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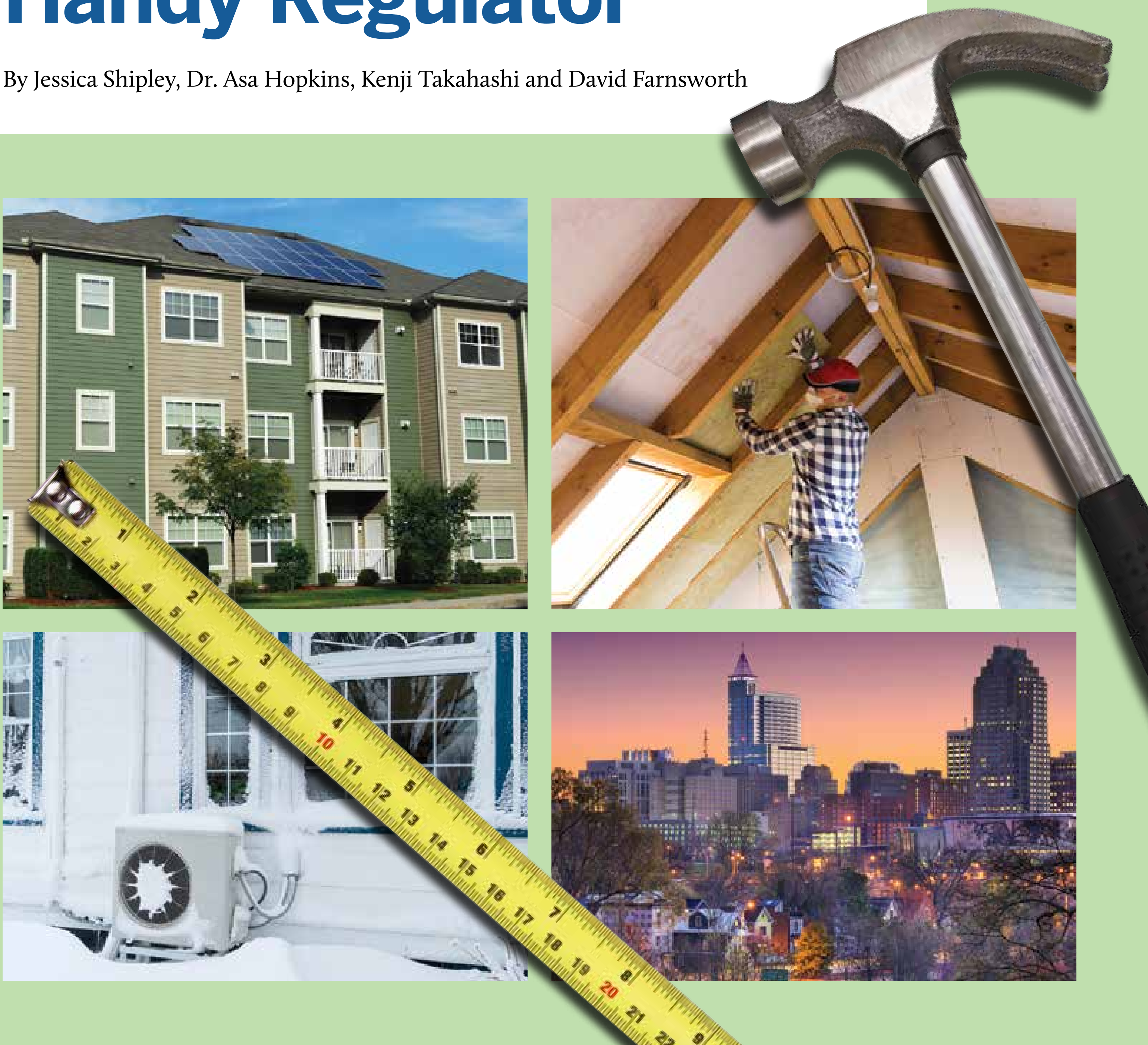
Renovating Regulation to Electrify Buildings: A Guide for the Handy Regulator

By Jessica Shipley, Dr. Asa Hopkins, Kenji Takahashi and David Farnsworth



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Regulatory Assistance Project (RAP)®
50 State Street, Suite 3
Montpelier, VT 05602
USA

Telephone: 802-223-8199
Email: info@raponline.org
raponline.org
linkedin.com/company/the-regulatory-assistance-project
twitter.com/regassistproj

Synapse Energy Economics, Inc.
485 Massachusetts Avenue, Suite 3
Cambridge, MA 02139
USA

Telephone: 617-661-3248
Email: communications@synapse-energy.com
synapse-energy.com
linkedin.com/company/synapse-energy-economics
twitter.com/SynapseEnergy

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Authors and Acknowledgments

Jessica Shipley is a senior associate and David Farnsworth is a principal at the Regulatory Assistance Project. Dr. Asa Hopkins is a vice president and Kenji Takahashi is a senior associate at Synapse Energy Economics.

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Abbreviations

CLCPA ..... Climate Leadership and Community Protection Act

EE .... energy efficiency

EERS ...... energy efficiency resource standard(s)

EV .... electric vehicle

FERC ...... Federal Energy Regulatory Commission

GEB .... grid-interactive efficient building

GHG .... greenhouse gas

HVAC ...... heating, ventilation and air conditioning

kWh .... kilowatt-hour

RGGI....... Regional Greenhouse Gas Initiative

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Introduction

Why Electrify Buildings?

It is no secret that new technologies are changing the way we produce and use energy. This is due, in part, to the availability of cleaner and more efficient end-use resources. Air source heat pumps, for example, transfer heat instead of making it. They are over 100% efficient, and if a building equipped with electric heating and cooling is well insulated, it will need less energy to maintain comfort levels and will maintain those levels for a longer period of time.[1] These features of electrified buildings can produce benefits for building owners and occupants, such as lower energy costs[2] and improved comfort, as well as benefits to society, such as reduced greenhouse gas (GHG) emissions.[3]

The flexible capabilities of many home energy technologies, such as smart thermostats, can turn a building into a thermal battery, precooling or preheating its spaces and water supply, and can also help shift electricity demand away from more expensive times to hours when prices are lower and when variable resources — such as renewables — are generating power.[4] With pricing that reflects relevant power system conditions, utilities can encourage building owners and managers to use energy during periods when it is less expensive or cleaner to serve them.[5] Furthermore, as the power system gets cleaner, so does the fuel that electrified buildings use. These resources can significantly reduce building-related GHG emissions and greatly help to meet economywide carbon reduction goals.

> We are moving from a world where we forecast load and schedule generation to meet that load to a world where we forecast generation and schedule load.

When we consider these changes in the power sector, we should remember that we are moving from a world where we forecast load and schedule generation to meet that load to a world where we forecast generation and schedule load. The flexible nature of electrified buildings can allow multiple benefits to be achieved while keeping costs as low as possible by avoiding or limiting the need for additional investments in generation, transmission and distribution.

Why Renovate Existing Regulatory Frameworks?

Regulatory frameworks need to evolve to enable this transition. Many existing energy policies and regulatory structures, which may have served us well in the past, create unnecessary barriers to electrifying buildings. Addressing these challenges will help realize the full potential of electrified, flexible, grid-integrated buildings.

1 Rosenow, J., & Lowes, R. (2020). *Heating without the hot air: Principles for smart heat electrification*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/heating-without-hot-air-principles-smart-heat-electrification/

2 Efficiency Maine. (2020, October 28). *Compare home heating costs.* https://www.efficiencymaine.com/at-home/heating-cost-comparison/

3 The achievement of these benefits depends in part on the climate where the building is located. For example, electrification of space heating in cold climates, particularly when a building is not well insulated, remains a challenging economic proposition. Calculating the potential costs and benefits of space heat electrification options for various climates, housing types and other circumstances is outside the scope of this guidebook; however, readers may find the following publication useful: Shipley, J., Lazar, J., Farnsworth, D., & Kadoch, C. (2018, November). *Beneficial electrification of space heating*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/beneficial-electrification-of-space-heating/

4 Frankel, M. (2018, August 22). *Gridoptimal buildings: Achieving maximum benefit for smart building-to-grid integration*. New Buildings Institute. https://newbuildings.org/grid-optimal-buildings/

5 Lazar, J., & Gonzalez, W. (2015). *Smart rate design for a smart future.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/smart-rate-design-for-a-smart-future/

For example, in the early 1990s, efficiency and environmental benefits came from replacing electric resistance water and space heating equipment with on-site fossil fuel space heating and water heating technology.[6] Today, the opposite is often true: Cost-effective fuel switching can replace fossil-fueled end uses with more efficient electrical options.

In addition to technology changes, there is now a growing awareness of long-overlooked social implications of building stock disparities, energy burdens and disconnections.[7] Housing type and opportunities affect members of the public differently. For example, there are over 44 million renters in the United States, and one-quarter of them spend at least half their income on rent.[8]

Much like inefficient buildings, regulation and policy need to be renovated to realize the benefits now available. For example, gas-only efficiency programs that disallow fuel switching are barriers because they miss what might be more efficient electrification-related heating and cooling choices for buildings. Electrification alternatives to on-site fossil-fueled heating are as much as three times more efficient than the status quo, so utility programs should enable customers to make those choices. The world has changed; regulation and policy need to do the same.

Renovating regulation can open the door to and accelerate building electrification. In this guidebook, we explore some of the opportunities:

Equitable Building Electrification

While the policy discussions in this guide are designed to improve building energy use across the country, ensuring that these benefits reach everyone will require particular focus on the needs of all energy consumers, including low-income

6 Nadel, S. (2017). *Natural gas energy efficiency: Progress and opportunities* (Report U1708), p. 22. American Council for an Energy-Efficient Economy. http://www.ourenergypolicy.org/wpcontent/uploads/2017/07/u1708.pdf. See also Nadel, S., Eto, J., Kelley, M., & Jordan, J. (1994). *Gas DSM and fuel switching: Opportunities and experiences.* American Council for an Energy-Efficient Economy. http://aceee.org/sites/default/files/publications/researchreports/U932.pdf

7 Lyubich, E. (2020, June). *The race gap in residential energy expenditures* (Energy Institute WP 306). https://haas.berkeley.edu/wp-content/uploads/WP306.pdf

8 Choi, J. H., Zhu, J., & Goodman, L. (2020, April). *COVID-19 policy responses must consider the pandemic's impact on young renters and renters of color.* Urban Institute. https://www.urban.org/urban-wire/covid-19-policy-responses-must-consider-pandemics-impact-young-renters-and-renters-color

households. This will require an affirmative effort to get to know them and to ensure that in serving them, the public interest is met. Although the topic of equity is broad, this chapter looks at challenges that utilities and utility regulators can address.

Load Flexibility and Grid-Interactive Buildings

Buildings' energy demand, if made flexible and actively managed, can respond to grid needs and serve as an essential resource in today's electricity system. Achieving this will require shifting building loads away from high-cost times and toward times of day when excess renewable energy is being produced. Rate design is essential for enabling and rewarding this kind of flexibility, and thus it is essential for the economics of building electrification.

Energy Efficiency Resource Standards

These set a high-level policy framework within which efficiency programs and measures are developed and delivered. If energy efficiency resource standards (EERS) are fuel-neutral, they can encourage the most efficient choices available regardless of fuel source. If they are fuel-specific, then they may not promote the most energy-efficient choices. Because they have significant influence over what types of efficiency options are pursued in a given state, EERS need to be revised so that they recognize all available benefits and opportunities, including those related to electrification.

