cold climate heat pumps and further development of large commercial building electrification technologies, an emerging conclusion from our workshops is that we can achieve most of the progress needed to align EE and GHG reductions without additional breakthrough technologies.

ROLES FOR DIFFERENT ACTORS

As we enter the decisive decade for climate, we must unite around a shared vision for how utilities can work with their customers to deliver rapid emissions reductions through various technologies and approaches. No single stakeholder group can realize the potential of climate-forward efficiency on its own. In *The Need for Climate-Forward Efficiency*, we documented examples of legislators, regulators, and utilities taking early action to meet their decarbonization goals. To realize the vision of climate-forward efficiency, each of those actors will need to be rowing in the same direction. They'll also need to engage and support the value chain for climate-forward efficiency technologies (e.g., electric heat pumps) from manufacturers to suppliers to contractors to the customers themselves.

We now briefly describe the role of different actors in realizing each of the three action categories.

Policy Alignment

Decision makers at state legislatures, state public utilities commissions, and sometimes governors' offices or executive branch agencies will lead the transition to policy changes. Depending on authority, which varies from state to state, these decision makers can establish high-level climate goals and conduct studies to establish economy-wide pathways to meet those goals, including targets for the power generation and building sectors and clear interim targets. They can refresh criteria for what can be included in customer programs, and set metrics and standards for what success, or *performance*, looks like. Authority to unlock new funding sources varies, from PUCs or boards (in the case of municipal utilities and cooperatives), which lead on ratepayer funding, to legislatures, which often have a more direct role in determining how revenues from carbon pricing will be used. In some states, state energy offices, air regulators, or environmental or commerce departments play a role as well, including in directing federal funding. PUCs tend to lead on issues of utility business model reform, rate design, and ratemaking, although legislatures may direct PUCs to promulgate rules as well. Utilities, businesses, advocates, and a wide range of other stakeholders may also play a role in proposing, refining, and advancing changes to policies—and in setting and holding utilities to their climate commitments.

Market Preparation

Utilities and other program administrators take a lead role in providing the stakeholder engagement infrastructure (including with low-income and other marginalized communities), workforce development, and the data and transparency needed to enable climate-forward efficiency. However, policymakers, including state energy offices and regulators, also play a role here. Regulators have direct oversight of utility investments and performance across resource planning and procurement, and enable infrastructure such as data access and workforce standards. Regulators can also convene stakeholders to formally or informally engage in decision-making processes.

Program Delivery

Contractors, product suppliers, and program implementors often serve as the face of EE programs. In addition to creating business models that support climate-forward efficiency, these stakeholders also provide the on-the-ground education—to both customers and their own employees—that is required for market transformation. They directly interface with customers and lead residential customers on crucial "kitchen table" conversations. Other stakeholders, including utilities and policymakers, must ensure that their rules, requirements, incentives, policies, and other actions smooth the customer journey of getting to "yes" for low-carbon options. Utilities and program administrators can lead the way through smart program and incentive design, financing, marketing and outreach, customer education, and supply chain engagement. Other providers can innovate with low-carbon solutions that cross traditional energy sectors; among these solutions are integrated packages that combine weatherization and smart controls with right-sized heat pumps and solar-plus-storage. Regulators also play an important role in enabling the flexibility needed to meet performance targets and streamlining requirements to enable success.

STRUCTURE OF STRATEGIES

We now detail the nine climate-forward efficiency roadmap strategies. We first introduce the strategy, including salient background information and general considerations for its implementation. Next, we offer a more focused set of options that stakeholders should consider to advance the strategy, and follow with examples where the strategy has been executed or is under consideration. We conclude with pathways forward—that is, actions that stakeholders can take to advance each strategy in the near term (0–2 years) and beyond (3–5 years).

Figure 3 shows the 31 climate-forward efficiency options separated into the nine strategy categories and includes the actor(s) primarily responsible for each strategy's execution. Options on the left side of the figure can be implemented on shorter timescales, often without support from other stakeholder groups. Options on the right are more likely to be viable in several years, potentially after other enabling options have been enacted. This figure is of course approximate; each jurisdiction has its own starting point and unique constraints that determine the optimal timing and sequence for implementing the various options.

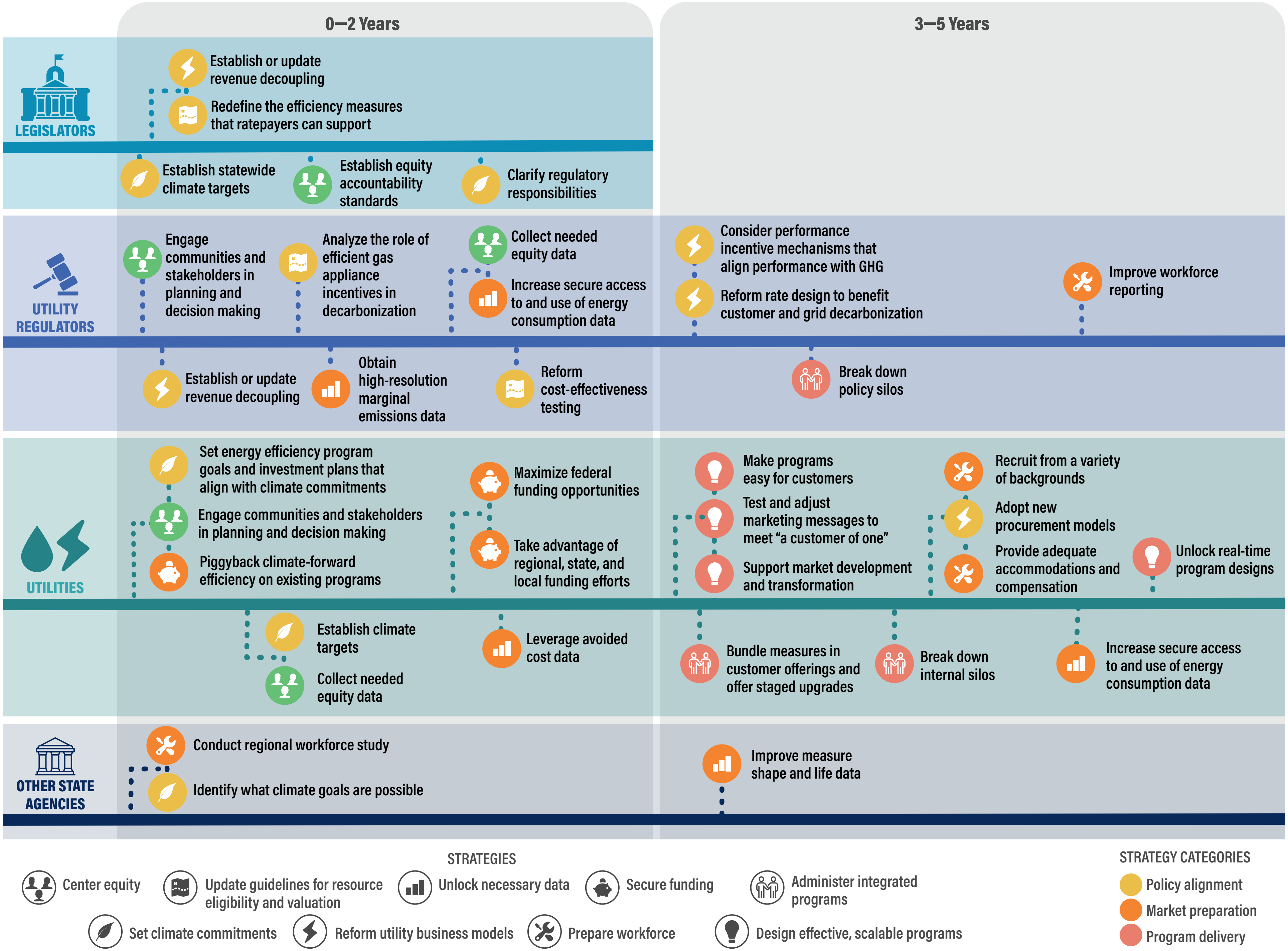


Figure 3. Roadmap of options that can be taken by legislators, utility regulators, utilities, and other state agencies to support climate-forward efficiency as a function of time. Each strategy is represented by multiple options.

CENTER EQUITY

The set of pathways that limit global temperature rise to 1.5°C is narrow, and transitioning to a net-zero energy system will require participation from a wide range of customers (IEA 2021). This includes those who have been traditionally underserved by EE programs, such as low-income customers, communities of color, rural residents, and members of environmental justice and other marginalized communities.[3]

Members of these communities bear a disproportionate share of climate change impacts, including vulnerability to extreme weather and its resulting power outages (Watson et al. 2020; Benevolenza and DeRigne 2019). They also stand to benefit more than most from EE, particularly by virtue of reduced energy burden. If policies and programs are not well designed and braided together, however, aspects of climate-forward efficiency can exacerbate existing inequities. For example, electrification can shift the source of pollution from automobile tailpipes to centralized power plants, adversely impacting the air quality of surrounding communities, while electrification of space heating can leave those unable to afford electric heat pumps stranded on the natural gas distribution system, bearing a steadily increasing share of fixed costs (Billimoria and Henchen 2020; Bilich, Colvin, and O'Connor 2019).

[3] Environmental justice communities are those that have been "historically marginalized and overburdened by pollution and underinvestment" (Young, Mallory, and McCarthy 2021). Common indicators of environmental justice communities include a high percentage of low-income individuals, a high percentage of individuals of color, and disproportionate levels of pollution.

If stakeholders want to foster an energy system that fairly distributes benefits and burdens for all community members, then they need to agree on common goals and metrics for measuring progress. ACEEE's energy equity efforts draw on work from the Urban Sustainability Directors Network to identify four components of equity: structural, procedural, distributional, and transgenerational. To achieve structural equity, legislators need to reform existing institutions that have perpetuated historical inequities. To achieve procedural equity, community members must participate in—and actively hold equal leadership roles in—the decision-making process. Distributional equity refers to immediate benefits for all, while transgenerational equity ensures that future generations will also enjoy a fair distribution of benefits (ACEEE 2022). Recognizing these components of equity can help stakeholders correct past inequities while avoiding new ones.

Designing climate-forward policies and programs begins with inclusive, accessible, and authentic engagement and representation from all impacted communities.[4] Successful efforts will achieve a fair distribution of benefits and burdens, which includes prioritizing offerings for those with the greatest need. Responsible institutions will recognize and work to reverse the structures and dynamics that create chronic and cumulative disadvantages for marginalized communities, and they will ensure accountability for achieving equitable outcomes.[5]

Options to Advance the Strategy

Engage Communities and Stakeholders in Planning and Decision Making

Legislators, regulatory bodies, and other state agencies can deliver on procedural equity using a combination of comprehensive public stakeholder processes, generic proceedings for information gathering, technical conferences, and ongoing working groups. Regulatory proceedings that engage communities where, when, and how they are available will improve transparency, illuminate clear value propositions for participants, and smooth the pathway to equitable outcomes. Fair engagement with state intervenors is one way to ensure a more equitable decision-making process, as the intervenors often represent small businesses and consumer groups who lack sufficient resources to frequently share their perspectives (McGowan 2021; CPUC 2021).[6] Enabling intervenor compensation, as nine states have done, can help to ensure that organizations and individuals with limited budgets receive appropriate reimbursement for their involvement (Slocum 2021).[7]

[4] Direct engagement with underrepresented communities can offer benefits for policymakers and participating communities and customers, including the ability to create a shared knowledge base, identify shared priorities and areas of divergence, and land on more endurable solutions and approaches.

[5] Collectively, the principles articulated in this paragraph are referred to as procedural equity (representation during design and implementation), distributional equity (fair distribution of benefits), and structural equity (accountability for equity outcomes) (Ribeiro et al. 2020).

[6] *Intervenors* are parties with legal standing who contribute comments on formal proceedings.

[7] For another example, the City and County of Denver invited residents of the low-income neighborhood of Montbello to participate in hour-long interviews to learn about their priorities related to a range of issues that intersected transportation electrification, including the pandemic, racial injustice, and inequities they see in their community. In appreciation for their time, $50 gift cards were provided to participating residents (Leal 2020).

It is not enough for utilities to wait for program implementation to pursue equity; they must commit to procedural equity during the program design process. Equitable community engagement is not a one-way exchange of ideas, but rather a collaborative process in which utilities work alongside community members (Dewey, Mah, and Howard 2021). Utilities can establish trust with their customers by deferring to the community for decision making and consensus building (Koewler et al. 2020). They can use both marketing tools (e.g., customer segmentation, surveys, focus groups, data leveraging) and community engagement techniques (e.g., engagement, involvement, consultation, ownership) to bridge the gap between utilities and customers (González 2020). Engagement with marginalized groups should be accessible in terms of the language, location, and time of day in which they are offered. Decision-making bodies (e.g., working groups, committees) that give community residents a formal role are more likely to experience improved outcomes.[8]

Actions to advance the center equity strategy
engage communities and stakeholders in planning and decision making:

Quick wins: 0–2 years	**Medium term: 3–5 years**
→ All stakeholders initiate/participate in workshops and conferences on energy and equity to build awareness and coalitions → Advocates lay groundwork by recommending a set of minimum equity standards → Advocates put pressure on institutions that are not actively engaging with community members → Regulators and utilities establish mechanisms to engage with customers and communities in program design, resource planning, and procurement decisions → Legislators and regulators authorize intervenor compensation for meaningful participation	→ Utilities expand focus of community engagement to implementing and evaluating solutions identified by communities

[8] For more on achieving equitable outcomes in building electrification and adaptation in policies and programs see ECC and PODER (2020); Miller et al. (2019); Mohnot, Bishop, and Sanchez (2019).

Establish Equity Accountability Standards

State legislators should set performance standards to ensure that the costs and benefits of achieving climate goals are equitably distributed in accordance with community needs. These standards—which should also extend to any resource-specific policies—can take multiple forms, including minimum levels of investment, net benefits, or GHG reductions for environmental justice communities. For example, the Justice40 Initiative directs 40% of its benefits from federal investments to environmental justice communities. Under the initiative, clean energy and EE benefits include increased EE programs and reduced energy burdens (Young, Mallory, and McCarthy 2021).