Energy Efficiency Program Delivery

Energy efficiency (EE) programs have historically focused on energy savings within the electric and gas systems separately but could deliver more value to consumers and society if they, like the EERS frameworks that govern them, were fuel-neutral. To be effective, efficiency programs need to expand beyond these silos and to educate consumers about all available cost-effective and efficient choices.

Building Codes and Performance Standards

State and local governments can play an important role in promoting building electrification through building energy and safety codes, building performance standards, and building energy disclosure and benchmarking. These policies and regulations can complement utility programs and other methods for supporting building electrification.

Gas Utility Line Extensions

Many current approaches to gas line extension run the risk of producing misaligned costs or benefits for customers, utilities and society. The result is that customers may see a biased economic choice between gas and electricity, which can mask the benefits of electrification. Line extension cost recovery policies and the gas utility's obligation to serve should be revisited in light of the potential benefits of building electrification.

This Guidebook

Today, the outlook for securing the benefits of electrification is not as favorable as it could be due in part to numerous outmoded energy policies that distort available opportunities rather than promoting positive economic and environmental outcomes. In this guidebook, we look at some barriers and suggest options for renovation. Although there are many more important issues than we could address in one publication, we have tried to focus on concrete options for regulators to remove barriers and enable beneficial electrification of buildings.

Equitable Building Electrification

The benefits of building electrification can only be fully realized if all energy consumers have the ability to access them. Persistent barriers exist throughout energy regulatory structures that must be addressed to realize the promise of equitable building electrification.

The policy discussions in this guidebook are designed to provide useful options to improve building energy use across the country. When we electrify buildings, they become assets on the power system, as well as healthier and more comfortable places in which to live and work.[9] Ensuring that these benefits reach everyone, however, will require regulators to develop additional understanding and policy expertise beyond what is found in traditional energy-related discussions — understanding and expertise that recognizes and takes action to meet the needs of all our society's energy consumers.

Put another way, efforts to electrify buildings in the United States face many challenges: upfront costs of appliances, electrical upgrades and other building modifications, depending on local circumstances. But one universal and persistent challenge — which presents itself regardless of jurisdiction, utility type, utility fuel mix or business model — is the pervasive need to ensure that all communities are able to access these opportunities and that they are equitably represented in related decisions that affect them. Because of the barriers that residents of low-income and environmental justice communities face in electrifying their homes, policy and regulatory intervention is needed to ensure that these households do not remain connected to a potentially increasingly expensive gas system while wealthier customers electrify and exit the system.[10]

Lay of the Land

Meeting the needs of all of society's energy consumers will require regulators to make an affirmative effort to get to know them and to ensure that, in serving them, the public interest is met.[11] Equity is a broad topic; this chapter looks at challenges that utilities and utility regulators can address.[12] Throughout the chapters that follow, readers will note specific strategies and recommendations for ensuring building electrification is equitable.

It is important for states to recognize that, even where they intend to be inclusive or already consider their policies to

9 Seals, B., & Krasner, A. (2020). *Health effects from gas stove pollution.* Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club. https://rmi.org/insight/gas-stoves-pollution-health

10 The Greenlining Institute and Energy Efficiency for All. (n.d.) *Equitable building electrification: A framework for powering resilient communities*, p. 22. https://greenlining.org/wp-content/uploads/2019/10/Greenlining_EquitableElectrification_Report_2019_WEB.pdf

11 "[E]nvironmental justice is not merely a box to be checked," in *Friends of Buckingham et al. v. State Air Pollution Control Board*, U.S. Court of Appeals for the Fourth Circuit, January 7, 2020, p. 44. https://www.southernenvironment.org/uploads/words_docs/Fourth_Circuit_opinion_Friends_of_Buckingham_19-1152_.pdf

12 VEIC proposes six dimensions of equity that may be a useful resource for those wishing to understand further the nuances of equity and ways to incorporate it into energy policy decisions. See VEIC. (2019). *The state of equity measurement: A review of practices in the clean energy industry.* https://www.veic.org/Media/default/documents/resources/reports/equity_measurement_clean_energy_industry.pdf

be so, they may not have all the information they need to actually deliver on good intentions. Articulating utility policy is the job of state lawmakers and regulators. They often need better information to craft truly equitable policy.

Regulatory process sponsors and participants need to get to know all affected communities. The California Public Utilities Commission defines environmental and social justice communities as places whose residents are:

- Predominantly people of color or living on low incomes.
- Underrepresented in the policy-setting or decision-making process.
- Subject to disproportionate impact from one or more environmental hazards.
- Likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities.[13]

Regulators should recognize the need for meaningful engagement in public utility commission processes and work to enable that engagement — encouraging speaking appearances at hearings and submission of written comments, or meeting with stakeholders prior to the opening of a docket or a rulemaking. Depending on the stakeholder or community, however, regulators should understand that public utility commission processes are not intuitive and participating in a hearing or docket can be a considerable barrier. The formal litigation of a regulatory proceeding, where decisions are made on the basis of an evidentiary record developed by different parties, may be a foreign concept to many and will likely require the assistance of an attorney. This requires time and resources and constitutes still another barrier to meaningful participation.

> Developing a successful building electrification program requires an understanding of all of the communities being served and the many barriers they face.

Developing a successful building electrification program requires an understanding of all of the communities being served and the many barriers they face. "Low income" may have a variety of meanings, but it is likely to describe consumers who lack the means — because of cost, access or other circumstances — to consider energy improvements such as electrified space and water heating. Many low-income households rent rather than own their homes and therefore do not have the ability to make decisions about appliances like water heaters and stoves. Landlords, meanwhile, have little or no incentive to spend money on equipment upgrades that would only benefit renters who pay the utility bills.[14] Low-income households also tend to live in buildings that are in relatively greater need of weatherization and other basic upgrades and repairs, which can pose a challenge to electrifying their energy uses in ways that increase their home comforts and lower their bills. But without electrification, these households will potentially be left behind, relying on an increasingly unaffordable fossil gas system and bearing a larger and larger share of that system's fixed cost — while wealthier customers electrify and disconnect from fossil gas.[15]

Successful building electrification programs will recognize these along with other challenges, including language preferences and cultural barriers such as a lack of trust in government and utilities. These and other community-specific factors will affect the success of efforts to equitably electrify buildings.

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13 These communities also include tribal lands and low-income households and census tracts under other state-specific designations and disadvantaged communities identified by the California Environmental Protection Agency's "CalEnviroScreen." California Public Utilities Commission. (2019, February 21). *Environmental and social justice action plan.* Version 1.0. https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/DC/Env%20and%20Social%20Justice%20ActionPlan_%202019-02-21.docx.pdf

14 Robbins, L., & Bartolomei, D. (2018). *Seizing the moment: Incorporating efficiency, health, and renewables upgrades into affordable housing financing events.* 2018 Summer Study on Energy Efficiency in Buildings. American Council for an Energy-Efficient Economy. https://www.energyefficiencyforall.org/resources/seizing-the-moment-incorporating-efficiency-health-and-renewables-upgrades/

15 In this guidebook we use the term "fossil gas" to refer to the commodity commonly known in the industry as natural gas. We have done this to distinguish it from other forms of methane such as renewable natural gas or biogas, which do not come from fossil fuel.

A Renovation Toolkit

To ensure that building electrification programs can meet the needs of all energy consumers, regulators can start by considering whether the programs that utilities are delivering meet state equity goals, where those goals exist, and how existing programs further concepts of equity as desired in their state. Regulators can also examine how utilities can be most effective in their engagement and how to apply those lessons in the context of building electrification. In this section, we discuss actions to gain useful information, plan effective convenings and adopt programs to deliver building electrification more equitably.

1 Get a better handle on how well existing programs and policies are working. States that aren't certain of the effectiveness of traditional clean energy programs could start by surveying communities and gauging the actual level of participation, and by collecting data on the effectiveness of existing programs and identifying lessons learned for building electrification.[16] In ascertaining the effectiveness of clean energy programs, states could draw upon data related to energy burden[17] and utility disconnection rates.[18] As an example, when the California Legislature determined that it lacked sufficient information to ensure that clean energy resources would, in fact, serve all communities in the state equitably, it included in SB 350, the landmark clean energy bill passed in 2015, a directive to state agencies to assess equity barriers.[19] In doing so, the Legislature recognized and was willing to rectify the shortcomings in clean energy policies that were mistakenly presumed to be accessible by all.[20] The legislation directed state agencies to identify the relevant barriers and provide recommendations on how to increase equitable access to, for example, building electrification, energy efficiency and building weatherization.

2 Improve opportunities for meaningful engagement in policy and regulation. State regulators can endeavor to make proceedings more inclusive and thus more likely to produce outcomes that address broader concerns.[21] Regulators can adopt numerous specific outreach and engagement strategies, including holding meetings in varied locations to make it easier for more communities to attend; partnering with local community groups to host those meetings; providing child care; providing alternative ways of submitting public comment, such as by recorded voicemail or with an online form; providing translation for the meeting when appropriate; holding meetings outside of 9-to-5 business hours; and refraining from using jargon and acronyms. The Energy Trust of Oregon, the program administrator for energy efficiency programs for the investor-owned utilities in that state, has a diversity, equity and inclusion plan that includes six goals directly related to procedural fairness and representation, which may also serve as an example for regulators and program administrators.[22]

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16 For a survey of metrics and data sources that could be used to evaluate existing programs and identify options for improvements, see VEIC, 2019.

17 Drehobl, A. (2016, May 20). *Explaining the unique energy burden of low-income households.* American Council for an Energy-Efficient Economy. https://www.aceee.org/blog/2016/05/explaining-unique-energy-burden-low

18 See, for example, Lauf, D., & Peters, D. (2020, April). *State moratoriums on utility shut-offs and related actions during the COVID-19 pandemic.* National Governors Association. https://www.nga.org/wp-content/uploads/2020/05/State-Actions-on-Utility-Disconnections-May-2020.pdf; National Association of Regulatory Utility Commissioners. (2020, August 3). *State response tracker.* https://www.naruc.org/compilation-of-covid-19-news-resources/state-response-tracker/; and LIHEAP Clearinghouse. (n.d.). *State disconnection policies.* https://liheapch.acf.hhs.gov/Disconnect/disconnect.htm

19 California Energy Commission. (n.d.-a). *Clean Energy and Pollution Reduction Act — SB 350.* https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/clean-energy-and-pollution-reduction-act-sb-350

20 See, for example, California Energy Commission. (n.d.-b). *Energy equity indicators.* https://www.energy.ca.gov/data-reports/tracking-progress/energy-equity-indicators

21 For example, the Jemez Principles for Democratic Organizing could provide a useful starting point for those organizing convenings that they wish to be more inclusive. See Working Group on Globalization and Trade. (1996, December). *Jemez principles for democratic organizing.* https://www.ejnet.org/ej/jemez.pdf

22 See Energy Trust of Oregon. (2018, December 14). *Energy Trust of Oregon: Diversity, equity and inclusion operations plan.* https://www.energytrust.org/wp-content/uploads/2018/10/DEI-Operations-Plan-Executive-Summary.pdf. See also VEIC, 2019.

3 Intentionally design more effective building electrification programs. As they improve their levels of engagement, regulators can likewise encourage the development of programs that address local barriers to electrification and prioritize benefits particularly important to communities. The Greenlining Institute and Energy Efficiency for All, in their report *Equitable Building Electrification: A Framework for Powering Resilient Communities*, articulate useful recommendations for promoting equitable building electrification and understanding local barriers that prevent community members from being able to electrify their homes. The report points out the importance of a program that is "culturally competent" — in other words, a program that first seeks local buy-in, demonstrates local benefits and recognizes the value in coordinating with local, community-based organizations. In addition to counting benefits like carbon emissions reductions, the report emphasizes benefits like job creation and ensuring that program participants can pay their energy bills "without sacrificing other essential expenses."[23]

Other programmatic changes can broaden and deepen access to the benefits of building electrification. The Greenlining Institute and Energy Efficiency for All recommend that decision-makers ensure building electrification programs are properly coordinated with complementary programs, such as existing weatherization programs, and that funding cycles are predictable and sufficient to deliver the most benefits to all qualifying households. Marrying electrification with weatherization and building shell improvements, as we discuss further in the efficiency programs chapter, is especially important for low-income customers in order to address the frequently poor quality of the building stock and ensure that occupants' comfort is not sacrificed and total utility bills do not increase. Building electrification programs should also adopt a feedback mechanism that can inform needed adjustments where necessary to improve program shortcomings.

State example: Serving low- and moderate-income communities[24]

New York state's 2019 Climate Leadership and Community Protection Act (CLCPA) provides a good example of designing a state energy efficiency program to better serve low- and moderate-income communities and to improve upon that service as program administrators incorporate relevant data and lessons learned. The CLCPA requires that a part of state residential energy efficiency funding go to disadvantaged communities. A related Public Service Commission order identifies the need for a definition of, and more data on, disadvantaged communities. The order also allocates 20% of the new EE funding to low- and moderate-income customers.[25] It directs the New York State Energy Research and Development Authority to track and report data on this spending and to make improvements to its tracking as its ability to identify disadvantaged communities improves. Furthermore, the Public Service Commission directs the energy authority to develop a "Customer Hub" to better serve these communities, and it plans to revisit the spending levels based on recommendations from a Climate Action Council that was formed pursuant to the CLCPA.

23 The Greenlining Institute and Energy Efficiency for All, n.d., p. 6.

24 Napoleon, A., Kallay, J., & Takahashi, K. (2020, February). *Utility energy efficiency and building electrification portfolios through 2025: A brief on the New York Public Service Commission's recent order.* Synapse Energy Economics. https://www.synapse-energy.com/sites/default/files/NY-EE-Brief-19-082.pdf

25 New York State Department of Public Service, Case No. 18-M-0084, Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025, January 16, 2020, p. 103. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b06B0FDEC-62EC-4A97-A7D7-7082F71B68B8%7d

4 Reassess and improve programs regularly. Incorporating review opportunities into programs and policies can allow for reassessment and improvements in the future. For example, the Regional Greenhouse Gas Initiative's (RGGI) program review mechanism is an opportunity to review the effectiveness of the program and reflect current equity considerations in potential program modifications.[26] The program review will afford environmental and social justice advocates and their supporters an opportunity to push for changes to the program that affect their constituencies. Advocates can use the program review to ask RGGI states to both recognize the program's effects on the environmental and economic status of all communities in the region and to consider the needs of these communities as states allocate program allowance revenues. Within the framework of RGGI's cap-and-invest mechanism, the program review is an opportunity for member states to direct investment dollars generated from auction proceeds into equitable building electrification.

Takeaway

Enabling building electrification has the potential to make buildings more comfortable to live in and an integral part of a cleaner and more flexible power system. Delivering on that promise will require that regulators ensure all consumers are able to experience those benefits. This brief discussion illustrates the need for regulators to determine just how broadly utilities are currently providing services, ensure that regulatory processes are sufficiently inclusive and develop programs that deliver benefits equitably.

26 Farnsworth, D., Littell, D., James, C., & Speakes-Backman, K. (2016, July). *RGGI program review: A model to reduce uncertainty in state carbon plans.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/rggi-program-review-model-reduce-uncertainty-state-carbon-plans/

Rate design: A foundational issue

Underlying many of the issues and recommendations discussed in this guidebook is the question of how electricity rates are designed — an issue that poses fundamental challenges to building electrification as well as the cost-effective adoption and utilization of distributed resources more generally. Retail rate design, both for electric and gas customers, affects the economic motivations of customers to make choices about their energy sources and consumption patterns. The way that utility costs are apportioned into different types of charges (energy, demand and fixed charges, for example) determines whether retail rates will encourage or discourage customer behavior that benefits the grid and whether electrification will be cost-effective.

A couple of specific rate design concepts are worth highlighting in the context of electrification. First, non-time-differentiated energy charges for electric customers create an economic challenge for building electrification. One of the most valuable capabilities of electrified buildings, as discussed in the next chapter, is flexibility with regard to when electricity is consumed. Without time-varying rates, which provide an opportunity for building operators to save money by using this flexibility, the economic justification for electrifying building end uses becomes much less clear.

Second, gas utility retail rates create barriers to electrification. Gas rates are artificially low because of the tendency to amortize gas infrastructure costs over extremely long time frames, up to 80 years in some places, which do not account for the imperative to shift away from the use of gas sooner to meet climate goals. In addition, where they exist, high fixed charges for gas customers mean that electrification can result in significant gas bill savings only if the entire building is electrified — often an expensive prospect. If more costs were recovered through the volumetric (per therm) portion of the bill, there would be more immediate economic justification for electrification of individual end uses. This has important implications for low-income customers who want to electrify. Increased electric bills need to be offset by the elimination of gas bills in order to make electrification accessible and equitable.

A third issue implicates both electric and gas retail rate design, namely the tendency to fund achievement of state policy goals through riders added to electric bills but not gas bills. For example, policy requirements for the acquisition of renewable energy — such as renewable portfolio standards — have only been paid for through electric rates, whereas historically gas utilities have not been required to meet similar standards. Energy efficiency programs tend to be more generously funded through electric bills than gas bills. And all of these riders tend to be applied as a flat, per-kWh fee, which creates an additional economic barrier to switching to electric by diluting the potential flexibility benefits available from time-varying rates.

We address rate design further in the next chapter.

Load Flexibility and Grid-Interactive Efficient Buildings

Electrified, flexible and grid-interactive buildings have the potential to contribute to overall energy savings, the integration of renewable energy, reduced system costs and improved customer economics and productivity. Multiple challenges currently prevent building owners and operators from understanding and capturing the value that flexible loads can provide.

Flexible building loads that are actively managed to respond to grid needs can serve as essential resources in the electricity system. Buildings can be made into a grid resource by focusing their energy demand reductions at high-cost times or shifting load to times of day when excess renewable energy is being produced. Active management of demand can provide more value to the grid than traditional demand response (see the text box on Page 15). Building electric loads can be actively managed by a utility, a third-party aggregator or customers themselves, in response to a grid signal or grid need. For example, a utility could notify customers when loads need to be shed or shifted, and customers can respond to an incentive or price signal to reduce certain demands or alter the timing of their usage. Alternatively, utilities or third-party aggregators can directly control devices such as smart thermostats or electric vehicle (EV) chargers to shed, shift or shimmy their load in response to grid needs.

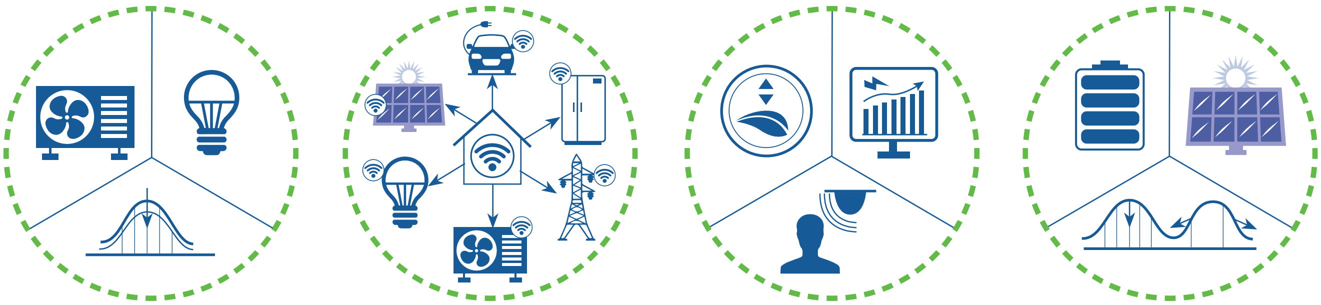
For buildings to be grid interactive and provide value to the grid, end uses of energy in buildings need to be electrified. Building electrification could lead to positive or negative impacts on the grid. As new loads are added, there could be adverse impacts to the grid if those loads are exacerbating peaks. Conversely, if electrified buildings are also grid interactive, they can be part of a strategy to increase energy savings, manage grid resources and integrate more renewable energy, reduce system costs and improve customer economics and productivity. The most prominent technologies related to building electrification, such as efficient heat pump space and water heaters, have the potential to increase the flexibility of building loads because they have some amount of associated thermal storage.[27]

In describing the ability of grid-interactive efficient buildings (GEBs) to improve the functioning of the grid, the U.S. Department of Energy has identified four main characteristics of such buildings, as shown in Figure 1 on the next page.[28] While all four are important, it is flexibility that allows GEBs to deliver significant value to the grid. To access that value, the building must be efficient, connected (able to send and receive signals from the grid) and smart (analytics and controls can manage various aspects of behind-the-meter activity).

27 With current technology, it is challenging if not impossible to shift space heating away from peak hours on the coldest days in cold climates. A discussion of the details of how flexibility works from a technological perspective is outside the scope of this guidebook.

28 Neukomm, M., Nubbe, V., & Fares, R. (2019). *Grid-interactive efficient buildings.* U.S. Department of Energy. www.energy.gov/sites/prod/files/2019/04/f61/bto-geb_overview-4.15.19.pdf

Figure 1. Characteristics of grid-interactive efficient buildings



Source: Neukomm, M., Nubbe, V., and Fares, R. (2019). *Grid-Interactive Efficient Buildings*

Grid-interactive commercial buildings are likely to have more technological elements than residential buildings, such as an energy management and information system, zone controls for heating, ventilation and air conditioning (HVAC), controllable window shading and plug-load controls. In both commercial and residential GEBs, there may be other on-site distributed energy resources such as EV chargers, solar photovoltaics or battery storage. These technological considerations affect what kinds of flexibility, and therefore the services and values, a GEB can provide to the grid.

Challenges and barriers within current regulatory structures prevent building owners and operators from understanding and capturing the value that flexible loads can provide. These challenges must be addressed for the full potential of electrified, grid-integrated buildings to be realized.

Lay of the Land

In this section, we consider challenges that utilities and regulators can address directly.

There is a need for a better understanding of the value of the benefits that GEBs can provide. In the building electrification context, load flexibility provides the opportunity to mitigate the increased costs that electrification could otherwise create. At a high level, the capabilities of efficient, smart, connected and flexible buildings have been well articulated in other research:[29]

- Energy and capacity savings.
- Ancillary services provision.
- Reliability.
- System efficiency.
- Renewable energy integration.
- Reduction in greenhouse gases and other pollutants.
- Enhanced occupant comfort and productivity.