At the state level, equity metrics and progress vary. So far, at least eight state governments have passed legislation that directly instruct utilities to consider or adopt equity goals. In Massachusetts, the Department of Public Utilities must prioritize equity while reducing GHG emissions. New York State's Climate Leadership and Community Protection Act has more explicit requirements to ensure that 35–40% of clean energy benefits go to disadvantaged communities (DACs) (Farley et al. 2021). Similarly, 21 states have minimum investment requirements for EE programs, and some utility electrification programs require that a certain percentage of benefits accrue to targeted communities (Howard et al. 2021; Berg and Drehobl 2018). Others have set targets to channel program funding through community-based or women/minority-owned businesses and organizations, such as the District of Columbia's requirement that the DC Sustainable Energy Utility spend 35% its contract through certified local businesses (District of Columbia Department of Small and Local Business Development 2022). Washington State has targets that ensure almost half of the carbon emissions reduction investments associated with the Washington climate commitment act provide direct and meaningful benefits to Indian tribes, vulnerable populations, and overburdened communities (Washington State Legislature 2021).[9]

[9] The law also requires that benefits for electric utilities from auctions of carbon dioxide allowances be used "for the benefit of ratepayers, with the first priority the mitigation of any rate impacts to low-income customers."

Actions to advance the center equity strategy ***establish equity accountability standards***:

Quick wins: 0–2 years	Medium term: 3–5 years
→ Utilities and implementers encourage individual and workforce training on equity, building training and growth into individual annual performance expectations for program managers and implementors → Where authority is available, regulators design metrics for performance incentives and goals, including minimum accountability standards for equity with data broken out by race → Regulators set utility requirements for securing a minimum amount of funding from diverse suppliers and/or community-based enterprises	→ Utilities submit for regulatory approval plans that detail how utilities will meet equity standards → Legislators or regulators build minimum equity standards into new state climate legislation/regulation → Legislators grant regulators authority to prioritize equity in setting requirements and performance standards

Collect Needed Equity Data

Regulators should select metrics that can measure utility progress toward meeting equity accountability standards. Stakeholders can use these metrics to better understand the extent of underserved communities, enabling decision makers to identify and adjust program resources to better serve them. Use of these metrics may require tracking and collecting new data sources regarding building conditions, local pollution, and other demographic information. Existing tools, such as California's CalEnviroScreen or the U.S. Department of Energy (DOE) Low-Income Energy Affordability Data (LEAD) tool, may be useful; otherwise, regional alternatives may need to be developed using more locally relevant data. Data transparency is also important. Once regulators have collected relevant program data, they can make it publicly available to help customer groups and other stakeholders stay informed about which measures have been taken and how utilities have factored in community input. Regulators can further incentivize accountability and robust data utilization by tying utility compensation (e.g., through performance incentive mechanisms, or PIMs) to performance on equity metrics. For example, a portion of Michigan's EE shareholder incentive is tied to lifetime low-income EE savings (Relf and Nowak 2018).

Actions to advance the center equity strategy ***collect needed equity data***:	
Quick wins: 0–2 years	**Medium term: 3–5 years**
→ Regulators set utility reporting requirements for key equity metrics for which they already have data → Regulators organize existing data to understand impacts on marginalized communities of color	→ Utilities and regulators track and assess progress on minimum equity standards, modifying processes as necessary → Based on collected data, utilities revise their programs to better serve low-income and marginalized communities

Examples

MAPPING DISADVANTAGED COMMUNITIES: CALENVIROSCREEN

The CalEnviroScreen tool identifies DACs in California based on a score that combines pollution exposure data (e.g., particulate matter), environmental effects (e.g., cleanup sites), population indicators (e.g., asthma), and socioeconomic factors (e.g., housing burden). DACs are defined as census tracts with the highest 25% of scores. Utilities have used CalEnviroScreen for programmatic decisions, such as building equity targets for the Transportation Electrification Framework and Building Decarbonization efforts (Kennedy 2020). The California Environmental Protection Agency used CalEnviroScreen for identifying the top 25% of census tracts that experience the highest air pollution levels. CalEPA then designated these areas as DACs, which made them eligible for beneficial GHG reduction projects funded by California's Greenhouse Gas Reduction Fund (OEHHA 2021).

ESTABLISHING EQUITY ACCOUNTABILITY IN CLIMATE LEGISLATION: WASHINGTON

Washington State passed a suite of bills from 2019–2021 that center equity in utility and state decarbonization. The 2019 Clean Energy Transformation Act (CETA), which requires utilities to reach carbon neutrality by 2030, includes requirements for identifying vulnerable communities and equitably distributing benefits. This includes funding for "energy assistance" and "direct customer ownership in distributed energy resources" to low-income households; the tangible goals are to reach 60% of eligible customers by 2030 and 90% by 2050. CETA also requires the Utilities and Transportation Commission to add equity and the social cost of carbon to its decision-making processes (Roberts 2019). The 2021 Climate Commitment Act (SB5126) "cap and invest" program is designed with community concerns in mind; access to offsets can be revoked if there are local air quality harms (Washington State Legislature 2021).

SET CLIMATE COMMITMENTS

Setting climate commitments gives utilities a practical goal to accomplish, which can inform their mid- and long-term planning. Achievable emissions reduction targets demonstrate awareness of cost-effective decarbonization solutions that will be in play decades or more in the future. This knowledge helps utilities take appropriate actions that will maximize emissions savings—and avoid actions that would compromise attainment of those goals. Given the massive role that the United States must play in decarbonization efforts, many state and local governments and an increasing number of utilities have created commitments and climate action plans for reducing emissions. These are often actualized through state and local policies and utility corporate investments.

Greater utility efforts are needed to translate a 1.5°C goal to tangible, cost-effective EE offerings. The boundaries between utility-wide targets (e.g., performance-based regulation) and EE program-level targets can be fuzzy, and it can be difficult to determine “where to draw the line.” Utilities may encounter political or regulatory headwinds to setting such goals, or they may fail to understand how to meet the opportunities or obligations inherent in a low-GHG future. They may feel that they do not yet have the data or metrics of success needed to act on climate commitments, which can sap enthusiasm and accountability for taking actions. But perhaps most importantly, commitments must include more than simply issuing goals. Most utilities that have pledged to reduce their GHG emissions are falling short of meeting those targets (Romankiewicz, Bottorff, and Stokes 2020). Utilities that commit to deep decarbonization should align processes through their organization, ensuring that those commitments become a key part of the utility mission and culture.

Options to Advance the Strategy

Establish Climate Targets

States and utilities can begin by setting complementary 1.5°C-aligned climate targets, with policy mandates that back up those commitments and set clear market signals.[10] State commitments can be an important first step because they are formal mandates that require utilities to decarbonize. Nonetheless, in states that have yet to set such targets, utilities can set their own commitments that align with a 1.5°C goal, as well as set interim milestones. Working together, states and utilities can identify policy drivers for efficiency and decarbonization (e.g., legislation, executive orders, commission orders), and ensure that those drivers remain aligned. For example, after Xcel Colorado set its own corporate target in 2018, the Colorado legislature built it into statute the following year through a requirement to review the company's Clean Energy Plan and integrated resource plans (IRPs) (Xcel Energy 2018; Colorado General Assembly 2019). To translate targets into tangible investments for utilities, states might also consider setting goals for the procurement of utility resources, including EE resource standards and clean energy standards or renewable portfolio standards. Such resource-specific standards can be updated as needed to match the criteria described in *The Need for Climate-Forward Efficiency* (Specian and Gold 2021).

Actions to advance the set climate commitments strategy ***establish climate targets*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ All stakeholders engage in robust public education campaigns explaining why they are making climate commitments and the ways they intend to meet them → Legislators and utilities set statewide/corporate climate targets aligned with a 1.5°C climate goal	→ Regulators approve new EE frameworks that align programs and metrics of success with state and utility climate and equity commitments

[10] For an accounting of GHG emissions targets by state, see C2ES (2021).

Clarify Regulatory Responsibilities

The specific role of utility regulators varies by state. While most regulatory commissions are charged with ensuring reliable delivery of electricity and just and reasonable rates, fewer are explicitly accountable for meeting environmental goals. State legislators can strengthen climate-forward efficiency by explicitly redefining or clarifying the responsibilities of their PUCs to extend beyond economic regulation to include protecting the environment, mitigating climate risk, preserving equity, and maintaining public health. For example, Mississippi's legislature has encouraged its commission "to take every opportunity to advance the economic development of the state" and avoid "wasteful, uneconomic and inefficient uses of energy" (Mississippi PSC 2019), steps that are supportive of climate-forward efficiency. Maryland took a stronger step in May 2021, updating the charge of its Public Service Commission to consider climate change and fair labor standards as part of utility regulation; it also required the commission to consider whether its actions are consistent with state climate commitments (Maryland General Assembly 2021).

Actions to advance the set climate commitments strategy
***clarify regulatory responsibilities*:**

Quick wins: 0–2 years

- Legislators pass legislation that explicitly establishes climate-forward goals such as GHG reductions, environmental protection, and equity as part of their state's regulatory mandate

Set EE Program Goals and Investment Plans That Align with Climate Commitments

Utilities should translate state climate mandates or their own corporate decarbonization commitments into targets for their demand-side management portfolios. Since these mandates usually cover all utility operations, utilities can determine the share of emissions reductions achievable through both supply- and demand-side interventions, then identify the extent to which different customer EE programs will be able to deliver those reductions for their service territory.[11] Utilities can then validate the soundness of their calculations by leveraging quality climate models, possibly with the assistance of expertise within state environmental agencies.

Because GHGs have a cumulative impact on climate change, utilities would do well to set interim targets that minimize GHG emissions enroute to meeting their overarching decarbonization goal. These determinations can be aided by engaging the expertise of non-utility partners, including program administrators, implementors, and community-based organizations. By identifying major

[11] A potential model is that of Brown et al. (2021), which offers a framework for developing localized carbon reduction strategies from foundational global and national decarbonization work.

interactions in each utility region (e.g., the connection between transportation electrification and carbon reductions given the grid's carbon intensity), stakeholders can create high-quality studies that quantify potential GHG reductions given their state's definition of EE.[12]

With clear goals in hand, utilities can build IRPs and distribution system plans (DSPs) that are aligned with meeting those goals. Key plan elements should include EE, demand flexibility, and end-use electrification. Such plans should account for cost, either through a measure of relative climate return on investment or another tool for cost-effectiveness screening or decision making as determined by regulators (see for example, Woolf et al. (2020)). Where an IRP or DSP is not required, legislation or rules may be necessary to ensure that plans are updated regularly to enable adjustments. Regulators should have oversight over, and the ability to modify or reject, plans that are inconsistent with state policy or utility GHG commitments.

Actions to advance the set climate commitments strategy
set EE program goals and investment plans that align with climate commitments:

Quick wins: 0–2 years	Medium term: 3–5 years
→ Utilities collaborate with their program administrators, implementors, state environmental agencies, and other stakeholders to translate decarbonization goals into demand-side management (DSM) targets → Utilities publish roadmaps with interim DSM targets that detail the decarbonization contributions of different EE technology categories while accounting for interactive effects between efficiency solutions and supply-side reduction costs, and ensuring equitable distribution of costs and benefits	→ Regulators evaluate utility projects to verify the extent to which electric system reliability is maintained while delivering climate-forward efficiency → Utilities engage in integrated planning activities to drive an orderly transition to electrification, properly accounting for EE's capability to right-size infrastructure → Regulators in states with new decarbonization mandates promulgate new rules for utility compliance → Legislators, regulators, and utilities regularly update climate-forward efficiency policies and programs to accommodate changing penetrations of renewable energy and improved integration of demand-side resources (5+ years)

[12] If electrification is included as a form of energy efficiency, for example, regulators may determine that setting annual savings targets as a fraction of annual retail electric sales is no longer appropriate, as massive load growth could make it impossible to meet those targets.

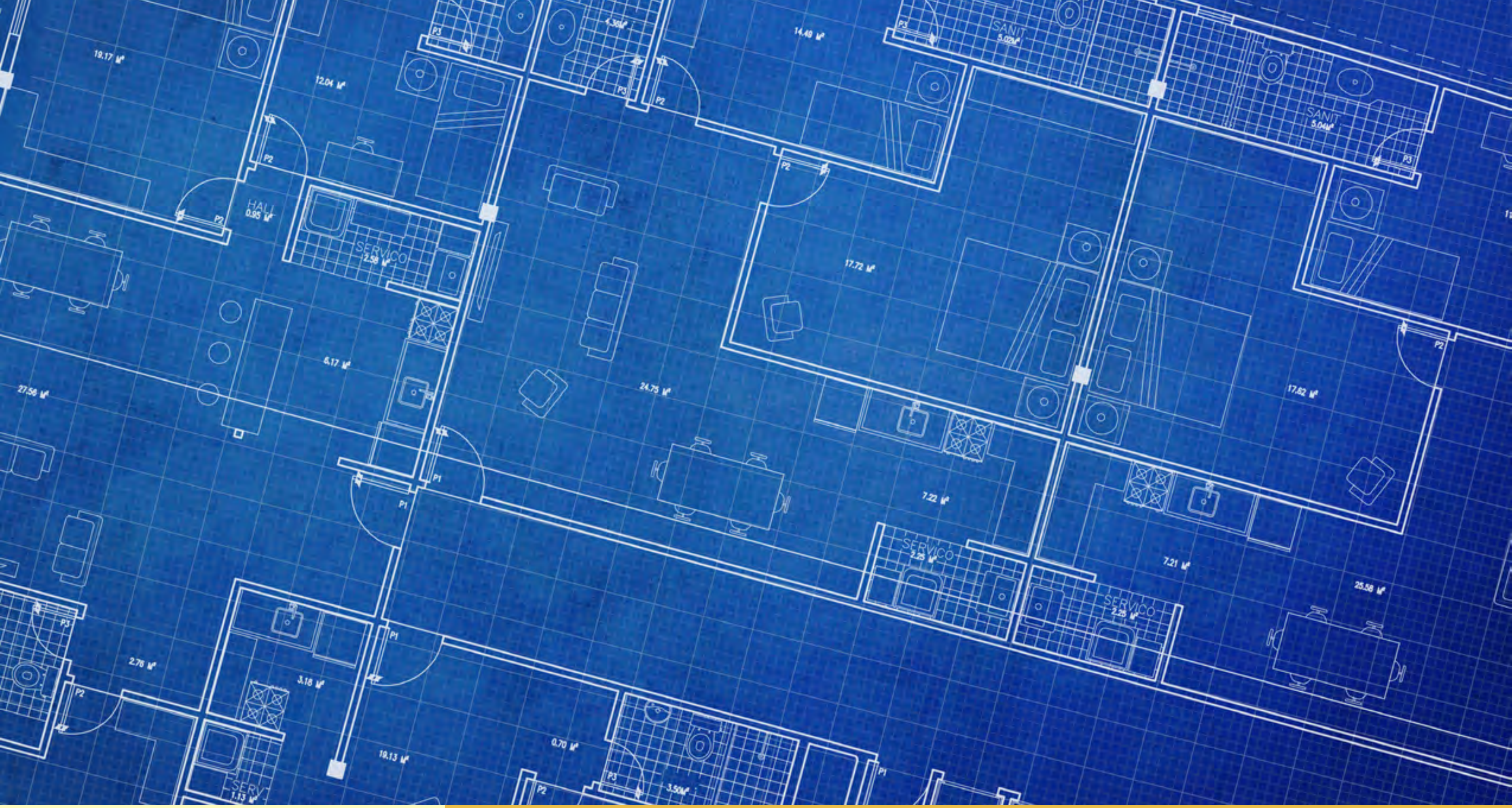
Examples

ILLINOIS CLIMATE AND EQUITABLE JOBS ACT

In 2021, the State of Illinois passed the Clean and Equitable Jobs Act, which establishes a statewide goal of 100% clean energy by 2050 and lays out policies to achieve it (Illinois Office of the Governor 2021). EE is a key pillar of the bill's framework, alongside beneficial electrification, peak demand reduction, renewable energy, and energy storage. Demand-side EE provisions include substantial increases in low-income or income-qualified utility EE spending, the allowance of beneficial electrification under EE programs, funding for EE workforce training, and an opt-in building energy stretch code.