However, when speaking specifically in the context of building electrification, the value of load flexibility and the capability of GEBs to optimize the grid have not yet been fully characterized. To ensure that more buildings are electrified and grid integrated, regulators, utilities and building operators need more information about GEBs and how they can become a resource to provide value to customers and the grid.

Utilities lack the financial incentive to deploy the services and capture value from flexible buildings. Under the traditional cost-of-service regulatory paradigm, utilities would see increased investment opportunities and profits from electrification, but adding load flexibility to the portfolio at the same time would reduce those opportunities.

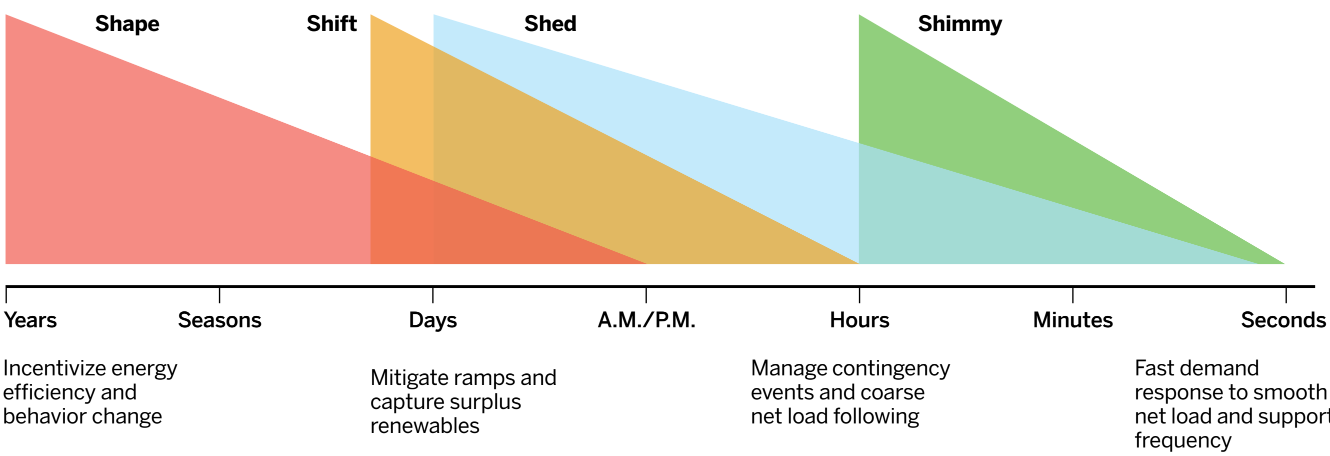
29 NASEO-NARUC Grid-interactive Efficient Buildings Working Group. (n.d.). *Grid-interactive efficient buildings: State briefing paper.* National Association of State Energy Officials. https://naseo.org/data/sites/1/documents/publications/v3-Final-Updated-GEB-Doc-10-30.pdf

Defining the forms of active demand management

Throughout this chapter, we refer to the different forms, and related grid services, of active management of demand. We use the terms and definitions put forward by Lawrence Berkeley National Laboratory as shown in Figure 2.[30] These services take place over varying time scales, ranging from years down to minutes and seconds. Flexible, grid-interactive buildings can provide many of these services and deliver value to the grid. We include here a brief description of these values:

- Shape (actions over years or seasons): Incentivize energy efficiency and customer behavior change over the longer term and change the long-term trajectory of grid needs.
- Shift (actions over the course of a day or a few hours): Mitigate costs associated with steep increases in demand at peak hours and move that usage to another time of day when, for example, surplus renewable energy is available on the grid.
- Shed (actions over the course of days, hours or shorter time frames): Manage grid stress events, such as critical peak hours. Shed actions are what many think of as traditional demand response.
- Shimmy (actions over the course of hours, minutes or seconds): Provide power quality and support frequency.

Figure 2. How active demand management benefits the grid



Source: Alstone, P., et al. (2017). *2025 California Demand Response Potential Study — Charting California's Demand Response Future: Final Report on Phase 2 Results*

Outdated legacy retail rate designs (the prices customers pay for their electric service) dull consumer awareness and thus limit customers' ability to take full advantage of demand flexibility, which reduces the potential economic benefit of electrifying. But redesigned rate structures can monetize the grid services that flexible loads can provide and give an incentive to building owners and operators to participate in pilots, programs and the broader market as it develops. If electricity pricing is not structured in a way that communicates accurate, cost-based information about the value of various services to the grid, then customers (including managers of grid-interactive buildings) will not be encouraged

30 Alstone, P., Potter, J., Piette, M. A., Schwartz, P., Berger, M. A., Dunn, L. N., Smith, S. J., Sohn, M. D., Aghajanzadeh, A., Stensson, S., Szinai, J., Walter, T., McKenzie, L., Lavin, L., Schneiderman, B., Mileva, A., Cutter, E., Olson, A., Bode, J., … Jain, A. (2017, March). *2025 California demand response potential study — Charting California's demand response future: Final report on Phase 2 results*. Lawrence Berkeley National Laboratory. https://eta.lbl.gov/publications/2025-california-demand-response

to fully capitalize on the potential benefits that they could provide to the grid.

Long-term planning typically fails to recognize how grid-connected, flexible buildings can act as a resource to the grid and avoid potential increases in system costs as large new electric loads are added. This failure often results from not fully recognizing demand-side resources in the process of planning for future grid needs and regulators' limited visibility into utility distribution planning processes. Consequently, utilities and wholesale market operators overlook useful resources and avoid acquiring them.

A separate challenge applies to states and utilities that operate in organized wholesale markets. Current market structures and rules can impede or outright prevent distributed resources, such as those available in grid-connected buildings, from participating in the market. For example, minimum bid sizes effectively block the small and medium-sized demand-side resources from bidding into wholesale markets. Federal Energy Regulatory Commission (FERC) Order No. 2222, which requires each market operator to establish rules that allow aggregations of distributed resources to participate directly in wholesale markets, will create a more level playing field for distributed resources in those markets. Exactly how the order will be implemented in each organized market is yet to be determined.

A Renovation Toolkit

The following discussion looks at ways to remove barriers and encourage the many opportunities that GEBs provide.

1 **Illuminate and reveal the value that demand flexibility can provide.** Because all utility systems are different due to various factors — generation mix, climate and weather, customer base and economics, among others — it is important to understand the value that electrified grid-interactive buildings can provide on a more granular level. Pilots can help illuminate the various value streams produced by demand flexibility from reducing things like peak demand, ramp rates, grid congestion and renewable curtailment. Regulators can push utilities to implement more innovative pilots that would test the ability of buildings to provide real-time demand flexibility that is optimized according to generation resource availability. For example, Southern Company's Smart Neighborhood pilot tests combinations of technologies in highly efficient homes to determine how they can provide values like enhanced reliability and resilience, reduced cost and increased interior comfort.[31]

2 **Address foundational barriers such as the throughput incentive and the utility capital bias** so utilities can proactively seek out the benefits that distributed resources such as flexible buildings can provide, especially when coupled with electrification. Regulators should consider performance incentive mechanisms or other ways to incentivize desired utility behavior. For example, Massachusetts requires state EE program administrators to implement programs that have a focus on both active demand response and electrification (switching from oil and propane to electricity, in this case). The state also gives a performance incentive to program administrators for energy efficiency and peak demand savings, encouraging them to enroll newly electrified customers in such programs.[32]

3 **Structure rate design to communicate the system value of flexible load** so customers are able to respond and receive benefits if they reduce demand at times of system stress and help utilities avoid associated costs. Regulators should work with utilities to develop rate structures that help align the use of technologies in flexible buildings with system needs. Time-varying rates that have a

31 Southern Company. (2019, May 21). *How Southern Company's smart neighborhoods are transforming the smart home industry.* https://www.southerncompany.com/newsroom/2019/may-2019/smart-neighborhoods-are-transforming-the-smart-home-industry.html

32 Gold, R., Myers, A., O'Boyle, M., & Relf, G. (2020, February). *Performance incentive mechanisms for strategic demand reduction* (Report U2003). American Council for an Energy-Efficient Economy and Energy Innovation: Policy & Technology. https://www.energyinnovation.org/wp-content/uploads/2020/02/Performance-Incentive-Mechanisms-for-Strategic-Demand-Reduction.pdf

significant peak to off-peak ratio (e.g., a 4:1 ratio) are effective at reducing peak demand and saving customers money.[33] These rate designs, and more dynamic structures that more closely reflect the needs of the grid, may be essential for the economics of building electrification to work. The additional monetary benefit that customers could derive from their electrified space and water heating loads on a time-varying rate could be significant.[34] In addition, demand charges should be deemphasized — indeed, avoided altogether — particularly for commercial and industrial customers.[35] These types of charges do not communicate system need or value and thus do not give these customers a financial benefit for using their on-site resources and adjusting their consumption in a flexible way.

4 Regulators should continue to push for innovative changes to utility planning processes. For example, they could require resource and distribution planning processes to incorporate forecasts of electrified and grid-interactive buildings as a load but also as a potential resource for meeting grid needs. A Rocky Mountain Institute analysis shows the potential long-term economic benefits of incorporating demand flexibility into portfolio analyses and planning, including avoiding duplicative investments in gas generation for meeting peak loads and integrating renewables.[36] This will require proactive engagement and planning on the part of utilities and regulators that incorporates the capabilities of flexible, grid-connected buildings.[37] Some states are moving forward on this; an example is Minnesota through its integrated distribution planning process.[38]

5 Wholesale market operators should also be planning for electrification and the value that increased flexible loads can provide. In addition to planning, market operators should ensure that participation rules do not unfairly prevent flexible demand-side resources from providing services. States can influence discussions within wholesale markets and communicate the need for better market rules for valuation of flexible loads. States can push wholesale markets to adopt rules that are fair to demand-side resources and develop products that seek out the services that aggregated demand-side resources can provide. FERC Order No. 2222 has created an important opportunity for states to do just that by engaging with their market operators in the process of developing compliance filings that market operators must now undertake.

Takeaway

Grid-interactive, flexible loads like those potentially available from electrified buildings will be essential for managing the grid of the future. Systemic and programmatic challenges must be overcome to realize the potential value these resources can provide. Not all barriers can be tackled by regulators, but progress is possible on a number of fronts. Regulators should work with stakeholders to determine the most important barriers within their states and move forward with steps to address them.