XCEL MINNESOTA ALTERNATE INTEGRATED RESOURCE PLAN

Xcel Energy has committed to reducing carbon emissions by 80% from 2005 levels by 2030, reaching 100% carbon-free electricity by 2050. In addition to significant reductions in supply-side emissions through coal fleet retirement and renewable energy additions, its IRP includes significant contributions from demand-side management. This includes greatly increased levels of EE, with average annual energy savings targets of more than 780 GWh and 400 MW of incremental DR resources (Xcel Energy 2021). Xcel proposes to achieve 2–2.5% energy savings annually, which exceeds the 1.75% goal established as part of Minnesota's ECO Act (Minnesota Legislature 2021).



POLICY ALIGNMENT STRATEGY

UPDATE GUIDELINES FOR RESOURCE ELIGIBILITY AND VALUATION

Many utilities face barriers that impede access to customer decarbonization solutions. These barriers include limits on the resources eligible for ratepayer-funded utility support and challenges in capturing the full range of benefits from climate-forward efficiency (including climate mitigation and adaptation).

Most states limit the definitions of eligible EE resources to a set that excludes viable decarbonization options. Other states explicitly prohibit utilities from deploying certain energy conservation measures. These restrictions are often the result of longstanding state rules. Examples of excluded options include those that replace fossil-fueled technologies with more-efficient electric technologies such as heat pump water heaters and electric heat pumps.

In addition to expanding the definitions of eligible measures, states and utilities should consider whether and how to incentivize new efficiency appliances such as furnaces, boilers, and water heaters that use fossil fuels (e.g., natural gas, fuel oil, and propane). While these measures may produce immediate reductions in fossil fuel use—and attendant GHG reductions—those savings will need to be compared against the potential to “lock in” the emissions stream over the device’s lifetime where lower-carbon options for electrification are available (Billimoria and Henchen 2020).

Advancing climate-forward efficiency will also require reform to CETs, which often fail to fully capture beneficial program impacts[13] [14] and can thus prevent technologies or program approaches from being included in a utility's portfolio of offerings. ACEEE surveys have found that existing tests are inconsistently applied across states, which motivated the publication of a recommended set of benefit-cost analysis principles in the *National Standard Practice Manual for Benefit-Cost Analysis of DERs (NSPM)* (NESP 2021). The *NSPM* lays out a general process that states and others can follow to incorporate their policy goals into CETs.[15] Its publication has sparked valuation conversations in multiple states, resulting in revamped tests. States interested in pursuing climate-forward efficiency can use the *NSPM* process to develop jurisdiction-specific tests that align with their policy goals.

Fully valuing EE faces some headwinds. In many regions, traditional system benefits are falling along with growing renewable energy generation and low natural gas prices. Some consumer advocates are concerned about rising costs of DSM and rate impacts, even as EE remains the least-cost resource on average (Cohn 2021). Moreover, for many communities, cost-effectiveness conversations tend to be inaccessible, which compromises their robust representation in reform discussions. In addition, some commissions and intervenors have historically expressed skepticism about evaluators' ability to measure nonenergy impacts with the same "accuracy" level as other impacts. As a result, many regulators consider it inappropriate to use valuations of nonenergy impacts in system planning.

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[13] Cost-effectiveness testing primarily establishes a "go/no-go" criterion for energy efficiency programs or portfolios. This is distinct from the crucial task of establishing the objectives around which utilities optimize their portfolios.

[14] Many standard cost tests—including the total resource cost (TRC) test, utility cost test (UCT), participant cost test (PCT), and ratepayer impact measure (RIM) test—fail to account for the impacts EE offers in the form of reduced emissions. A societal cost test (SCT) can account for these impacts, but only if the state requires the proper inputs.

[15] This includes accounting for EE's nonenergy benefits, such as decarbonization. About two-fifths of U.S. states have included the value of carbon emissions in their CETs, though often not at a high enough level to drive appropriate screening and selection of decarbonization measures.

Options to Advance the Strategy

Redefine the efficiency measures that ratepayers can support

Legislators (and some regulators, depending on location) can update EE definitions in their legislation or rules to ensure that all climate-forward efficiency resources can be included in utility portfolios. They can also repeal bans on efficient fuel switching and programs that reduce (or replace) unregulated fuels. For example, in 2018, Massachusetts took steps to enable reductions in unregulated fuel consumption to count toward Btu energy savings targets (Massachusetts General Court 2018). In 2019, California adjusted its rules to allow for more-efficient fuel substitution of gas for electric technologies (CPUC 2019). In 2021, Illinois made building beneficial electrification measures allowable under EE programs, and required that at least 25% of all electrification savings go to income-qualified customers (Illinois General Assembly 2021). Such changes can make a wider range of measures eligible for updated targets and metrics of success; they can also make these measures eligible for PIMs that align with GHG reduction.

Actions to advance the update guidelines for resource eligibility and valuation strategy ***redefine the efficiency measures that ratepayers can support*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ Advocates initiate conversations or proceedings to update eligibility for EE, including electrification, through case studies and education/raising awareness among stakeholders about the need to shift	→ Where needed, legislators introduce and pass state legislation to address eligibility barriers for climate-forward efficiency, such as removing fuel-switching restrictions → Utilities and regulators break down silos across program design, funding and evaluating distributed energy resources (DERs) to enable focus on whole buildings and GHG or MMBtus → Utilities and regulators expand needed data, platforms, and telemetry across DERs, distribution utilities, and wholesale market operators

Reform Cost-Effectiveness Testing

Regulators can reform cost-effectiveness testing to update how utilities value climate-forward efficiency. Such reforms can also ensure that valuation uses best practices and supports state climate goals by delivering the most cost-effective, fuel-neutral decarbonization measures available. Cost-effectiveness tests (CETs) should account for the value that EE provides in the form of reduced GHG emissions, health benefits, and climate change resilience. In states where a robust accounting is not possible, an alternative step might include replacing the most common total resource cost (TRC) test, which often fails to fully account for the benefits efficiency delivers to program participants, to a utility cost test (UCT) that more fairly compares efficiency programs' costs and benefits (albeit only to the utility system).[16]

Another option is to offer cost-effectiveness testing flexibility or exemptions for low-income programs, as 42 states have done (Berg et al. 2020). States could, for example, choose to replicate California's decision to separate its EE portfolio into segments and lift the cost-effectiveness requirement for segments that deliver non-GHG climate-forward efficiency benefits, such as equity.

Deeper reforms can use the *NSPM* process to decide which benefits and costs of state policy goals (e.g., climate mitigation and adaptation through avoided CO_2 and customer resilience) to include in the test. With further changes to program and market designs, valuation can change from a go/no-go CET filter to a more robust market signal.

Actions to advance the update guidelines for resource eligibility and valuation strategy ***reform cost-effectiveness testing:***

Quick wins: 0–2 years	Medium term: 3–5 years
➜ Advocates develop and share case studies of states that have modified CET to reflect their policies and apply consistent benefit-cost analyses across all DERs ➜ Regulators require utilities in IRPs and DSM proceedings to make their key avoided-cost input data transparent ➜ Legislators or regulators initiate proceedings or legislation to revisit avoided-cost assumptions and processes ➜ Utilities propose new forms of valuation to PUCs and support relevant legislative action	➜ Utilities and regulators integrate regulatory proceedings to focus on common valuation end points (e.g., system value plus the social goals of decarbonization) ➜ Regulators set new benefit-cost analysis rules that fully capture the benefits of EE programs ➜ Utilities expand potential studies to address electrification and DERs without being constrained by outdated assumptions that exclude or undervalue GHG reductions and other nonenergy benefits

[16] In many cases, the UCT permits more EE than the TRC, particularly if the TRC is asymmetrical (i.e., counting all participant costs, but not all participant benefits). In these cases, even though the UCT looks only at utility system costs, its simplicity makes it easier to defend to regulatory commissions, and therefore allows for more EE to occur.

Analyze the Role of Efficient Gas Appliance Incentives in Decarbonization

State regulators should conduct analyses to understand the tradeoffs between short-term GHG reductions, which could result from more-efficient natural gas technology measures, and the long-term GHG reductions that would be lost by locking-in natural gas infrastructure for (potentially) 20 years or more. Such analyses must consider multiple factors, including the condition of the local building stock, electricity and gas rates, market impacts on lower-carbon technologies, potential utilization of renewable natural gas, and impacts on equity. Utility programs that incentivize efficient natural gas appliances as a bridge between inefficient legacy systems and electric heat pumps could undermine the heat pump transition's cost effectiveness by reducing the achievable savings. A couple states have begun scaling back incentives for gas appliances while maintaining support for gas utilities to improve building envelopes.[17] In addition, some gas utilities have proposed hybrid or "dual-energy" approaches that use heat pumps as the primary heating source and natural gas heaters as cold temperature backups (St. John 2021).

Actions to advance the update guidelines for resource eligibility and valuation strategy ***analyze the role of efficient gas appliance incentives in decarbonization***:

Quick wins: 0–2 years	Medium term: 3–5 years
➜ Regulators create a framework for local analysis of the GHG impacts of natural gas EE versus electrification in buildings ➜ Advocates initiate conversation about the role of natural gas efficiency in climate mitigation and adaptation	➜ Legislators and regulators initiate proceedings to give guidance on natural gas EE with respect to GHG reductions, taking state/utility commitments into account

[17] Envelope improvements can reduce heating loads, improving resilience and paving the way for electrification.

Examples

EXPANDING THE DEFINITION OF EFFICIENCY IN MINNESOTA

To address barriers to efficient fuel switching in its existing statute and practices, Minnesota passed the Energy Conservation and Optimization (ECO) Act, which expanded the set of measures utilities could support through ratepayer-funded efficiency offerings (Minnesota House of Representatives 2021). The ECO Act allows cost-effective load management and fuel switching measures when they result in a net decrease in source energy consumption. To address concerns regarding the bill's impact on propane interests, the law includes limits through 2026 on the degree to which fuel switching can count toward savings goals and be funded by ratepayer dollars. The Minnesota Department of Commerce will promulgate rules for implementing the new statutory requirements.

ADJUSTING THE ROLE OF EFFICIENT FOSSIL-FUEL-BASED APPLIANCE INCENTIVES IN MASSACHUSETTS

In its recent 2022–2024 proposed plan, Massachusetts program administrators attempted to balance analysis of both cost effectiveness and GHG concerns associated with efficient gas, fuel oil, and propane appliances. Over the three year period, their plan proposes to phase out incentives for some measures, such as central air-conditioning systems that are not heat pumps, and to immediately eliminate incentives for replacing condensing natural gas and propane heating systems with new condensing systems. However, the plan will continue offering residential incentives for condensing and efficient condensing oil furnaces as long as baseline data continue to show there are still material cost-effective savings and benefits to be realized (MA EEAC 2021).

POLICY ALIGNMENT STRATEGY

REFORM UTILITY BUSINESS MODELS

Several features of current utility business models disincentivize the acquisition of all available decarbonization options. The first is *throughput bias*, which arises because utility revenues are largely based on energy sales—that is, the more a utility sells, the more it earns. As a result, dual fuel or gas utilities are disincentivized from pursuing beneficial electrification. The second is capital expenditure, or *capex bias*, which arises because utilities can grow their rate base through capital expenditures—the very expenditures that EE often makes unnecessary.[18] Through revenue decoupling, which allows utilities a fixed rate of return independent of their sales volume, and PIMs, which can reward utilities for meeting efficiency targets, both of these biases can be ameliorated.

Even where business model reforms have taken place, however, they have been designed with earlier objectives—such as least-cost procurement—in mind. They therefore may need to be reexamined and updated to align with climate commitments. For example, many efficiency PIMs encourage net benefits or incremental annual savings; these may be more appropriately measured in lifecycle GHG reductions (Relf and Nowak 2018).

[18] Capex bias refers to a tendency for utilities to favor capital expenditure solutions over operating expenditure solutions (CEPA 2018).

Conventional rate design may also limit climate-forward efficiency by obscuring signals about the true costs on the grid and in the gas system. Movement toward larger demand charges for residential customers can provide perverse signals and hurt the economics of many climate-forward efficiency resources—such as heat pumps and EVs—that increase electric usage (Baatz 2017). A better alternative may be time-varying rates, which can reflect system costs and direct consumption toward low-carbon hours, encouraging both efficiency and electrification. Higher customer charges ("fixed charges")—and therefore lower volumetric charges—would also likely reduce costs for those who electrify, but they also introduce an anti-conservation bias that could compromise EE. While ratepayer funding is not the only funding source, it is important that utilities have the right set of incentives to drive and scale all forms of climate-forward efficiency.