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33 Faruqui, A. (2016). *Dynamic pricing and demand response.* The Brattle Group. brattlefiles.blob.core.windows.net/files/5760_dynamic_pricing_and_demand_response.pdf

34 Billimoria, S., Henchen, M., Guccione, L., & Louis-Prescott, L. (2018). *The economics of electrifying buildings: How electric space and water heating supports decarbonization of residential buildings*. Rocky Mountain Institute. http://www.rmi.org/insights/reports/economics-electrifying-buildings/

35 Linvill, C., Lazar, J., Dupuy, M., Shipley, J., & Brutkoski, D. (2017). *Smart non-residential rate design*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/smart-non-residential-rate-design/

36 Goldenberg, C., Dyson M., & Masters, H. (2018, February). *Demand flexibility: The key to enabling a low-cost, low-carbon grid.* Rocky Mountain Institute. http://rmi.org/wp-content/uploads/2018/02/Insight_Brief_Demand_Flexibility_2018.pdf

37 See, for example, this statement about the capabilities of storage: Washington Utilities and Transportation Commission, Docket No. U-161024, *Report and policy statement on treatment of energy storage technologies in integrated resource planning and resource acquisition,* August 23, 2016. https://www.utc.wa.gov/docs/Pages/DocketLookup.aspx?FilingID=161024

38 St. John, J. (2018). *Minnesota's integrated distribution plan: The Midwest model for grid edge integration?* Greentech Media. https://www.greentechmedia.com/squared/dispatches-from-the-grid-edge/minnesotas-integrated-distribution-plan-the-midwest-model-for-grid-edge-int

Energy Efficiency Resource Standards

Energy efficiency resource standards set a high-level policy framework within which efficiency programs and measures are developed and delivered. The goals and targets within the standards significantly influence what types of efficiency options are pursued in a given state. EERS policies need to be reexamined to encourage, support and capture the benefits and opportunities that electrification can provide.

EERS policies set binding energy savings targets for utilities to achieve. The standards have traditionally been designed to require savings of specific energy resources, namely electricity and fossil gas. Twenty-six states have some form of an EERS for electricity, and 19 have an EERS for gas. Most of these standards set savings targets as a percentage of retail sales, meaning that each year the savings from energy efficiency measures must equal a certain percentage of the utility's retail sales of that same product. Some states structure their EERS as an "all cost-effective" standard, meaning that utilities must acquire all energy efficiency that is deemed cost-effective according to the applicable cost-effectiveness frameworks in their state. Cost-effectiveness tests and associated challenges are discussed in the next chapter. EERS have been successful at driving energy savings: In 2017, states with an EERS achieved incremental electricity savings of 1.2% of retail sales on average, compared with 0.2% savings in states without an EERS.[39] Figure 3 shows state-by-state savings targets.[40]

Lay of the Land

Although EERS have historically been successful at accomplishing energy savings goals, these policies need reexamining in light of the potential benefits and new capabilities that building electrification provides. This includes new opportunities for consumers to save money on their total home energy bills and for states to achieve long-term environmental policy goals, such as GHG emissions reductions.[41] These outcomes are not maximized by EERS policies that solely focus on resource-specific energy reduction targets.[42]

In fact, traditional electric-sector EERS policies may hinder the willingness or ability of utilities and EE program administrators to accomplish building electrification because electrification will increase electricity consumption[43] and make compliance with electricity savings targets harder. This is particularly true for those EERS that set savings targets as a percentage of prior year sales, which means that with

39 Gold, R., Gilleo, A., & Berg, W. (2019). *Next-generation energy efficiency resource standards* (Report U1905). American Council for an Energy-Efficient Economy. https://www.aceee.org/research-report/u1905

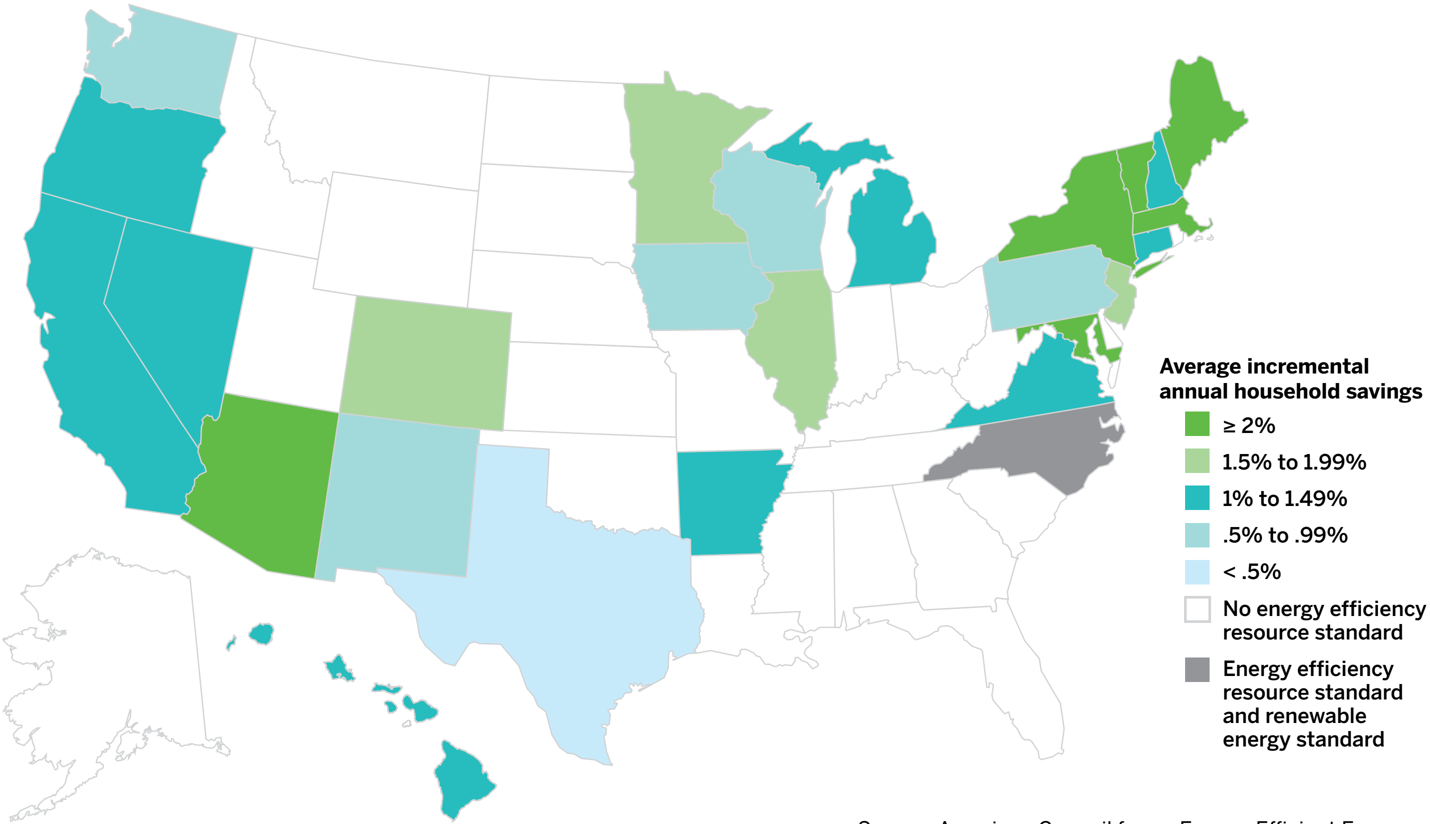
40 American Council for an Energy-Efficient Economy, personal communication, November 16, 2020.

41 Electric Power Research Institute. (2018). *U.S. national electrification assessment*. https://www.epri.com/research/products/000000003002013582

42 Gold et al., 2019.

43 Mai, T., Jadun, P., Logan, J., McMillan, C., Muratori, M., Steinberg, D., Vimmerstedt, L., Jones, R., Haley, B., & Nelson, B. (2018). *Electrification futures study: Scenarios of electric technology adoption and power consumption for the United States* (NREL/TP-6A20-71500). National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy18osti/71500.pdf

Figure 3. Electricity savings targets under state energy efficiency resource standards



Source: American Council for an Energy-Efficient Economy

electrification and associated load growth, utilities and EE program administrators must achieve ever more challenging amounts of energy savings to comply with the policy. Gas savings targets similarly do not welcome electrification as an allowed fuel-saving measure. Traditional EERS frameworks do not count unregulated fuel savings (e.g., reducing oil use by installing a heat pump) toward achievement of targets.

The current structure of most EERS policies also does not recognize the potential time- and location-specific benefits of flexible electrified loads.[44] As more devices and appliances in homes are connected to the grid, many of these will be controllable loads that can be programmed to respond to utility signals in demand response programs or to price signals communicated through time-varying rates. The most flexible of these loads are likely to be water heaters, while space heating will have some flexibility that depends, in part, on the performance of building shells. The flexibility and connectedness of new loads means that there are new opportunities to decrease electricity use at times of day when it is most valuable to do so. Flexible loads can also be programmed to draw energy from the grid at times when it is most advantageous to do so, such as when low-cost (or zero-cost) energy from renewables is available.

Timing and location-specific effects of flexible load will become increasingly important with greater quantities of variable generation on the grid, but most traditional EERS do not value flexibility because kWh savings targets are not differentiated by the times that are most important to the grid.

Finally, EERS goals have historically focused on the electricity savings accomplished in the first year of a program or measure, rather than savings over a longer period. This creates incentives for efficiency implementers to avoid measures that

44 Some states such as New York and California have begun to address this challenge by including time- and location-specific avoided costs in cost-effectiveness analyses for energy efficiency programs. This issue is briefly addressed elsewhere in this guidebook, while this chapter focuses on EERS policies themselves.

produce longer-lived savings. Many of those measures, however, are needed for successful building electrification, such as installing heat pumps for heating and cooling and water heating and improving building envelopes.

New opportunities for consumers and for achievement of broader societal goals argue for revisiting the structure of EERS targets and the types of goals underlying them.

A Renovation Toolkit

State policymakers and regulators have options for revising EERS savings targets and goals in light of the opportunities presented by building electrification. We briefly outline three of those options.

1 Consider replacing the existing targets with fuel-neutral targets or add a fuel-neutral target as an overarching goal. A fuel-neutral goal, denominated in Btu or GHG emissions rather than in units of specific fuel savings, will allow utilities and program administrators to look for the most cost-effective ways to save total energy, even if that may mean increasing the amount of electricity used.[45] A fuel-neutral goal could be implemented as the only energy savings goal in the jurisdiction, or it could be part of a broader set of goals that may also include resource-specific carve-outs or subtargets. Without an electricity-specific subtarget, utilities could disregard the importance of electric energy efficiency measures in favor of measures that simply add load while reducing total energy consumption.[46] Aside from implementing a subtarget for electric energy efficiency, one way to avoid this is to include requirements and guidelines for the types of measures that can be considered "beneficial" within the EERS policy. For example, the program could require heat pumps installed through the program to be highly efficient, as determined by an expert organization like the Northeast Energy Efficiency Partnerships.[47] Wisconsin and New York are two states that have different versions of fuel-neutral targets in their EERS policies.[48] Both also have required subtargets for electricity savings, maintaining the pressure on utilities to electrify beneficially. New York has an additional subtarget for energy savings specifically attributable to installation of heat pumps.

A fuel-neutral goal may necessitate a discussion about the source of funding for measures to meet that goal. Typically, electric and gas customers pay for measures designed to meet electric and gas savings goals, respectively. Taking a total-energy or fuel-neutral perspective within goal setting might require taking a broader, total-energy perspective on funding to meet those goals.[49] Ultimately, the funding source for accomplishing fuel-neutral savings may need to be broader or more diverse than relying solely on fuel-specific ratepayer funding.