In many places, EE is still not considered a grid resource on par with other resources (e.g., generation) even though it is often less expensive. The result is that EE is being "left on the table" during utility procurement. With approximately $70 billion in planned natural gas power plant investment through the mid-2020s, and a comparable amount in new gas pipelines, there are substantial financial resources at play in service of our energy future. Reforms to reinvigorate use of EE as a resource can create a platform for sustainable funding through procurement that acknowledges the values that EE brings to a climate-forward system; this will only occur, however, through real changes in how utilities view climate-forward efficiency within their business.

Options to Advance the Strategy

Establish or Update Revenue Decoupling

To mitigate utilities' throughput incentive, regulators can institute cost recovery reform through revenue decoupling. This decoupling provides utilities with revenues at a level approved by their regulator, regardless of the amount of kWh or therms they sell.[19] Decoupling removes the incentive for utilities to increase sales volume or to pursue nonbeneficial electrification, such as by promoting measures for inefficient electric resistance heating systems. As beneficial electrification increases utility sales, decoupling dispenses the excess revenue back to customers more quickly than the alternative (i.e., waiting until benefits materialize through more favorable rates), which is a distinct benefit for energy burdened customers. However, decoupling is not a one-size-fits-all policy, and the design of mechanisms matters a great deal in determining its success; such mechanisms may need to be updated to align with climate commitments. For example, revenue-per-customer decoupling for gas utilities may encourage system expansion, whereas adjustments based on total sales volume may better align with GHG reduction commitments and requirements (Billimoria and Henchen 2020).[20]

[19] Eighteen and 26 states have adopted decoupling for electric and gas utilities, respectively (NRDC 2018).

[20] When decoupling is conducted on a per-customer basis, utilities retain the incentive to add customers to their system.

Actions to advance the update guidelines for resource eligibility and valuation strategy ***establish or update revenue decoupling***:

Quick wins: 0–2 years	Medium term: 3–5 years
→ Legislators or regulators initiate (where needed) proceedings to examine misalignments in the utility business model with climate mitigation and adaptation → Regulators or analysts conduct data collection and analysis on decoupling	→ Regulators reevaluate cost recovery formulas to identify and address any misalignments with climate-forward efficiency and decarbonization targets → Regulators implement reforms to address lost revenue recovery

Consider Performance Incentive Mechanisms that Align Performance with GHG

Regulators can also establish PIMs that create a financial incentive for utilities to achieve desired outcomes in line with climate-forward efficiency. These PIMs might include GHG reductions, improved equity outcomes, and electrification indicators (e.g., number of electric heat pumps or EVs sold). While 16 states have EE PIMs in place, most are designed around first-year kWh or therms savings.[21] In some jurisdictions, the limited scope of regulatory authority may require PIMs to be enabled by legislators or proposed by utilities before regulators can take action to approve them.

Actions to advance the update guidelines for resource eligibility and valuation strategy ***consider PIMs that align performance with GHG***:

Quick wins: 0–2 years	Medium term: 3–5 years
→ Regulators or analysts conduct data collection and analysis on PIM effectiveness → Legislators and regulators enact shifts in EE performance incentives to align with climate-forward efficiency → Utilities appeal to investors who are interested in addressing climate risk	→ Legislators and regulators redesign PIMs to focus on carbon-based targets (or other broader measures of value) → Legislators and regulators implement key business model reforms to incorporate PIMs

[21] Current PIMs also contain examples of lifetime kWh or therms goals, as well as peak reduction goals to accelerate demand flexibility (Relf and Nowak 2018).

Reform Rate Design to Benefit Customers and Grid Decarbonization

Regulators can help scale climate-forward efficiency measures through innovative rate designs. Such rate designs include prices that vary based on time of day and season (e.g., critical peak pricing, time-of-use rates) and reflect both the grid's carbon intensity and the time-varying costs of delivering electricity. Rate design could also encourage customers to take advantage of excess renewable energy, perhaps through electrochemical or thermal storage, which can help avoid curtailments or additional investment in utility-scale storage. Customers who electrify with GEB technologies can benefit from their load shifting capability through lower off-peak rates, and the financial savings customers earn through their provision of grid services can improve the economics of their GEB technology purchases. Regulators should also consider the allocation of fixed and volumetric charges on customers' bills. Lower volumetric charges can incentivize beneficial electrification, while higher volumetric charges can incentivize solar production when coupled with net metering (Billimoria and Henchen 2020). Other innovative rate design options, such as subscription models (e.g., unlimited EV charging between midnight and 6 a.m. for a fixed monthly fee) should be considered to strategically shape customer load toward emission reductions. Regulators would be wise to consider the equity implications of any proposed reforms, as low-income customers unable to take advantage of novel rate designs may be stuck with uneven or less affordable energy bills.

Actions to advance the update guidelines for resource eligibility and valuation strategy ***reform rate design to benefit customers and grid decarbonization***:

Quick wins: 0–2 years	Medium term: 3–5 years
➔ Regulators clarify which policy objectives should be reflected in rate design, and then evaluate proposed rates accordingly ➔ Regulators authorize or require utility pilots of promising rate option(s) and design with scaling in mind ➔ Where pilots have been completed, regulators adjust designs based on learnings and launch broader adoption efforts, including default rates where appropriate[22] ➔ When possible, utilities use existing authority to propose reforms directly in rate cases	➔ Regulators default rates to climate-aligned rates, with easy ways to switch to customer-specific options, building on learnings from pilots

[22] For more details on these actions see, for example, Cross-Call, Li, and Sherwood (2018).

Adopt New Procurement Models

Utilities can adopt (or regulators can require) new procurement models that use technology- and ownership-neutral methods to ensure that they procure the most cost-effective and climate-aligned portfolio of resources, including climate-forward efficiency. These can include competitive requests for proposals (RFPs), auction mechanisms, and resource-specific procurements at the bulk or distribution level (Shwisberg et al. 2021). Such procurement policies may need to be paired with financial incentives (e.g., shared savings mechanisms) to make the utility indifferent to procurement of capital versus noncapital assets or to utility versus nonutility ownership. Examples of cost-effective, climate-aligned resources include virtual power plants composed of a portfolio of complementary resources including grid-interactive smart thermostats, EE, demand response, distributed generation, and storage.

Actions to advance the update guidelines for resource eligibility and valuation strategy ***adopt new procurement models***:

Quick wins: 0–2 years	Medium term: 3–5 years
➔ In states with ambitious climate goals and decoupling, utilities revisit details of mechanisms to support planned growth in electrification alongside resource-specific efficiency ➔ Utilities with near-term procurement opportunities design procurement to put climate-forward efficiency on an even playing field ➔ Regulators encourage or require utility IRPs to allow EE and DERs to be selected as preferred resources	➔ Legislators and regulators shift rules to require procurement of climate-forward efficiency on a level playing field, and institute necessary business model reforms to support ➔ Utilities re-engineer their business models to focus on energy service delivery rather than volumetric sales (5+ years)

Examples

GHG PERFORMANCE INCENTIVE MECHANISMS: XCEL ENERGY MINNESOTA

Minnesota utilities have had the opportunity to earn a shared benefit incentive for achieving electricity and gas savings since 1999. These incentives remain, but the performance-based regulation process initiated in 2017 is creating a complementary set of tracking metrics for environmental performance. These metrics, which are a mix of direct measures and proxies, include: 1) total carbon emissions by utility-owned facilities and PPAs; 2) total criteria pollutant emissions; 3) criteria pollutant emission intensity (emissions/MWh); 4) CO_2 emissions avoided by transportation electrification; and 5) CO_2 emissions avoided by electrification of buildings, agriculture, and other sectors (Minnesota PUC 2019). These metrics will enable regulators to identify where utility performance may warrant new financial incentives, as well as inform the baselines for potential future metrics (Goldenberg et al. 2020).

OUTCOME-BASED AMORTIZED INCENTIVES

Migden-Ostrander and Kushler (Migden-Ostrander and Kushler 2020) propose that policymakers create “outcome-based amortized incentives.” This reform combines two mechanisms with the capability of advancing climate-forward efficiency: multifactor PIMs and amortized recovery of incentive payments. The PIMs would provide utilities with a return or incentive based on meeting targets tied to GHG, equity, or other climate-forward goals. Amortization would allow the efficiency program costs to be recovered over a period of years, better aligning their timing with the appearance of their benefits (i.e., more akin to supply-side resources), as well as reducing system costs and lowering bills for program participants.

MARKET PREPARATION STRATEGY

UNLOCK NECESSARY DATA

Planning, implementing, and evaluating climate-forward efficiency programs will require more types of data—including avoided-cost and emissions data, measure load shape and lifetime data, and customer usage information—at a higher resolution than traditional EE programs. According to a Natural Resources Defense Council analysis, efficiency portfolios that prioritize measures based on both the economic value of meeting energy system needs *and* the monetary value of meeting policy goals are capable of delivering three times more benefits through lower electric rates and avoided GHG emissions than portfolios that achieve the same annual energy savings but lack that dual prioritization (NRDC 2020).[23]

The carbon intensity of delivered electricity avoided by EE varies based on the availability of renewable energy at different times and locations. To make effective planning decisions, such data must be frequent enough to capture significant changes in the grid's generation mix—generally on the order of 15 minutes or less. Typical methods of converting energy savings to GHG reductions multiply the grid's annual average carbon intensity (i.e., kg CO_{2e} / kWh) by annual energy savings (i.e., kWh); in so doing, however, they miss the value of avoiding electricity consumption whose marginal emissions intensity differs by season and time of day. This approach thus risks overvaluing measures, such as lighting, that deliver best on average, while undervaluing measures, such as HVAC, that deliver better on the margin during high emissions-intensity times.

[23] The Natural Resources Defense Council demonstrated this result using hypothetical combinations of real energy efficiency measures in both California and the Pacific Northwest, each of which achieved the same annual energy savings goal.

Energy savings load shapes for measures across customer classes are also crucial for effective planning and investment. The impact of GHGs on climate change is cumulative, so accurate measure-life data are also required to prioritize between different climate-forward efficiency and supply-side options. Forecasts of the grid's carbon intensity and high resolution avoided-cost data will also be required to quantify the benefits of those measures.

Currently, many of these data are of low quality, not publicly available, or simply nonexistent. The frequency at which data must be collected depends on the task; for example, real-time data will be needed for performance-based programs and evaluation, while forecasted data will be needed for program design and long-term portfolio planning. To collect, store, and process those data, utilities will need advanced data analytics capabilities. This may require hardware to collect data (e.g., advanced metering infrastructure (AMI)), new relationships or arrangements to acquire data collected elsewhere (e.g., emissions data from RTO/ISOs), and new algorithms to make sense of data (e.g., load disaggregation software, open source software platforms).

Data privacy and cybersecurity concerns loom large. Building on the experience of leading states that have tackled these issues (e.g., New York, California, and Texas), regulators and utilities may need to resolve questions about who owns customer consumption data, and adopt and abide by strict data privacy rules (especially for nonprogram participants) or risk undermining support for the programs.

Options to Advance the Strategy

Increase Secure Access to and Use of Energy Consumption Data

Regulators can approve and encourage the use of energy consumption data to improve climate-forward programs and their evaluation. If the appropriate software solutions are in place, interval data (e.g., from AMI) can be disaggregated into individual end uses, revealing opportunities to address loads correlated with the grid's carbon-intensive periods. These insights may facilitate more effective targeting by identifying customers who are able and likely to participate and reduce emissions significantly through EE programs, which can boost program savings and cost effectiveness. When shared with customers in a personalized manner (e.g., through online portals and applications, text messages, email), these insights can provide customers with actionable information needed to reduce carbon footprints. These insights can also provide more rapid feedback to evaluate and improve on active programs.

To take proper advantage of interval consumption data to enable decision making about climate-forward efficiency, utilities will need to expand their capabilities in data science, cybersecurity, and data-driven marketing. Policymakers and regulators should also consider lowering barriers that impede customers from sharing their energy data with third-party vendors who may be able to deliver innovative programs. Regulators can require that utility proposals involving AMI include plans for the effective use of customer data. This includes a demonstration of how these data will lead to cost-effective emissions reductions while simultaneously maintaining cybersecurity and privacy standards. States can consider performance incentive options that compensate utilities for effective use of (AMI) data in meeting climate-forward efficiency goals, as in Hawaii's AMI utilization PIM.

Actions to advance the unlock necessary data strategy
***increase secure access to and use of energy consumption data*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ Regulators from leading states share case studies of model data access and privacy practices → Advocates specify the type of data that they want utilities to make available to the public → In states with pending AMI applications, regulators approve or request AMI applications with clear business cases that deliver customer and system benefits → Regulators in states with AMI proposals create data access polices to enable clean energy use cases during approval process	→ In all states, legislators and regulators work with stakeholders to define clear privacy and cybersecurity rules for handling customer data → Utilities without advanced metering propose investments with clear business cases that deliver customer and system benefits

Obtain High-Resolution Marginal Emissions Data

States can take steps to ensure that high-resolution forecasted and real-time marginal emissions data are available for utilities to design and evaluate effective climate-forward efficiency programs. These data could be simulated (e.g., through predictive modeling) or real. If simulated, the algorithms should be open source and the inputs should be nonproprietary. If real, regulators and market monitors will need to examine the extent to which access to public emissions data could lead to market manipulation, and then develop mechanisms to mitigate negative outcomes. The level of resolution required will vary from region to region, with greater resolution required where emissions vary on smaller timescales. So, states and utilities will need to balance the increased cost of more-granular data with the need to provide data at the highest resolution feasible to ensure the accuracy of the resulting avoided-emissions calculations. Publicly available tools that can help quantify the emissions benefits of energy conservation, such as the Environmental Protection Agency AVERT or DOE Cambium tools, should be reviewed and used as appropriate (EPA 2021; NREL 2021a).