2 Remove fuel-switching barriers within existing EERS policies. In the absence of (or in addition to) a fuel-neutral goal or target, states could allow fuel-switching measures to count toward some portion of their efficiency targets. In other words, the energy saved through

45 It is worth briefly distinguishing between "site" and "source" energy. Site energy reductions occur on site at a customer's premises and can be significant when converting from a fossil fuel appliance to an electric version. Source energy reductions occur upstream at the generator, and these calculations must include the fuel inputs to electricity generation and line losses associated with delivering energy. As a result, the source energy reductions attributable to electrification will be lower than site energy reductions. However, as electric supply shifts away from thermal generators, losses from combustion and heat conversion to electric energy will become a smaller part of the energy picture, and site and source energy results will move closer together (and in a decarbonized system, arguably differ only by line losses). For the purpose of the discussion in this guidebook, which is focused on a forward-looking and decarbonizing context, we are generally referring to site energy use and site energy use reduction.

46 This concern arises from the traditional utility business model, which aligns with electrification in a way that reducing electricity consumption through efficiency does not.

47 See Northeast Energy Efficiency Partnerships. (n.d.). *CCASHP specification & product list.* https://neep.org/ASHP-Specification

48 See Public Service Commission of Wisconsin, Docket No. 5-FE-101 (Reference No. 343909), Final decision, Quadrennial Planning Process III, June 6, 2018. apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=343909; and New York State Energy Research and Development Authority. (2018). *New efficiency: New York*. www.nyserda.ny.gov/About/Publications/New-Efficiency

49 A comprehensive treatment of all potential program funding options is outside the scope of this guidebook. However, it is worth mentioning that there are a number of funding options, including putting a tax on fuels that ought to be discouraged, restructuring system benefit charges within efficiency programs, carbon taxes and cap and trade revenue.

fuel switching could be documented, converted to units of electricity using some pre-agreed-upon assumptions and counted toward compliance with a traditional EERS. To ensure that beneficial measures are pursued, guidance could be given to utilities and program administrators on what measures will qualify. In California, for example, the state recently revised the cost-effectiveness guidance for EE policies to be more broadly supportive of fuel switching when it is beneficial.[50] In addition to removing barriers to fuel switching, EERS policies should shift to focusing on lifetime savings rather than first-year savings in order to align efficiency program development with building electrification measures.[51] These changes at the target-setting level can facilitate similar shifts within program design, which is the topic of another chapter of this guidebook. In other words, if goals and targets become more aligned with electrification opportunities, program and incentive design can follow.

3 Consider additional targets and goals that focus on the flexibility needs of the future electric grid. With greater amounts of variable generation on the grid and the proliferation of connected, efficient end-use loads, energy efficiency and demand response can be more targeted and valuable. The targets and goals within EERS policies can encourage the development of measures that accomplish this. For example, peak demand reduction targets, such as those being implemented in Massachusetts, could be used to ensure that, as utilities pursue beneficial electrification, they have requirements to electrify in ways that don't exacerbate system peaks and drive up overall costs to ratepayers. Measures that target load reductions when inefficient fossil-fueled generators are operating (or add beneficial loads preferentially when renewable generators are operating) more effectively accomplish environmental goals such as reducing air pollution and greenhouse gases and potentially save more overall (total) energy.

Takeaway

Energy efficiency resource standards have been highly successful at driving electric energy savings but need revisiting in order to encourage and capture electrification's benefits and opportunities. In particular, regulators and policymakers need to refocus EERS goals and targets from solely focusing on reducing electricity or fossil gas use to decreasing total energy use, reducing GHG emissions or supporting the evolving needs of the future electric grid.

50 Takahashi, K., Frost, J., Goldberg, D., Hopkins, A., Nishio, K., & Nakano, K. (2020). *Survey of U.S. state and local building decarbonization policies and programs.* 2020 Summer Study on Energy Efficiency in Buildings. American Council for an Energy-Efficient Economy. https://www.synapse-energy.com/sites/default/files/Takahashi_et_al_2020_Survey_of_US_Building_Decarb_Initiatives.pdf

51 Gold, R., & Nowak, S. (2019). *Energy efficiency over time: Measuring and valuing lifetime energy savings in policy and planning* (Report U1902). American Council for an Energy-Efficient Economy. https://www.aceee.org/research-report/u1902

Energy Efficiency Program Delivery

Energy efficiency programs have historically focused on energy savings within the electric and gas systems separately, but they can deliver more value to consumers and society by enabling customers to make the best choice, regardless of fuel. Such comparisons can reveal the potential for beneficial electrification of energy end uses.

Utilities and other state-level administrators deliver energy efficiency savings through programs of various types across the United States. These programs are funded with ratepayer dollars, often collected through some sort of on-bill charge.[52] In 2018, the cumulative energy savings from ratepayer-funded electric energy efficiency programs was over 250 million megawatt-hours (see Figure 4).[53] Other EE programs are administered and paid for by state governments and by the federal government through programs like the Weatherization Assistance Program.

Energy efficiency programs consist of a wide range of structures and offerings. They include, for example, financial incentives for customers to purchase certain types of products, appliances and equipment, building audits to identify promising EE upgrades, direct installation of efficient products such as free lightbulbs, training for building engineers and contractors to increase their awareness of efficiency measures and educational outreach to customers to increase their knowledge of the benefits of energy efficiency.

Lay of the Land

Much like EERS policies, traditional approaches to energy efficiency programs have been successful at accomplishing electricity and gas savings, but similarly need reexamining in light of building electrification. There are opportunities and barriers to building electrification within EE program design and delivery.

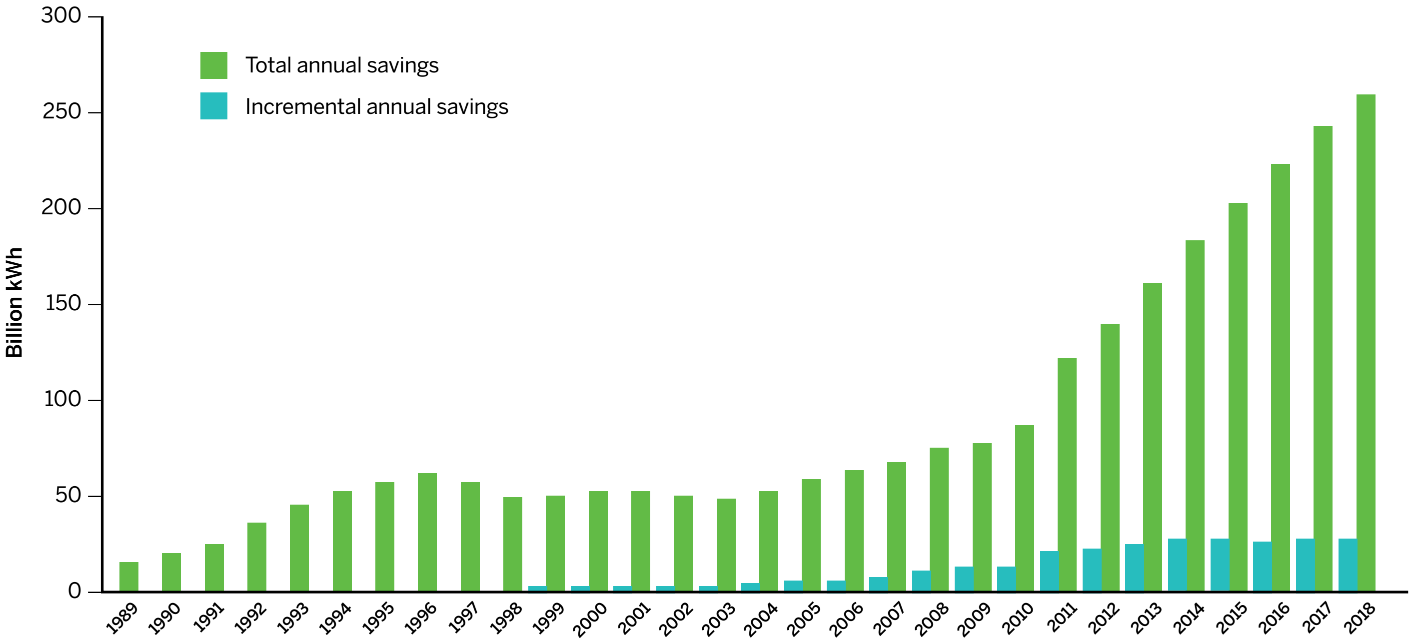
First, many state EE policies prohibit the use of program funds for fuel switching. These policies prevent utilities and EE installers from discussing options with consumers, such as replacing a gas furnace with an electric heat pump, that might reduce their overall household energy burden, lower emissions or increase occupant comfort and indoor air quality. Instead, programs often create an added barrier to electrification by only providing incentives to upgrade to a more efficient appliance using the same fuel. For example, gas utility EE programs offer incentives for more efficient gas appliances. Sometimes those incentives are so large that they more than offset any lifetime savings a customer might experience by switching to a more efficient electrical appliance.[54] In addition, gas program

52 For much more detail on the structure and performance of utility energy efficiency programs, see Berg, W., Vaidyanathan, S., Junga, E., Cooper, E., Perry, C., Relf, G., Whitlock, A., DiMascio, M., Waters, C., & Cortez, N. (2019). *The 2019 state energy efficiency scorecard* (Report U1908). American Council for an Energy-Efficient Economy. https://www.aceee.org/research-report/u1908

53 Berg et al., 2019.

54 For example, Massachusetts residential gas customers can receive roughly a $1,000 rebate for upgrading to a high efficiency gas furnace. This is almost certainly going to be larger than any potential savings a customer might see from switching to a heat pump, particularly because the economics of switching to heat pumps are more challenging in cold climates.

Figure 4. Electricity savings from ratepayer-funded efficiency programs



Source: Berg, W., Vaidyanathan, S., Junga, E., Cooper, E., Perry, C., Relf, G., Whitlock, A., DiMascio, M., Waters, C., and Cortez, N. (2019). *The 2019 State Energy Efficiency Scorecard*

incentives encourage customers to select or retain gas as a fuel if they are not given a comparison with electrical choices, locking in the customers to use fossil gas for the next two decades or so.

Second, the vast majority of furnace and water heater replacement happens at the time of failure, leaving very little opportunity for customers to think about replacing their equipment with a different fuel type. The urgency of such a replacement makes sense — often this occurs during the heating season, and there is not much time to spare in getting a working replacement up and running.

Third, opportunities to coordinate building shell improvements with heating and cooling system replacement are going unrealized. Better insulated and sealed buildings have a lower heating load requirement, meaning that a smaller, efficient heat pump could more suitably meet heating and cooling needs. Furthermore, better insulated buildings retain their indoor temperatures longer, thereby increasing energy savings and enabling flexibility through preheating or precooling. However, building owners may not be able to afford to address both the building shell and heating system within a short time frame, and few energy efficiency programs offer attractive financing options for customers.[55] This has the potential to exacerbate equity concerns if low-income customers are unable to pursue weatherization in conjunction with electrification.

Finally, policymakers need to recognize the role that cost-benefit analyses currently play in EE program delivery and the potential impact that the design of cost-benefit tests will have on the success of building electrification.[56] Specifically, EE programs and measures have historically been subject to cost-benefit testing, meaning that in order for programs and measures to be pursued, utilities and program administrators must demonstrate that benefits outweigh costs. Choosing a more narrow or limited cost-benefit test can be a barrier to beneficial electrification.

55 Deason, J., Leventis, G., Goldman, C. A., & Carvallo, J. P. (2016, June). *Energy efficiency program financing: Where it comes from, where it goes, and how it gets there*. Lawrence Berkeley National Laboratory. https://emp.lbl.gov/sites/all/files/lbnl-1005754.pdf

56 A full discussion of the limitations associated with certain cost-benefit tests is beyond the scope of this guidebook.