Actions to advance the unlock necessary data strategy
***obtain high-resolution marginal emissions*:**

Quick wins: 0–2 years	Medium term: 3–5 years
➜ Utilities leverage publicly available sources of emissions intensity data to estimate emissions reductions in planning, evaluation, and reporting	➜ Utilities work with wholesale market operators to develop marginal emissions factors for use in metrics and avoided costs (if they do not collect these data directly) ➜ Advocates use emissions data to hold accountable utilities that are not doing enough to meet their GHG reduction goals

Leverage Avoided-Cost Data

Planners can use avoided-cost calculators to identify the costs that utilities, program participants, or society would avoid through climate-forward efficiency investments. In many states, however, avoided costs are redacted or not available with sufficient granularity for analysis; even fewer are based on projections about which resources are needed to meet state policy goals. Opening these assumptions and methodologies for public (or at a minimum, intervenor) review can lower the bar for stakeholders to ensure that avoided costs align with decarbonization goals and can be used for climate-forward decision making. Specifically, when granular avoided-cost data are available, planners can better identify gaps in EE program deployment, enabling targeted interventions that meet demand *and* emissions reduction needs (NEEP 2021). Utilities and regulatory commissions may have limited perspectives, so a more open process can support better price discovery and decision making based on the latest data.

This level of openness is especially valuable if a state uses a metric like California's new total system benefit, which relies on an analysis of all cost-effective EE to set goals based on an avoided-cost calculator. Yet the benefits of openness also extend beyond state borders. Transparent avoided costs enable stakeholders developing programs in one state to more easily identify other jurisdictions in which their solutions will be deemed cost effective, thereby helping climate-forward efficiency programs to scale.

Actions to advance the unlock necessary data strategy ***leverage avoided-cost data***:

Quick wins: 0–2 years	Medium term: 3–5 years
→ Utilities or regulators in states with climate goals conduct analysis to align avoided costs with the power sector changes needed to meet climate goals → Regulators review redaction rules to allow necessary avoided-cost data to help the public or intervenors offer useful input about planning and investment	→ Regulators in regions/states with redacted avoided-cost data initiate proceedings to review data sharing practices in relevant dockets → Federal agencies establish a national data platform so avoided costs from states, utilities, and other regions can be conveniently updated and accessed by market entities

Improve Measure Shape and Life Data

Resource and distribution system planning require accurate data about current and projected loads for major groups of customers and end uses. In addition, for climate-forward efficiency measures to serve as resources, planners require information about the seasonal and hourly shape of savings for major end uses and technologies and how those savings develop over time. EE planners in many locations already have processes to update technical reference manuals on a regular basis; these may need to be updated to prioritize measures targeting GHG reductions rather than energy savings. In locations with AMI data, planners can use meter-based savings protocols in pay-for-performance programs to support better forecasting estimates. Where such data are not available, utilities might consider drawing from the DOE's calibrated, validated end-use load profiles for the U.S. building stock (NREL 2021b).

Actions to advance the unlock necessary data strategy
***improve measure shape and life data*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ Regulators, utilities, or local EE collaboratives initiate processes to update technical reference manuals on a regular basis to reflect measures' GHG reduction potential	→ Utilities leverage AMI and other data sources to improve on existing research on end use load profiles and load-savings shapes

Examples

SCE HOUSEHOLD CONSUMPTION DATA

Southern California Edison shared with researchers from the University of California, Davis, and the University of California, Berkeley, household-level electricity consumption data before and after those customers received a rebate for installing a new energy-efficient central air conditioner. Researchers found that those households experienced a 13% decrease in electricity consumption during July and August (and less in off-peak months), leading to what the authors call a *timing premium* for the technology (Boomhower and Davis 2019). Researchers did not identify similar timing premiums for other technologies such as clothes washers, refrigerator, and lighting. Without the open sharing of data by the utility, these insights would not have been possible.

FLEXVALUE

Public avoided-cost data allows third parties to identify and develop innovative cost-effective programs capable of delivering system benefits and value to customers. Recurve has used such data from the California PUC to develop its FLEXvalue engine, which computes grid and carbon benefits of demand flexibility along with the cost effectiveness of measures, portfolio value, and optimization pathways. By leveraging publicly available avoided-cost data, the tool helps develop innovative programs.

MARKET PREPARATION STRATEGY

PREPARE THE WORKFORCE

The transition to climate-forward efficiency will require a workforce capable of implementing updated utility programs. Utilities will rely on staff and service providers who can explain, install, and maintain technologies that support decarbonization goals, such as air source heat pumps and grid-interactive building controls. This can create new employment opportunities, but potentially introduce disruptions to the existing workforce or their existing practices and business models, requiring training and different incentives.

In addition to preparing a workforce, it is equally important to ensure that the workforce remains engaged for years to come. Workers who see a pathway from an entry-level job to a rewarding career (e.g., entry-level residential contracting to sophisticated commercial retrofits) that offers a solid return on their training investment will be more likely stay in and help grow the field. Climate-forward efficiency links to many nonfinancial values that workers are likely to care about, including sustainability, decarbonization, and delivering benefits to customers who need them most.

Training programs for a climate-forward efficiency workforce should be flexible enough to accommodate both prospective and experienced workers. Technical panels that identify core climate-forward efficiency technologies and the minimum sets of skills needed to install and maintain them will be useful here. Incorporating the findings of such an endeavor into standardized curricula that result in certifications will help climate-forward efficiency scale by providing employers and customers confidence that the workers they hire will be up to the task anywhere in the country.

Like any climate-forward efficient strategy, workforce preparation must center equity as it plans a course of action. Traditionally, women and people of color have been greatly underrepresented in energy industries (DOE 2017a). To correct these disparities, utilities can work with vocational programs to intentionally attract and train members of underrepresented communities, particularly those located near contractor bases who are able to take advantage of growing employment opportunities.

Options to Advance the Strategy

Conduct Regional Workforce Study

The impact of climate-forward efficiency on workforce development will depend on a region's local characteristics, including its decarbonization strategies (e.g., electricity, industry, transportation). To customize a region's policy approach, states can commission workforce studies to understand the number and types of jobs that would be required for local conditions. Such studies should identify the jobs required, skills needed to accomplish them, demographic and geographic distribution of those jobs, whether other jobs would be displaced, and a timeline for a transition. These studies should assess challenges in both attracting new workers and retraining existing contractors who may be hesitant to install or recommend climate-forward efficiency technologies due to a lack of familiarity with them. Study results can be used to address workforce gaps (e.g., lack of training programs, pay adequacy) that need to be overcome to scale climate-forward efficiency. Programs such as New York State's Workforce Development Initiative and Massachusetts's Workforce Skills Cabinet provide models for how to leverage statewide funds toward regionally customized workforce development projects (Commonwealth of Massachusetts 2021; New York State 2021).

Actions to advance the prepare the workforce strategy
***conduct regional workforce study*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ State agencies conduct studies on current workforce data and demographics	→ Utilities, regulators, and federal policymakers set common classifications for different types of workers that describe required skillsets and desirable areas of expertise

Improve Workforce Reporting

To better manage the job transitions involved with climate-forward efficiency, utilities can commission consultancies, research organizations, or NGOs to evaluate current workforce trends in the EE sector. For example, the consulting firm Guidehouse conducted a workforce analysis report for National Grid to determine the number of people employed across the utility's Rhode Island programs. The report also assessed how the COVID-19 pandemic affected employment numbers through layoffs and reduced project work (Guidehouse 2021). Similar reports could capture employment demographic information, job-completion timelines, and other data that could be used to improve utility offerings. The reports could measure the economic gains made by the workforce and assess how equitable the job impacts are on those employed through utility programs. Such tracking could translate into accountability metrics for regulatory oversight or performance-based incentives.

Once utilities have a better understanding of the factors that contribute to a capable, equitable workforce, they can work with legislators and regulators to develop unified standards for EE workers. Unified standards could also help utilities design training programs that would prepare workers for climate-forward efficiency projects.

Actions to advance the prepare the workforce strategy ***improve workforce reporting***:

Quick wins: 0–2 years

- Utilities commission outside organizations (e.g., consultancies, NGOs) to assess workforce trends

Provide Adequate Accommodations and Compensation

If utilities want to attract and retain diverse workers, they should make it easier for people to access jobs. One of the primary ways to do this is through fair compensation. Given the lasting impacts of the COVID-19 pandemic on labor availability, offering competitive wages and benefits is necessary to support the growing demand for EE practitioners. To grow a diverse workforce, utilities need to provide fair pay at all levels of job experience. Even at the internship level, paid positions can train students in the EE sector and allow those that cannot afford to work without pay to develop important skills while exploring a potential career path.

Recruitment and development officers should also consider appropriate logistics and accommodation for meetings. Hosting trainings and other events at times and places convenient to the community is a prerequisite for inclusion. Examples of effective accommodations include hosting events in public venues and providing free on-site childcare. Utilities should also partner with and invest in community workforce centers to leverage local knowledge of the specific accommodations a community needs.

Actions to advance the prepare the workforce strategy ***provide adequate accommodations and compensation***:

Quick wins: 0–2 years

- Utilities offer competitive wages and benefits to prospective employees
- Utilities partner with community workforce centers to identify and provide appropriate accommodation for recruitment events

Recruit from a Variety of Backgrounds

Accomplishing climate-forward efficiency goals will require a workforce with a variety of skillsets. Utilities can center equity in their efforts by recruiting new workers from groups that have not traditionally been represented in the EE industry, then assisting with their training, apprenticeship, or onboarding. For example, PG&E's PowerPathway program focuses on utility industry training for members of underrepresented communities while Illinois' Climate and Equitable Jobs Act supports a clean energy training program for previously incarcerated individuals (Illinois General Assembly 2021; PG&E 2021). An additional program targets laid-off fossil fuel workers and helps them transition to solar and storage development (Roberts 2021). The DC Sustainable Energy Utility's workforce development program connects residents with local contractors for five-month externships that provide exposure to the field, direct work experience, skills development, and job placement assistance at little to no cost to the contractors themselves (DCSEU 2022).

Actions to advance the unlock necessary data strategy
recruit from a variety of backgrounds:

Quick wins: 0–2 years	Medium term: 3–5 years
→ Educators teach students (especially those at the high school and community college level) about the career prospects of learning a trade that supports climate-froward efficiency, such as HVAC or energy-efficient construction	→ Based on demographic studies, utilities concentrate their recruitment efforts on underrepresented groups and regions that do not have enough workers

Examples

SMUD WORKFORCE DEVELOPMENT

As of January 2021, the Sacramento Municipal Utility District (SMUD) was in the planning stages of an effort to engage with local community-based organizations on workforce development activities for transportation electrification. The effort includes supporting SMUD's existing training programs and working with vocational schools to integrate EVs into their operations and curricula. Students, including those from low- and moderate-income (LMI) communities, will gain exposure to EV technology and workforce training. SMUD also works with a local business development group, the California Mobility Center, to scale workforce development to meet the needs of growing local businesses (B. Boyce, Electric Transportation Program, SMUD, pers. comm., January 29, 2021).

MASSACHUSETTS CLEAN ENERGY CENTER PAID INTERNSHIPS

The Massachusetts Clean Energy Center (MassCEC) runs two paid internship programs for students who want to enter the clean energy industry: the Vocational Internship Program (VIP) for vocational high school students, and the Clean Energy Internship Program for college students and recent graduates. The VIP was developed in response to a 2017 MassCEC Industry Report, which revealed that employers were having trouble recruiting competent candidates for technical jobs (MassCEC 2022). While there is limited evaluation data on the VIP, the Clean Energy Internship Program has successfully placed 3,640 interns at 468 different companies since its inception in 2011 (MassCEC 2022).

MARKET PREPARATION STRATEGY

SECURE FUNDING

Climate-forward efficiency requires dramatic growth in investment from multiple sustainable funding streams, especially given political pressure and the need to avoid stark rate increases. Mixing utility or ratepayer funding with government and other funding sources (e.g., nonprofit, philanthropic, insurance)—referred to as *braided funding*—can provide more robust support for climate-forward efficiency measures by coordinating with and leveraging the common goals of multiple organizations. With coordination, braided funding can improve program effectiveness and scale, allowing utilities to reach more customers with higher-value offerings (Soriano, Steiner, and Collier 2020). It enables utilities to pull in financial resources from organizations not traditionally associated with EE. Braiding also helps if any individual funding sources are interrupted, as other funding sources can be called in to fill the temporary gap.

Leveraging other resource streams can help utilities to accomplish goals unsupported by ratepayer funding. For example, a significant challenge in the low-income space is that weatherization programs cannot be completed in buildings with certain structural deficiencies, such as leaky roofs that might damage new insulation. Using braided funding opens a new avenue to tackle such barriers, which could otherwise scuttle an entire project (Hayes and Gerbode 2020). In Connecticut, the state's Energy Assistance Program combines funds from the federal Low Income Home Energy Assistance Program (LIHEAP) and the LIHEAP CARES Act to provide weatherization services and help low-income residents pay for winter heating (Connecticut General Assembly 2021). By mixing ratepayer funds with funds earmarked for health and social welfare, utilities can pursue climate-forward efficiency goals such as performing healthy home assessments, communicating with participants and partners, participating in education and training, obtaining material and labor to mitigate in-home hazards, and impact assessments (Hayes and Gerbode 2020).

Coordination, flexibility, and long-term planning will be important to making this funding strategy work. Utilities will need to consider the full set of needs of customers they serve and identify organizations with common aims. To attract private capital, utilities can create funding plans that span multiple years. Accomplishing other climate-forward efficiency goals will require sustainable, long-term funding, especially since non-utility organizations will have their own goals, timelines, and program designs (including some that may not support climate action). Utilities will have to ensure that their programs are compatible with other stakeholder aims through robust community engagement; they also must take care to ensure that equity considerations are met. Despite these challenges, the blending of multiple actors can open new pathways for innovation that would have otherwise been impossible had the organizations gone it alone.

Options to Advance the Strategy

Maximize Federal Funding Opportunities

Utilities can explore the range of federal programs, grants, loans, and other processes that support climate-forward efficiency and take steps to align with them. More specifically, utilities should consider federal programs that support climate-forward goals of energy conversation, GHG reduction, air quality improvement, health and safety improvement, equity increases, job creation, and resilience increases. Possible programs include the following:

- The DOE State Energy Program directs funding to states to support statewide energy roadmaps, customer education, energy audits, building retrofits, and more.
- The DOE Weatherization Assistance Program supports EE improvements for low-income families.
- The DOE Industrial Assessment Centers train students to improve the efficiency of small- and medium-sized manufacturing plants.
- Federal preventative care and medical support funds, which include Medicaid, CHIP Health Service, Preventative Health and Health Service Block Grants, and Lead Hazard Control Grants.
- The Federal Emergency Management Association offers pre- and post-disaster recovery dollars.
- The U.S. Department of Housing and Urban Development offers Community Development Block Grants.
- The U.S. Department of Health and Human Services offers services through LIHEAP.
- Government-funded healthy housing initiatives reduce health and safety hazards in homes, with a focus on children and sensitive populations in low-income households.

A significant source of new federal funding is the Infrastructure Investment and Jobs Act, which passed in November 2021. The law directs billions of dollars toward road infrastructure, clean energy transmission, residential weatherization, public transit, and other areas related to energy savings in the built environment. The DOE will receive more than $16 billion for EE and renewable energy programs, with $250 million going to the Energy Efficiency Revolving Loan Fund Capitalization Grant Program. States could access these funds through the State Energy Program and use them to support commercial and residential retrofits (117th Congress 2021).

Actions to advance the secure funding strategy ***maximize federal funding opportunities***:

Quick wins: 0–2 years	Medium term: 3–5 years
➔ Federal legislators and agencies identify and consider financially supporting climate-forward efficiency investments that would not pass utility ratepayer CETs on their own	➔ Legislators update funding streams to match increased climate-forward efficiency technology adoption and lower cost of equipment ➔ Utilities continue leveraging federal funding programs that best meet their climate forward efficiency goals

Take advantage of Regional, State, and Local Funding Efforts

To address funding gaps, utilities can work with states, cities, and other regional funding entities to align goals and mutually support larger efforts. Examples include Volkswagen settlement funds for transportation electrification and local air resources boards for programs that improve air quality. Utilities can also work with states to help direct the efficient spending of carbon pricing revenues, such as those from the Regional Greenhouse Gas Initiative (RGGI).[24] The Virginia General Assembly, for example, is directing $55 million of RGGI auction proceeds toward a range of EE and weatherization programs for low-income households (McGowan 2021).

Utilities could also work with state/local partnerships in several ways. One option is to support revolving loan funds that finance energy conservation projects with low-interest loans. Two models include the Texas LoanSTAR program and the Rhode Island Efficient Building Fund, which collectively support EE projects in public facilities. Other options include utilizing retail tax revenues to fund climate action, providing technical and financial assistance to municipalities who are running programs to reduce carbon emissions, and helping their customers access financing from green banks—such as the DC Green Bank—that facilitate private investment in low-carbon solutions (Orfield and Neely 2020).

[24] RGGI is a cap-and-trade system in which member states set a maximum cap on emissions that must be met either through emissions reductions or purchasing allowances. The member states have independent authority on how to invest the auction proceeds.

Actions to advance the secure funding strategy ***take advantage of regional, state, and local funding efforts:***	
Quick wins: 0–2 years	**Medium term: 3–5 years**
➜ State and federal legislators and utilities align available funds to optimize financial support for deep retrofits and equipment	➜ Utilities leverage lower technology costs to expand programs and technology adoption into new cost-effective opportunities

Piggyback climate-forward efficiency on existing programs

Utilities should look within their cities, states, and organizations for opportunities to leverage existing efforts in a way that would augment climate-forward efficiency adoption. For example, the Los Angeles Department of Water and Power (LADWP) is partnering with other City of Los Angeles departments to conduct building audits by piggybacking on a city program that inspects premises for habitability. In this way, LADWP can reduce its costs to administer programs, making EE more cost effective to procure.

Weatherization programs not only improve a building's EE, but they also reduce respiratory illness among residents. The New York State Energy Research and Development Authority (NYSERDA) Healthy Homes Value-Based Payment Pilot acknowledges these simultaneous benefits and combines them with other complementary health- and safety-related services to address asthma and trip-and-fall risks (Hayes and Gerbode 2020). The program, still in pre-evaluation pilot stages, relies on New York's Clean Energy Fund to reimburse costs of home EE improvements and is intended to draw funds from managed care organizations associated with Medicaid (Hayes and Gerbode 2020).

Actions to advance the secure funding strategy
***piggyback climate-forward efficiency on existing programs*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ Legislators encourage private sector actors to invest in green banks → Legislators direct Medicaid funds to weatherization projects that simultaneously improve health and EE	→ Establish new green banks and revolving loan funds in regions that need them → Federal legislators and agencies establish health standards that directly relate to building EE codes → Legislators pass technology-neutral decarbonization policies that allow crediting for electrification

Examples

CLEAN CARS FOR ALL

California utilities interested in supporting transportation electrification and incentivizing EV replacement among their individual customers can partner with one of four local air quality management districts (CARB 2022). Through the Clean Cars for All program, customers can turn in their old cars in exchange for EV incentives (Bay Area Air Quality Management District 2019). SMUD provides an extra incentive for dealers for any cars that are sold into that program, engaging a key market actor for EV adoption.

NORTH CAROLINA PARTNERS IN HOME PRESERVATION

The Partners in Home Preservation pilot is an effort to combine home repair and weatherization services for low- and moderate-income households in North Carolina's Research Triangle. The Southeastern Energy Efficiency Alliance funds the pilot while the Triangle J Council of Government, Rebuilding the Triangle Together, and the North Carolina Justice Center carry out the residential work. These organizations have used centralized home assessments, a shared database, and a unified screening and intake process to streamline services. This coordination of multiple organizations' resources has been beneficial in identifying the appropriate service providers for residents' needs (TJCOG 2021).

PROGRAM DELIVERY STRATEGY

DESIGN EFFECTIVE, SCALABLE PROGRAMS

Compared to traditional EE programs, climate-forward efficiency programs have more expansive goals, and they often have different metrics of success. They require greater effort from utilities and implementors to manage a variety of time-sensitive data on the back end, such as the grid's carbon intensity. They also must appeal to more diverse customer needs. As a result, the conventional utility program model must evolve to ensure that climate goals are being met effectively and in a way that scales to meet the magnitude of our climate challenge.

The many nonenergy benefits of climate-forward efficiency offer a range of customer value propositions for utilities to promote. These include emissions reductions, reduced cost of heating and cooling, healthier homes, job creation, reliability, resilience, and support for a grid that is more capable of accommodating growing amounts of low-cost renewable energy. While the design and evaluation of these programs may require complicated technical assessments and measure bundling, customers will benefit from designs that are simple to understand and easy to access. Utilities can maximize uptake by identifying which customers are most likely to benefit from different measures and by developing targeted customer engagement that promotes the benefits most likely to drive adoption (Scheer et al. 2018). These communications may need to include an educational component, as many customers remain unaware of the monetary savings, comfort, and health benefits that climate-forward technologies such as heat pumps and induction cooktops provide.

Many of the more effective and long-lived climate-forward efficiency measures such as HVAC electrification and weatherization have higher up-front costs. Low-income customers may struggle to afford these measures, even when the measures offer greater long-term savings. Moreover, if wealthier customers are the first to take advantage of electrification options, that can leave lower-income customers to bear a higher share of fixed costs of legacy infrastructure, such as those of the natural gas system (Gridworks 2019; Bilich, Colvin, and O'Connor 2019). If program design and delivery fail to prioritize equity, low-income customers will not only miss out on a program's benefits, but they also may be actively disadvantaged by the program. To avoid this, equitable outreach plans, financing options, incentives, and customer ownership options that take advantage of diverse funding sources will be required.

Utilities, governments, and other organizations often run programs with overlapping goals or that use similar program designs. Without concierge or "one-stop-shop" options, customers may struggle to identify which programs they are eligible for and how to participate in them, especially if each offers different incentive levels. Utilities may benefit from braiding these diverse funding sources on the back end and creating easy-to-access sets of choices for their customers. To design effective, scalable programs, utilities also will need to overcome challenges discussed in other climate-forward efficiency roadmap strategies, including fuel switching prohibitions, inflexible program rules and funding streams, insufficient data for program design and evaluation, and the need to blend and braid diverse funding sources.

Options to Advance the Strategy

Make Programs Easy for Customers

While climate-forward efficiency involves additional complexity for utilities and implementors, programs must be simple to access and entail limited administrative burden for customers. Utilities can structure programs with bundles of climate-forward efficiency measures, reducing choice fatigue from an overwhelming set of options. These improved program offerings can take forms similar to telecom bundles (e.g., where representatives ask questions to assess a customer's bandwidth needs in nontechnical terms) or concierge services that minimize the need for customers to engage with technology details. Programs can also leverage high-scale opportunities such as default offers at key times (e.g., when a customer sets up a new utility account) or partnering with neighborhood or community associations, churches, or other groups for bulk purchases that buy down the cost of low-carbon technologies using a limited time window and a "deal" that activates with enough participation from group members (Gold, Guccione, and Henchen 2017). Targeting participation from renters and low-income homeowners, programs can pair streamlined financing offers and attractive interest rates with loan guarantees or on-bill financing to reduce initial capital and credit barriers, making it easier for customers to finance EE measures.

Actions to advance the design effective, scalable programs strategy
***make programs easy for customers*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ Utilities initiate a fact-finding process to understand existing barriers to program scaling → Utilities pilot high-level opportunities for programs, such as default customer offers and bulk purchases	→ Regulators take action to address local barriers identified by fact-finding → Utility program designers and regulators identify and implement processes that make it easier for LMI customers to participate in programs

Test and Adjust Marketing Messages to Smaller Customer Segments

Different classes of customers will be compelled by climate-forward efficiency's benefits in different ways. To accelerate uptake, utilities should ensure customers are being marketed to in the appropriate language and with messages and messengers that appeal to what they care about. Successful customer acquisition requires leveraging available data about their usage (for example, through nonintrusive load monitoring and disaggregation), customer surveys, and third-party demographic and purchase data. Utilities can also use a community-based social marketing strategy, which involves identifying the specific barriers that prevent community members from enacting EE improvements, and the benefits that they can receive by participating in efficiency programs, and then tailoring communication and incentives accordingly (DOE 2017b). One example would be messaging to families with young children on how weatherization programs can improve health and comfort, even though the process may be disruptive (Sussman, Chikumbo, and Gifford 2018). Targeting messages toward customers most at risk from climate change and least able to improve their building's resilience on their own can enhance equity.

Actions to advance the design effective, scalable programs strategy
test and adjust marketing messages to smaller customer segments

Quick wins: 0–2 years	Medium term: 3–5 years
→ Utilities conduct market research and community outreach to understand and then deliver needed language services → Utilities and regulators program marketing messaging through A/B testing, focus groups, and other tools to prioritize the most effective messages	→ Regulators require language-accessible programs for the top three to five languages in a service territory → Utilities adjust their marketing strategies based on observed customer uptake of climate-forward efficiency offerings

Support Market Development and Transformation

Utilities, regulators, manufacturers, wholesalers, retailers, and service providers can engage in a variety of interventions to accelerate climate-forward programs. Investments in upstream and midstream incentives, which target product manufacturers and retailers respectively, can help support market development and ensure that low-carbon technologies are available and affordable for customers. Embedding wholesale buy-down incentives directly into the product sales price reduces transaction costs and improves value for customers (Vincent and Fabbri 2016). Service providers can train their staff members to install and service low-carbon technologies, such as heat pumps, while professional societies can publish best-practice guides or provide certifications that recognize competency in those tasks. Regulators can support utility pilots designed to demonstrate the feasibility of innovative programs, products, and services. Both utilities and regulators can help transform the market by supporting building code and appliance standard adoption to increase the climate performance of products and buildings, and thereby help lock in improved efficiency (York et al. 2017).

Actions to advance the design effective, scalable programs strategy
***support market development and transformation*:**

Quick wins: 0–2 years	**Medium term: 3–5 years**
→ Utilities review program-offering logic models and consider whether mid- or upstream strategies can increase adoption → Regulators approve utility pilots that demonstrate feasibility of climate-forward technologies in buildings → Service providers train staff to install and maintain low-carbon technologies, and to provide climate-forward services	→ Utilities work within and across state boundaries to establish or support regional market transformation strategies for the most promising low-carbon technologies → Regulators develop models to encourage and reward utilities for moving low-carbon products toward appliance standards → Utilities and regulators support updated building codes and equipment standards for demonstrated low-carbon products and technologies

Examples

FORT COLLINS UTILITIES' EFFICIENCY WORKS PROGRAM

The single-family residential program in Fort Collins, Colorado, uses a streamlined approach, including a third-party audit resulting in three package options (*good*, *better*, and *best*); easy connection to qualified contractors; and on-bill financing. The 2016 pilot also used a model to estimate the propensity of particular neighborhoods to participate, and then used community-based social marketing outreach techniques in each location. Such an approach was designed to address key participation barriers: high up-front costs, lack of time, complexity of options, and contractor distrust. The successful pilot resulted in 60% greater GHG reductions with no additional program cost per home (Devoe and Phelan 2018). The program is now a collaboration between various northern Colorado utilities.

EFFICIENCY VERMONT HEAT PUMP SPACE AND WATER HEATING PROGRAMS

In January 2020, Efficiency Vermont launched a program that offers an up-front discount of up to $600 for heat pump hot-water heaters to eligible customers when they hire a contractor. This midstream incentive is redeemed directly through participating distributors for select products and requires no mail-in forms or wait times. Additional discounts up to $200 are offered to income-qualified customers, and the program's web platform connects customers with resources on low-interest financing to help cover up-front costs. Since the incentive was shifted to wholesale distributors, program participation has increased by 750% (ENERGY STAR 2021).

In November 2021, the program was scaled to include ductless and ducted air source heat pumps. Offering instant savings on both ductless and ducted heat pumps allows all residents, regardless of the age of their home, to install highly efficient space heating technology.

PROGRAM DELIVERY STRATEGY

ADMINISTER INTEGRATED PROGRAMS

The range of low-carbon technologies that can be adopted under a climate-forward efficiency framework crosses multiple conventional silos. A holistic decarbonization strategy, for example, may involve a combination of EE, demand flexibility, electrification, renewable energy, and storage. Most utilities employ separate internal teams for one or more of these areas, or may not be permitted to offer specific types of technologies (for example, see York, Relf, and Waters (2019)). Communicating and coordinating efforts between teams can be difficult, especially when each team has separate targets, budgets, methodologies, timelines, and evaluation metrics.

Under climate-forward efficiency, the boundaries between these silos would be softened or removed to better deliver whole-building solutions. Doing so can benefit customers in the form of lower energy bills, easier program participation, access to a greater menu of options, and greater satisfaction overall. All ratepayers may be able to benefit through lower costs, since EE and demand flexibility typically improve the cost effectiveness of clean energy portfolios that include wind, solar, and storage (Teplin et al. 2019). Utilities and grid operators may benefit through more streamlined internal planning and communication, reduced administrative and system costs, and greater grid reliability.