A Renovation Toolkit

Related to the issues identified above, we describe several options below that policymakers and regulators could use for addressing barriers and renovating their energy efficiency programs.

1 Reconsider fuel-switching prohibitions and incentive structures to encourage fuel-neutral, beneficial decisions by program administrators, end users and suppliers. Energy efficiency programs ought to allow participants to choose an appliance that uses a different fuel if it achieves some beneficial outcomes, such as lower overall costs or reduced emissions. In the case of utility or third-party-administered EE programs, this would effectively mean that program funds originating from electric customers could be used to provide incentives for switching from one fossil fuel (e.g., oil or gas) to electricity. One example is a heat pump incentive offered by the state of Maine in which income-eligible or mobile home households can receive up to $2,000 for a ductless heat pump, regardless of the existing primary heating fuel.[57] The possibility that utilities would then shift significant focus toward these fuel-switching types of measures (and possibly away from electricity-saving measures) means that policymakers would likely need to put some criteria or limitations on the use of such funds (e.g., GHG emissions reductions).

Incentive structures within efficiency programs need to be reviewed in light of the need to address the siloed, fuel-specific nature of program design and implementation. At the very least, consumers ought to be eligible for an incentive to choose an efficient heat pump when they opt to switch away from a fossil-fueled appliance. Ideally, however, the incentive structure would reflect the overall energy efficiency benefit of various appliance choice options, regardless of fuel type. The greatest incentives should go to choices of appliances that operate most efficiently (on a total energy basis), have the potential to provide flexibility to the grid, emit less harmful pollution and have the potential to save consumers and the energy system the most money. As noted in the EERS chapter, a total-energy approach to the use of program funds may need to be accompanied by a broader approach to the collection of such funds.

2 Develop early replacement appliance offerings within EE programs. Consumers can be encouraged to evaluate the remaining useful life of their existing appliances before an emergency replacement is needed; such offerings would allow them to consider the full range of replacement options — including fuel switching. For example, it may be worth cutting six months off the useful life of a fossil-fueled furnace to have the benefit of the option of switching to a high-efficiency heat pump.[58] Such installations can take time to evaluate and complete, which can be an insurmountable barrier during heating season. Early replacement options could also be helpful to contractors and suppliers in scheduling their work over the course of a year, rather than all in the rush of heating season. To encourage consumers to consider this option, programs should include an evaluation of the remaining useful life of existing appliances and the potential costs and benefits of electrifying, which could be done at the time of a previously scheduled EE home visit. Such programs should also consider including assistance to customers who may need to upgrade existing electrical service or run a new circuit to facilitate electrification and evaluate whether future incremental electric sales could justify the socialization of some or all of those costs.

Where they have existed, early replacement programs have often explicitly prohibited fuel switching. These prohibitions should be removed, and incentives for early replacement should take into consideration and be structured to acknowledge the potential for lifetime net benefits of such actions.

57 Efficiency Maine. (n.d.). *Heat pump rebates for low and moderate income Mainers.* https://www.efficiencymaine.com/income-eligible-heat-pump/

58 This might be especially true if there is an immediate need to replace an air conditioner. In this instance, even if an existing fossil fuel furnace has remaining useful life, it makes sense to consider a heat pump to replace (or displace) both space heating and cooling appliances.

3 Evaluate comprehensive options, including weatherization and beneficial electrification, in program offerings and incentive structures. A whole building retrofit that makes the building envelope more energy-efficient will improve the economics and viability of the installation of heat pumps for water and space heating, particularly in certain climates. Weatherization can make an electrified building more flexible by enabling preheating and precooling and other forms of demand response without compromising performance. Energy efficiency programs and incentives can be structured to encourage or ensure that building electrification is connected to overall building efficiency measures when it is prudent to do so. This will be especially important for low-income and multifamily properties that tend to be less efficient to begin with. In cold climates, weatherization of the building envelope may be essential to making a heat pump effective at both saving energy and maximizing comfort.

4 Reconsider cost-benefit analysis frameworks for efficiency and beneficial electrification. Traditional cost-benefit frameworks may not be appropriate for evaluating the merits of building electrification measures. For starters, some traditional methods do not capture the potential cost savings of fuel switching. The utility cost test, for example, does not include as a benefit the cost savings to the end users or the overall economic benefit of reducing total fuel costs if the fuel cost savings come as a result of switching from one fuel type to another. In addition, many states' cost-benefit frameworks do not consider non-energy benefits, such as carbon reduction, indoor air quality, health impacts or economic development, which may be important policy drivers for pursuing building electrification.

Regulators should consider whether their existing cost-benefit framework and the way costs and benefits are calculated reflect the potential benefits of building electrification that are relevant to their state, such as GHG reductions, integration of renewable energy or reduced energy burden for low-income residents. It is possible that changing to a different cost-benefit test (e.g., the societal cost test) or making selected changes to the existing framework could remove unnecessary barriers.[59] For example, using GHG emissions rates for the electric system that reflect the grid resource mix over the long term would better capture the full benefits of expected renewable energy growth. Another possibility is to create new goals and metrics to be achieved along with existing energy savings goals, allowing utilities to meet these new targets through electrification measures.

Takeaway

Energy efficiency programs run by utilities and other administrators have historically been quite successful at directly reaching customers with energy- and money-saving strategies and technologies. Today, however, they need renovation to enable all utility customers to enjoy the benefits of fuel switching. We have identified four major barriers in current program structures that regulators and policymakers should address, particularly removing barriers to fuel switching in existing program design and cost-benefit analysis frameworks. It is also important to reevaluate program design and implementation to unlock the potential benefits of building electrification.

59 For example, California had a test called the Three Prong Test, which presented a barrier to electrification measures. One of the requirements under this test was for fuel substitution measures to be cost-effective at the measure level under both the total resource cost test and the utility cost test. Because electrification measures increase electric consumption, they cannot pass the utility cost test. Recognizing this critical barrier to electrification, the California Public Utilities Commission recently made a major reform by replacing this requirement with a requirement that the overall program portfolio must be cost-effective. For more details, see Takahashi et al., 2020, p. 9.

Building Codes and Performance and Disclosure Standards

Regulatory approaches to building decarbonization, such as building energy codes and performance standards, can complement programs and other methods for supporting building electrification.

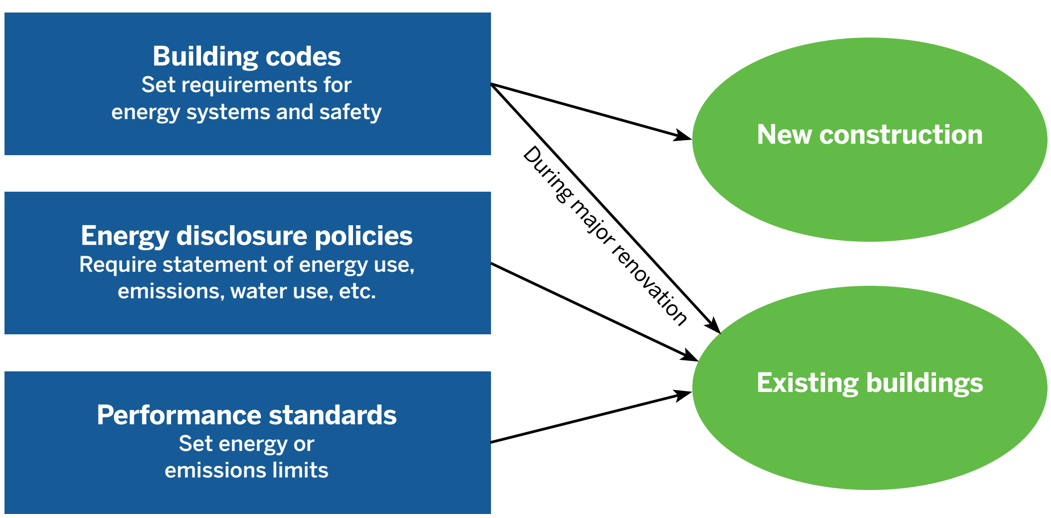
The regulatory tools that governments can implement include building energy and safety codes, building performance standards and building energy disclosure and benchmarking.[60] The effectiveness of the various tools we discuss in this chapter depends on whether the focus is on new or existing buildings. Figure 5 illustrates how these tools are generally applied to new and existing buildings and the basics of what the tools do.

Lay of the Land

New Buildings

The lack of authority to develop their own building codes is one of the biggest barriers cities and towns in most states face in promoting electrification.[61] States generally set minimum building energy codes that apply to all cities and towns within their jurisdictions. Some states allow cities to adopt a stronger code called a stretch code, but often

Figure 5. Regulatory tools and their roles



60 Although not the focus of this chapter, local and state governments can also offer programs such as tax credits, incentives and rebates, education and financing programs, including property-assessed clean energy. See Neme, C., & Wasserman, N. (2012). *Policies to achieve greater energy efficiency.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/policies-to-achieve-greater-energy-efficiency/

61 There are some exceptions to this, namely some large cities that have their own codes (e.g., New York, Seattle, Boston) and several states that allow local governments to adopt their own codes (e.g., Arizona, California, Kansas, Mississippi, New Hampshire, Texas). For a list of states that allow for local code adoption, see Building Codes Assistance Project. (n.d.). *Local adoptions by state.* https://web.archive.org/web/20200616234543/http:/bcapcodes.org/code-status/local-adoptions/

there is only one stretch code to choose. This is the case in Massachusetts, which has just one stretch code that cities and towns may adopt, and it is not currently designed with electrification in mind.

Other potential barriers are outdated building codes that favor fossil-fueled heating equipment over heat pumps or that do not have an adequate process for approval of heat pump space or water heaters. For example, California's code historically did not allow gas water heating systems to use the default compliance pathway and did not recognize heat pump water heaters as an option. The 2019 building code addressed these barriers.[62]

Even though most local governments do not have the authority to develop their own codes, they can take action to promote electrification. For example, local governments can leverage their special permit process for new construction to promote electrification. In these processes, local governments often negotiate terms that go beyond the base building construction code with new building owners who are interested in constructing buildings that require special zoning approval. Using this process, local governments, as a condition for receiving special permits, could require new buildings to be all-electric or to have the capability of becoming all-electric in the future. Such an approach cannot be easily scaled because it takes more time and resources to promote electrification on a building-by-building basis and applies only to buildings that require special approvals.

Local governments at the forefront

One exception to the statewide approach to building code regulation is California's reach code model. This approach allows cities to develop and adopt their own codes; these codes do not have to be state approved, as long as the city can prove its code is cost-effective.[63] Under this regulation, local governments can develop stronger energy codes that go beyond the state-mandated minimum building energy code and promote electrification — for example, by banning gas hookups in new construction or mandating stricter energy efficiency requirements for new buildings that use gas or other fossil fuels. Many local governments in California established new reach codes to promote electrification in 2019. A few leading cities that have regulatory authority on building codes (e.g., Boston, New York City and Washington, D.C.) are now planning to adopt net-zero energy codes, which generally require all new buildings to produce enough energy to meet their needs over the course of a year. Other cities with similar regulatory powers could follow suit and adopt net-zero energy codes ahead of state actions and show leadership for their states. In doing so, cities should work with housing agencies and consumer protection organizations to advance building codes and promote electrification in an equitable way.