However, integrated programs may introduce diverse and sometimes conflicting objectives (e.g., improved efficiency can lower DR potential). Auditors and contractors may have to invest additional effort to determine the most appropriate solution set for each building. Service providers may need to spend additional time educating customers, encouraging adoption of bundles that meet their needs, and setting up customers to manage and properly use new resources, especially where automation or compensation for grid services is involved.

Utilities also must learn how to balance behind- and in-front-of-the-meter strategies. DSM, generation, and distribution planning processes are often disconnected, meaning that there is not a built-in incentive to align those outcomes. Integrated programs that cover multiple technology areas may currently fall under the purview of utilities, federal agencies, state offices, and other entities. If organized properly, aligning programs under a common entity could streamline the process for customers. Otherwise, integration could sow confusion among customers regarding which organization they should engage with for which benefit.

Options to Advance the Strategy

Bundle Measures in Customer Offerings

Climate-forward efficiency provides an organizing framework that utilities can use to organize multiple separate demand-side goals. Integrated, fuel-neutral goals could justify allowing utility funds to more easily flow between conventional utility silos, linking cost effectiveness to the holistic value delivered by combined resources. This would better allow program implementers to capture (and reward) the multiple services delivered by climate-forward efficiency technologies (sometimes simultaneously, e.g., EE and DR), making it easier to scale associated programs. Regulators can support these changes by approving investments in enabling infrastructure such as smart metering and information technology, as well as new rate structures that better reflect carbon intensity through time-varying prices.

In addition, well-designed bundles can save on total customer cost of ownership. For example, a whole-home solution that includes converting a gas furnace to an electric heat pump can be bundled with envelope upgrades in order to right-size the new HVAC equipment and avoid contributing to system reliability issues (e.g., driving winter peaks) (Specian, Cohn, and York 2021). Such costs are much lower if contractors and retailers have low-cost, low-carbon options available when existing equipment fails. For example, installing a heat pump when a central AC fails creates an opportunity to gain heating capabilities; it also future-proofs the home for when the existing fossil system reaches its end of life.

Actions to advance the administer integrated programs strategy
***bundle measures in customer offerings*:**

Quick wins: 0–2 years	Medium term: 3–5 years
➔ Utilities begin to design programs to cross-promote existing offerings to customers across program silos ➔ Utilities and stakeholders identify barriers to integrated programs in existing EE collaboratives or public input venues ➔ Utilities help train service providers with delivery of integrated technologies and help them update their business models to align with program integration	➔ Utility program designers redesign programs to include integrated technology options for customers to choose from ➔ Utility program designers re-orient program delivery around customer segments and building types to better match technology options with customer/segment needs

Offer Staged Upgrades

While bundles that address all opportunities to decarbonize a home may offer efficiencies in cost effectiveness and reduced transaction costs, few customers will be able to take on all possible upgrades at once. With staged upgrades, customers can split a retrofit process into multiple stages so that they can address emergency or immediate needs first, with a mechanism for ongoing contractor engagement to complete a full retrofit at a later date. This approach also aligns best with contractor business models, as few contractors offer envelope, heating and cooling, onsite generation, and storage combined.

NYSERDA's Comfort Home Program offers incentives that encourage homeowners to invest in envelope and duct improvements before replacing fossil-fueled heating systems with high-efficiency cold climate heat pumps (Schryer et al. 2020). In this way, the state can capture near-term savings from gas and oil use while preparing homes for effective future heat pump installation and operation. Staged upgrades target key transactions in homeownership, enabling customers to get more savings from work they are already planning, such as maintenance and repairs, equipment replacement, remodeling or additions, equipment tune up or repair, and refinancing or selling a home (DOE 2015).

Actions to advance the administer integrated programs strategy ***offer staged upgrades*:**

Quick wins: 0–2 years	Medium term: 3–5 years
➔ Utilities pilot staged upgrade strategies for promising bundles of climate-forward efficiency technologies ➔ Utilities tailor their incentives to appeal to changing customer interests, such as growing adoption of EVs or acceptance of air source heat pumps	➔ Utilities structure incentives to encourage staged upgrades and reward service providers for building toward deeper retrofits over time

Break Down Silos in Regulation and Utility Operations

To better integrate supply- and demand-side resources into a combined utility planning framework, utilities should consider shifting their EE planning into an integrated demand-side management planning team; they can then build toward full integration of these resources into grid planning and operations. In this context, investments should be future-proofed over the lifetime of the measures to accommodate the state or utilities' decarbonization trajectory. Considerations here include avoiding potential lock-in of emissions resulting from the installation of fossil-fueled equipment, ensuring that efficient equipment is installed with grid-interactive controls, and encouraging net-zero new construction.

In many states, regulatory changes will be needed to enable such utility actions. This strategy depends on clearing the playing field for integrated offerings, as discussed in the Update Guidelines for Resource Eligibility and Valuation strategy, as well as ensuring that quantifiable objectives and performance metrics are in place to pursue each integrated program component, as discussed in the Set Climate Commitments Strategy. Without clear goals, utilities may be incentivized to invest combined budgets in, for example, DR at the expense of EE. In addition, regulators will need to examine legacy constraints within program structures that impede the ability to achieve climate-forward efficiency, such as common restrictions on shifting funds between programs or customer groups.

Actions to advance the administer integrated programs strategy
***break down silos in regulation and utility operations*:**

Quick wins: 0–2 years	Medium term: 3–5 years
➜ Utilities educate regulators about the benefits of integrated programs, while addressing potential conflicts between resources (e.g., EE compromising demand flexibility) ➜ Utilities support internal organizational challenges that support implementation of integrated programs ➜ Regulators facilitate integration by approving rate structures that better reflect the time-varying value of EE	➜ Legislators and regulators move away from single issue policies and encourage integrated solutions ➜ Regulators establish updated minimum filing requirements and other oversight tools for EE programs that focus on equitable reduction of GHG ➜ Utilities engage in internal reorganization as needed to de-silo all climate-forward efficiency offerings

Unlock Real-Time Program Designs

To better capture real-time emissions savings, programs should consider meter-based pay-for-performance program designs enabled by AMI or intelligent, connected technologies. PG&E's Residential Pay-for-Performance program (launched in 2018) rewards customers for technology-agnostic energy savings. Combined with other EE measures, PG&E reported territory-wide savings of 1,288 GW in the program launch year (PG&E 2019). NYSERDA has invested $50 million in a series of pay-for-performance pilot projects. The Business Energy Pro program matches participating small and medium businesses that have smart meters with EE service providers to recommend energy-saving solutions (NYSERDA 2022).

Another strong strategy is using market signals and time-of-use rates to incentivize climate-focused energy savings. Resource integration could also be outsourced to third-party aggregators, who can respond to technology-neutral, GHG-focused targets in RFPs or markets.[25] This would reduce the need for utilities to develop more complicated integrated incentives, allowing them to instead direct payments to innovative aggregators that can deliver outcomes. Such action might enable the development of business models focused on delivering resource combinations (e.g., weatherization and solar PV).

Actions to advance the administer integrated programs strategy
***unlock real-time program designs*:**

Quick wins: 0–2 years	Medium term: 3–5 years
→ In locations with AMI, utilities pilot meter-based pay-for-performance program designs that reward GHG reductions → Regulators create regulatory sandboxes or pilot structures to enable pay-for-performance where existing rules prevent testing	→ Regulators review progress from pilot P4P programs, adjust, and order utilities to propose full-scale programs in next program cycle

[25] Aggregators are demand-side service providers who interface with customers, combining their smaller distributed energy resources into larger, combined grid service products for retail or wholesale markets.

Examples

CITY OF FORT COLLINS UTILITIES RESIDENTIAL SOLAR REBATE PROGRAM

The municipally owned Fort Collins Utilities began offering solar rebates in 2008 and residential efficiency incentives in 2010. In 2015, the City of Fort Collins set a goal to achieve an 80% reduction in GHG emissions by 2030 and carbon neutrality by 2050 compared to 2005 emissions. The residential Solar Rebate Program helps the city meet both targets by encouraging customers to consider efficiency upgrades before installing photovoltaics in order to optimize energy and GHG savings from the two measures.

ENERGY TRUST OF OREGON PATH TO NET ZERO

Energy Trust of Oregon offers Path to Net Zero as part of its New Buildings program. Commercial building owners and businesses constructing or renovating a new building work with program staff to include deep EE measures and on-site solar generation in their building plans (Energy Trust of Oregon 2022). By bundling EE and onsite renewable generation, net demand and emissions are reduced. To participate, customers set a design goal that is 40% more efficient than required by code. The program supports design teams and building owners throughout the project, from early design to post-occupancy, by providing technical assistance and financial incentives at key milestones.

Conclusion

The global climate crisis demands that we use every tool at our disposal for decarbonization. EE is capable of getting us halfway to the needed reductions, but it requires an enhanced role for utilities. Beyond simply saving energy, utilities have a role in delivering solutions at the right time and in ways that realize EE's full suite of benefits.

To this end, we introduced here a new roadmap framework—climate-forward efficiency—to guide legislators, regulators, and utilities in moving EE forward. While emissions reductions are a key component of climate-forward efficiency, the framework values the wider range of benefits that are increasingly justifying EE portfolios. These include advancing equity, job creation, health and safety, and resilience. While many of the technologies used to advance conventional efficiency still play a role, climate-forward efficiency invites energy savings through electrification and time-sensitive valuation of resources in a way that is distinct from classic EE. These changes require utilities to adopt a new set of strategies to reach a new set of goals.

Our roadmap framework presented nine initial strategies that resulted from internal research, expert interviews, and workshop feedback. One strategy, Center Equity, is designed to be considered alongside the others. A focus on both equitable processes and outcomes can reduce energy burden, make DACs more resilient, and mitigate the disproportionate impact climate change is already having on those least equipped to weather it.

The remaining eight strategies broadly fall into three categories: policy alignment, program delivery, and market preparation. These strategies are not static. Successful implementation of one can influence and improve the likelihood of success for others.

Strategies associated with policy alignment include setting climate commitments, updating guidelines for resource eligibility and valuation, and reforming utility business models. Such approaches can better enable utility program delivery, including through the design of effective, scalable programs that are properly incentivized, as well as administering integrated programs that enable more holistic, whole-building solutions that optimize the combined offerings of EE, demand flexibility, electrification, renewable energy, and storage programs. Finally, the market will need to be prepared for climate-forward efficiency to fully take root. Strategies to consider here include unlocking necessary energy and climate data, securing and braiding funding streams, and preparing the workforce.

New goals require new policies, metrics of success, programs, and market conditions. Given the variety of business models, regulatory structures, and market conditions around the country, some options will be more appropriate for some contexts than others, but each strategy will be required to deliver on the promise of climate-forward efficiency. We recommend that each jurisdiction consider how these strategies may be best applied to its unique circumstances.

No one sector will be able to realize all of the strategies on its own. Leaders in the utility, regulatory, legislative, and occupational spaces must step forward to form collaborations, align goals, achieve synergies, and realize the full potential of EE.

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Appendix A. Research Objectives and Methodology

This report is the practical extension of companion research, *The Need for Climate-Forward Efficiency: Early Experience and Principles for Evolution*, which accomplished several goals:

- Establishing the need for alignment of utility energy efficiency (EE) programs and policies with net-zero decarbonization goals
- Reporting how states and utilities are beginning to address the lack of alignment
- Recognizing potential drawbacks of alignment approaches
- Proposing principles of alignment or guidelines to consider when evolving EE to be more responsive to net-zero goals
- Offering options for how to measure the success of such approaches

The Need for Climate-Forward Efficiency report's literature review and expert interviews were used to generate a preliminary roadmap of EE and greenhouse gas (GHG) alignment strategies. This roadmap included identification of actors who had the ability to advance climate-forward efficiency (e.g., utilities, regulators, state legislators, implementors, and service providers) and through which means (e.g., legislation, regulation, and utility action). The collection of approaches emerging in both practice and theory established an early vision for what climate-forward efficiency can look like in different (e.g., geographic) contexts, as well as strategies to scale efficiency to the extent needed to meet decarbonization goals.

We improved on this early roadmap through three virtual workshops held in summer 2021. The first two workshops lasted 2–3 hours each, while the third lasted 90 minutes. All featured experts drawn from electric and gas utilities, regulatory offices, program administrators and implementers, and consumer advocates. Workshop participants were invited based on either their professional experiences related to EE/GHG alignment or their knowledge of sectors in which alignment changes would ultimately need to occur. We chose participants based on our personal knowledge of their expertise and through recommendations of other experts that we interviewed during the project's research phase. Additional workshop participants were drawn from ACEEE's Climate-Forward Efficiency initiative mailing list, through which any interested party could sign up to receive updates on ACEEE research activities. The participant list was vetted internally to ensure equitable geographic and occupational sector representation.

A total of 49 unique experts contributed input over the course of the three workshops. A high-level agenda for those workshops is presented in Appendix B. We asked invitees to reflect on proposed pathways and options to shift current policies, programs, and practices toward climate-forward EE. We further asked them to generate ideas about how workshop participants could take actions to move toward climate-forward efficiency and to identify which research, tools, and technical assistance are needed to make these changes.

On June 25, 2021, ACEEE hosted the first workshop—a virtual two-hour event with more than 30 participants from a range of organizations from around the country, including PUCs, electric and gas utilities, program administrators, program implementors, federal government agencies, and NGOs. We collected feedback on the draft roadmap during a breakout session that focused on discussions of and answers to the following questions:

- How does this framework align with your current thinking about how EE needs to evolve to be climate-forward?
- What might be missing from the framework of strategies to advance climate-forward efficiency? What should be removed or reframed?
- How could the framework be most helpful to you in your role?

We gave participants access to a cloud-based document and invited them to provide their input in real time (through a notetaker) during the breakout sessions. They were also given a link to this document immediately following the workshop and invited to insert any clarifications or additions.

Following the first workshop, we polled potential attendees, asking them to rank their interest in participating in breakout sessions on each of (at the time) 10 preliminary roadmap strategies. We also asked participants to rate their level of expertise on those topics on a three-point scale (i.e., no expertise, some knowledge, expertise). The combination of feedback from this survey and the first workshop compelled the authors of this report to reorganize the strategies into the set of nine reflected in this report.

On July 8, 2021, ACEEE hosted its second workshop focused exclusively on developing this report's roadmap strategies. Participants included 19 people from Workshop #1 and 8 more people who participated only in Workshop #2. Due to a shortage of experts on workforce development among our participants, we decided prior to the second workshop to host a separate, third workshop to discuss that strategy. At the second workshop, ACEEE facilitators created eight working groups, one for each of the remaining strategies, with most participants contributing to two working groups each. We endeavored to populate working groups only with people who had indicated an interest in the strategy being discussed and seeded each group with individuals who self-identified as having expertise in that area.

We gave participants approximately 40 minutes to discuss each strategy, aided by a facilitator. The facilitators guided workshop participants through the following questions:

- What are the barriers to progress for this strategy?
- What are the opportunities for new solutions for this strategy, and are there emerging examples?
- What needs to happen in the next 1/5/10 years to make progress, and who needs to do it?
- What information do we not have now that is needed to make progress? What are our unanswered questions?

Participants were asked to submit their answers in a shared, cloud-based file that could be collectively edited by workshop participants in real time.

After this second climate-forward efficiency workshop, we planned a specialized, 90-minute workshop to discuss workforce development strategy. We reached out to organizations and individuals who had previously participated in a climate-forward efficiency workshop and in ACEEE's Inclusive Energy Efficiency workshop. We encouraged these workforce development workshop participants to submit additional comments and ideas on strategies in a file that was shared both during the workshop and in the days immediately following it.

We held the breakout session on workforce development on August 9, 2021. This workshop's 14 participants were divided into two breakout groups, where they answered questions such as the following:

- If we want to understand the most important elements of the strategy around strengthening workforce in the context of climate-forward efficiency, what elements immediately come to mind to you to start with?
- Are there examples where workforce is being handled in a climate-forward way that we ought to highlight as models for others to follow?
- What options do we have to strengthen the climate-forward efficiency workforce, and who are the primary actors?

ACEEE staff facilitated each breakout room, with one to two staff members moderating the discussion and one staff member taking notes. This was the final online workshop for engaging with experts to inform climate-forward efficiency strategies.

In total, the final roadmap was the result of 78 stakeholders' input over an eight-month period, from March 2021 to November 2021. During this period, the 78 individuals provided their expert feedback through interviews, workshop participation, and/or external review. Figure A1 shows the research timeline, and figure A2 shows an approximate breakdown of how many stakeholders contributed to each activity.

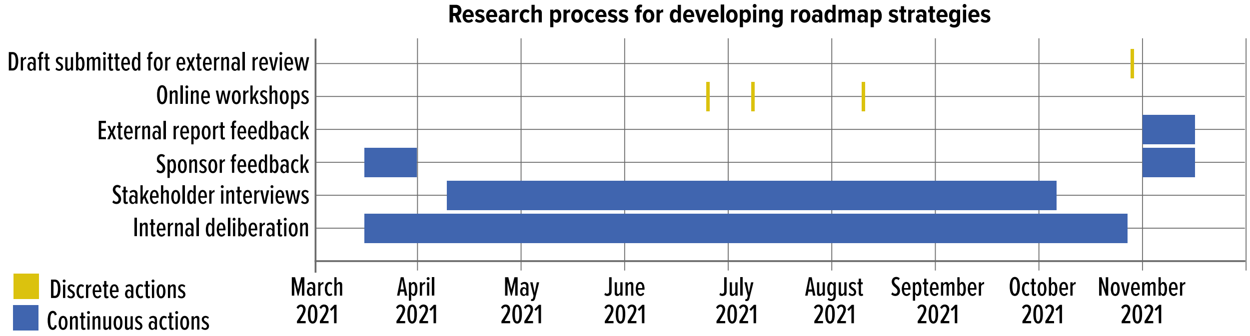

Figure A1. Research timeline for developing roadmap strategies. Blue blocks represent continuous actions, while yellow lines represent discrete events.

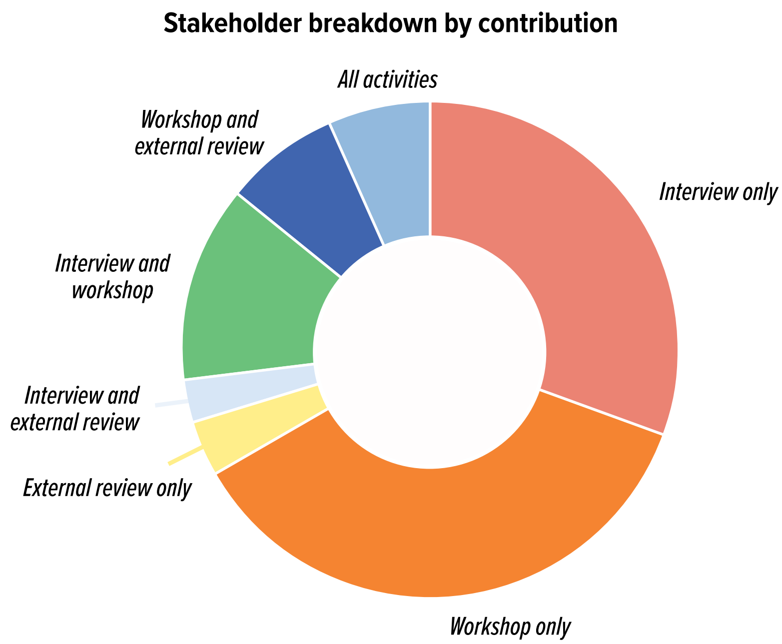

Figure A2. Stakeholders by contributions to different research activities. A total of 78 stakeholders were involved across the various activities.

Each stakeholder represented one of eight different sectors (program implementer, utility, NGO, government, research, regulator, consultant, advocate). Many of these sector identifications were based on stakeholder answers to the climate-forward efficiency newsletter survey. For those who did not answer the survey, an ACEEE researcher determined their sectors based on their respective organizations. Figure A3 shows this breakdown.

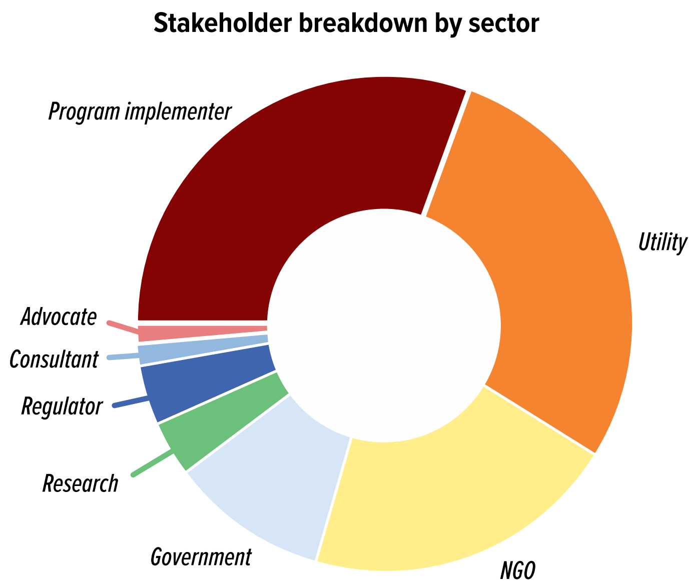

Figure A3. Stakeholders by sector

Appendix B. Workshop Agendas

Workshop #1 Agenda

ACEEE Climate-Forward Efficiency Workshop #1

Friday, June 25, 2021 2:00pm – 4:00pm EST Zoom Virtual Meeting

Utility energy efficiency programs have a track record of saving customers energy and money, but the vast majority are not yet meeting their potential to mitigate climate change. Amid a rapid rise in renewable power generation and in technology enabling demand flexibility, it's time to restructure efficiency efforts to focus them on doing their critical part to reduce greenhouse gas emissions.

This workshop, part of ACEEE's *Climate-Forward Efficiency* initiative, will engage stakeholders drawn from leading utilities, program administrators and implementors, state regulators, government, advocacy organizations, and the modeling/analysis communities to create a roadmap for this transformation and support those stakeholders with the research, tools, and technical assistance to make these changes.

Desired Outcomes:

- Surface the potential needs and challenges with the shift to climate-forward efficiency from the perspectives of key stakeholders, across regions and roles
- Understand, test, and collaboratively refine a roadmap framework for advancing climate-forward efficiency

Agenda

2:00 – 2:20	**Welcome / Introductions / Check-In** • Establish ground rules, norms, and mutual agreements for workshop series
2:20 – 2:30	**Motivation for Climate-Forward Efficiency** • **Working draft of energy efficiency / greenhouse gas alignment framework** - Motivating the need for realignment of energy efficiency portfolios with GHG emissions - Potential drawbacks, challenges, and concerns associated with alignment - *Rachel Gold, Director Utilities Program, ACEEE*
2:30 – 2:50	**Breakout Session 1** • **Reactions to Climate-Forward Efficiency motivation** - Is your motivation for climate-forward efficiency included in our working draft? - What drawbacks might you see from 100% alignment of energy efficiency with climate?
2:50 – 3:00	**Break**
3:00 – 3:10	**Presentation: Draft Roadmap Framework for Climate-Forward Efficiency** - *Mike Specian, Utilities Program, ACEEE*
3:10 – 3:35	**Breakout Session 2** • **Discuss reactions to roadmap framework in groups:** - Is this framework in line with your current thinking? - What might be missing? What should be reprioritized? - How could the framework be most helpful to you?
3:35 – 3:45	**Breakout Session Shareout**
3:45 – 4:00	**Prioritization Exercise** - Identify which framework strategies participants would like to dive deeper into during Workshop #2 on July 8.

Workshop #2 Agenda

ACEEE Climate-Forward Efficiency Workshop #2

Thursday, July 8, 2021 1:00pm – 4:00pm EST Zoom Virtual Meeting

Utility energy efficiency programs have a track record of saving customers energy and money, but the vast majority are not yet meeting their potential to mitigate climate change. Amid a rapid rise in renewable power generation and in technology enabling demand flexibility, it's time to restructure efficiency efforts to focus them on doing their critical part to reduce greenhouse gas emissions.

This workshop, part of ACEEE's *Climate-Forward Efficiency* initiative, will engage stakeholders drawn from leading utilities, program administrators and implementors, state regulators, government, advocacy organizations, and the modeling/analysis communities to create a roadmap for this transformation and support those stakeholders with the research, tools, and technical assistance to make these changes.

Desired Outcomes:

- Understand, test, and collaboratively refine a roadmap framework for advancing climate-forward efficiency
- Generate ideas about how participants can take action to advance climate-forward EE, and identify what research, tools, and technical assistance are needed to make these changes

Agenda

1:00 – 1:10	**Welcome / Introductions / Agenda Overview**
1:10 – 1:20	**Updates to Climate-Forward Efficiency Framework** • **Updates to roadmap framework based on feedback from Workshop #1** - *Mike Specian, Utilities Program, ACEEE*
1:20 – 2:05	**Breakout Session 1** • **Parallel small group breakouts to dive deeper on specific strategy elements of the roadmap framework exploring:** - What are the barriers to progress for this strategy? - What are the opportunities for new solutions for this strategy, and are there emerging examples? - What needs to happen in the next 1/5/10 years to make progress, and who needs to do it? - What information do we not have now that is needed to make progress? What are our unanswered questions?
2:05 – 2:15	**Break**
2:15 – 2:55	**Breakout Session 2** • **Parallel small group breakouts to dive deeper on specific strategy elements of the roadmap framework exploring:** - What are the barriers to progress for this strategy? - What are the opportunities for new solutions for this strategy, and are there emerging examples? - What needs to happen in the next 1/5/10 years to make progress, and who needs to do it? - What information do we not have now that is needed to make progress? What are our unanswered questions?
2:55 – 3:05	**Break and Gathering of Notes**
3:05 – 3:40	**Shareout and Discussion from Breakout Sessions**
3:40 – 3:50	**Offers and Requests** - Opportunity for participants to identify requests of others to accelerate their work on climate-forward efficiency, and to offer support for other participants.
3:50 – 4:00	**Closing Remarks**
4:00	**Adjourn**

Workforce Development Workshop Agenda

ACEEE Climate-Forward Efficiency Workshop: Workforce

Monday, August 9, 2021 4:00pm – 5:30pm EST Zoom Virtual Meeting

Utility energy efficiency programs have a track record of saving customers energy and money, but the vast majority are not yet meeting their potential to mitigate climate change. Amid a rapid rise in renewable power generation and in technology enabling demand flexibility, it's time to restructure efficiency efforts to focus them on doing their critical part to reduce greenhouse gas emissions.

In this workshop, part of ACEEE's *Climate-Forward Efficiency* initiative, we will discuss strategies to strengthen the network of program delivery partners needed to install and maintain climate-forward efficiency technologies. This may include cultivating hard and soft skills needed to deliver electricity savings, electrification, demand flexibility, and EE-aligned renewable energy — and ultimately, to decarbonize the building sector at scale. These programs can also provide economic opportunity to individuals and communities most affected by climate change and the transition away from fossil fuels.

Desired Outcomes:

- Understand, test, and collaboratively refine our understanding of workforce issues surrounding climate-forward efficiency
- Develop options to advance workforce considerations within climate-forward efficiency framework

Agenda

4:00 – 4:10	**Welcome / Introductions / Agenda Overview**
4:10 – 4:25	**Introduction to Climate-Forward Efficiency Framework** - *Mike Specian, Utilities Program, ACEEE* - *Mary Shoemaker, State and Local Policy, ACEEE*
4:25 – 5:25	**Working Session** • **Breakout group(s) to dive deeper on specific questions related to workforce in the climate-forward efficiency context including:** - What climate-forward efficiency workforce development examples are you aware of? - What opportunities exist to strengthen inclusive climate-forward efficiency workforce development, and who are the primary actors? - Do those opportunities vary geographically, by regulatory context, or other local characteristics? - What is your vision for a climate-forward efficiency workforce (e.g. types of workers, skills needed, EE workforce size)? - What do you see as the most important elements of a strategy around strengthening the workforce for climate-forward efficiency? - Which of these elements are unique to climate-forward efficiency, and which focus more on general EE workforce development? - What are the unique barriers to a CFE workforce? - What's the timeline for actions? ▪ What are some quick win actions that stakeholders can take right now to support an equitable CFE workforce? ▪ What is needed over a longer time horizon?
5:25–5:30	**Closing Remarks**
5:30	**Adjourn**