Existing Buildings

Efforts to electrify existing buildings face a number of barriers. We focus on the barriers that are best addressed with regulatory solutions. First, while all homeowners and building owners have access to their energy usage data via their bills, most of them do not know how energy-efficient their buildings are or how much carbon dioxide or other pollutants their buildings are emitting. This lack of information on baseline energy use and emissions makes it difficult for building owners to assess the merits of other options, such as electrification investments.

Second, building owners and renters have different incentives. Owners may not care about how energy-efficient their buildings are because they are simply passing on expensive energy bills to renters. On the other hand, renters cannot take any meaningful actions (e.g., energy retrofits) to reduce their energy bills. These split incentives mean that no entity has a reason to consider an energy efficiency upgrade or switching out an appliance for an electric one.

62 California Energy Commission. (2015). *2016 building energy efficiency standards for residential and non-residential buildings.* Section 150.1 (c), 8. https://ww2.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf; California Energy Commission. (2018). *2019 building energy efficiency standards for residential and nonresidential buildings.* Section 150.1 (c), 8. https://ww2.energy.ca.gov/2018publications/CEC-400-2018-020/CEC-400-2018-020-CMF.pdf; and Hopkins, A., Takahashi, K., Glick, D., & Whited, M. (2018). *Decarbonization of heating energy use in California buildings.* Synapse Energy Economics. https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

63 California Energy Commission, 2018, Section 10-106.

Further, even if building owners are interested in making investments to reduce their energy bills or environmental impacts, they may lack information and familiarity with electrification technologies. The same issue is also applicable to HVAC contractors, builders and architects who are designing and performing energy efficiency retrofits. Regulatory approaches for existing buildings could indirectly address these information barriers (especially when they become sufficiently strict) by creating new demand and markets for electrification. On the other hand, local governments can smooth this transition and directly overcome these barriers by offering public outreach to consumers and technical assistance to building owners and contractors. Some of the other approaches that this guidebook addresses, such as utility programs, can also contribute to addressing these barriers.

A Renovation Toolkit

To address the barriers described above, we suggest state and local governments consider the following options for policy and regulatory renovation.

New Buildings

1 State and local governments can use building energy codes to help overcome barriers to building electrification. Depending on the design choices in building energy codes, they can ensure or encourage that new buildings are built all-electric or all-electric-ready. Codes also require building industry professionals to become familiar with the technologies and approaches that are required, so they can indirectly address the knowledge and familiarity gap. Generally, local and state governments can use one or a combination of the following approaches to mandate or encourage electrification of new buildings:

- **All-electric codes** prohibit the installation of fossil-fueled appliances and equipment for all end uses or certain end uses in new buildings and in some cases ban fossil gas connections.[64] In 2019, Berkeley, California, became the first community in the nation to ban the installation of gas lines in new buildings (low-rise residential) and to require that builders adhere to an all-electric code. Berkeley has since been joined by numerous other California communities, each with its own tailored approach.
- **Electric-preferred codes** encourage all-electric buildings by mandating additional requirements for new construction that opts for the use of fossil gas or other fossil fuels (e.g., requiring higher efficiency standards beyond the state's minimum building codes for new mixed-fuel buildings). California cities that have adopted this approach include San Jose, San Francisco and San Luis Obispo.
- **Electrification-ready codes** require that new buildings be wired for an eventual switch from combustion to electric appliances and/or electric vehicle infrastructure. When such codes are applied only to EV infrastructure, they are called EV-ready codes. Berkeley, San Francisco, San Jose and Menlo Park, also in California, are among the communities that have adopted electrification-ready codes as part of their main electrification codes.[65]

2 States can adopt a reach (or stretch) code that encourages electrification, such as a code for net-zero energy buildings or electrified buildings, and allow localities to adopt it.[66] Alternatively, states could give municipalities the authority to adopt their own reach codes provided that some criteria (e.g., cost-effectiveness) are met.

Current examples of building code innovation are largely from California because the state allows city-level energy code

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64 All-electric codes may also be characterized as non-fossil-fuel codes in that they can allow the use of non-electric systems like solar water heating or wood stoves.

65 Such codes are applicable to EV infrastructure in all new buildings in San Francisco and to both EV infrastructure in new residential buildings and electric wires for appliances in nonresidential mixed-fuel and high-rise residential buildings in San Jose.

66 For sample code language, see Northeast Energy Efficiency Partnerships. (2015). *Model residential stretch code.* https://neep.org/model-residential-stretch-energy-code

Figure 6. Examples of California communities' approaches to electrification codes

Sources: City of San Jose. (n.d.). *San José's Natural Gas Infrastructure Prohibition and Reach Code Ordinances;* City of Carlsbad, Ordinance No. CS-348, 2019; Codron, M. (2019). *Consideration of a Resolution Establishing a Clean Energy Choice Policy and Implementation Measures Including an Ordinance Approving Local Amendments to the Energy Code; and an Ordinance Implementing a Carbon Offset Requirement with an In-Lieu Fee Option;* and Menlo Park City Manager's Office. (2019). Introduction of Ordinance No. 1057

adoption. Communities have taken various approaches to mandate or encourage electrification suitable for the needs of the communities, including those shown in Figure 6.[67]

Existing Buildings

1 Building energy disclosure or benchmarking policies can help remove barriers related to a lack of incentive to learn about and consider electrification technologies on the part of installers, contractors and current or prospective building owners and occupants. Such policies can be implemented at the state or local level and typically require disclosure of all buildings' energy consumption level along with other key building information, such as emissions rates and water usage. This enables new tenants and homebuyers to understand energy efficiency levels and expected energy bills for the buildings they are interested in buying or renting. The policy also encourages building owners to invest in energy retrofits and for contractors to offer energy-efficient options. However, building disclosure and benchmarking policies alone are not sufficient to promote building electrification effectively because the policy itself does not require investment in energy retrofits or electrification.

2 Building performance standards help overcome information and split incentive barriers by establishing limits on energy use or emissions for existing buildings, typically by building type. Such standards will also indirectly address other types of barriers, such as lack of

67 City of San Jose. (n.d.). *San José's natural gas infrastructure prohibition and reach code ordinances.* www.sanjoseca.gov/home/showdocument?id=45668; City of Carlsbad, Ordinance No. CS-348, 2019. edocs.carlsbadca.gov/HPRMWebDrawer/RecordHTML/533053; Codron, M. (2019). *Consideration of a resolution establishing a clean energy choice policy and implementation measures including an ordinance approving local amendments to the energy code; and an ordinance implementing a carbon offset requirement with an in-lieu fee option.* Council Agenda Report, Community Development, City of San Luis Obispo. http://opengov.slocity.org/WebLink/DocView.aspx?id=96415&dbid=0&repo=CityClerk; and Menlo Park City Manager's Office. (2019). Introduction of Ordinance No. 1057 (Staff report No. 19-187-CC). www.menlopark.org/DocumentCenter/View/22773/F5---20190910-Intro-reach-code-ord---CC?bidId=

familiarity with electrification technologies among contractors and building occupants. If the limitations are expressed in terms of GHG emissions or site energy, when they are reduced over time to be sufficiently strict, existing buildings will need to electrify their space and water heating or switch to renewable energy sources (e.g., solar hot water and biomass) to meet the lower limits. This policy is often first applied to large commercial and multifamily buildings for which data are available because the buildings have been subject to disclosure and benchmarking. New York City, Washington, D.C., and St. Louis have adopted building performance standards for large commercial buildings, and Boston and other cities are currently examining building performance standards.[68]

Cities or states considering establishing performance standards for existing buildings should begin by gathering the necessary information through disclosure and benchmarking policies. Disclosure and performance standards can be tailored to encourage electrification by:

- Establishing formal processes for consultation among city or utility electrification leaders, the owners of low-performing buildings, builders, architects and HVAC engineers regarding the options to improve performance through electrification.
- Gathering stakeholder feedback on feasible and workable building standard designs, limits and time frames.
- Setting a formal expectation and time frame for how disclosure and benchmarking policies will be followed by performance standards, to encourage action even before it is required.
- Setting emissions performance standards, rather than only energy use performance standards, on a path to a level that will essentially require electrification or the use of renewable fuels for most buildings within a known time frame, with strict limits on the ability to use off-site offsets.

New York City's approach is illustrative: The city's building performance standard targets GHG emissions, rather than energy use. The city enacted its building performance standard through Local Law 97 as part of the Climate Mobilization Act to help meet the city's target of an 80% GHG reduction by 2050. Local Law 97 targets emissions reduction for large buildings in a two-phase strategy. The law set emissions limits by various building types for 2024 and 2030, with the 2030 limits substantially more stringent (about half of or less than half of the 2024 limits). Municipal buildings have stricter emissions requirements than privately owned buildings (i.e., 40% reduction by 2025).[69] Further, building owners will be required to submit annual compliance reports to prove they meet the standard. If building owners do not comply with their building emissions limits, they are fined an amount proportional to their emissions overrun. The law establishes a new office to administer and oversee policy implementation and track emissions compliance.

Takeaway

Local governments have unique leverage and interaction with building owners through permitting and development regulations, as well as inspections. Cities can advance electrification in both new and existing structures by building on those regulatory levers. Where authorized under state law, cities can adopt electrification-friendly building codes, or they can advocate for their states to adopt them, and in doing so they can help avoid emissions and reduce energy use. For existing buildings, a promising emerging policy paradigm starts with energy benchmarking and disclosure, then moves on to emissions performance standards that effectively require electrification or renewable fuels.

68 Nadel, S., & Hinge, A. (2020). *Mandatory building performance standards: A key policy for achieving climate goals.* American Council for an Energy-Efficient Economy. https://www.aceee.org/sites/default/files/pdfs/buildings_standards_6.22.2020_0.pdf

69 Russo, C. (2019). A building-emissions overhaul: How NYC's LL97 impacts owners and prospective buyers moving forward. *National Law Review.* www.natlawreview.com/article/building-emissions-overhaul-how-nyc-s-ll97-impacts-owners-and-prospective-buyers

Policies for Extending the Gas Utility Network

Broadly speaking, current approaches to gas line extension run the risk of producing misaligned costs or benefits for customers, utilities and society. This means that customers may see a biased economic choice between gas and electricity, which can create an unfair barrier to electrification. Line extension cost recovery policies and the gas utility's obligation to serve should be revisited in light of the potential benefits of building electrification.

Gas line extensions, including mains that bring gas service to new geographic areas and the new service lines that connect each building to the network, are built because customers, including building owners and developers, decide to install gas appliances for energy uses like space and water heating, cooking and laundry. An alternative choice would be to install only electric appliances. The decision to connect to the gas pipeline is influenced by policies and regulations that determine who pays for the infrastructure and what costs and benefits are considered. For all-electric buildings to compete fairly with gas, the costs and benefits of the gas connection need to be apparent and clear to the customer making the decision.

Additions to the gas network, such as line extensions and service lines to new customers (illustrated in Figure 7 on the next page), are long-lived infrastructure that could remain physically operable long after GHG emissions reduction requirements necessitate that they carry no or almost no fossil gas. These pipes risk becoming stranded assets for the gas company, with some claim on public or ratepayer funds to make utility investors whole.

The way costs for line extensions are shared among ratepayers and a potential new gas customer therefore affects whether new customers can compare gas and electric options on equal footing and heightens the risk of stranded assets.

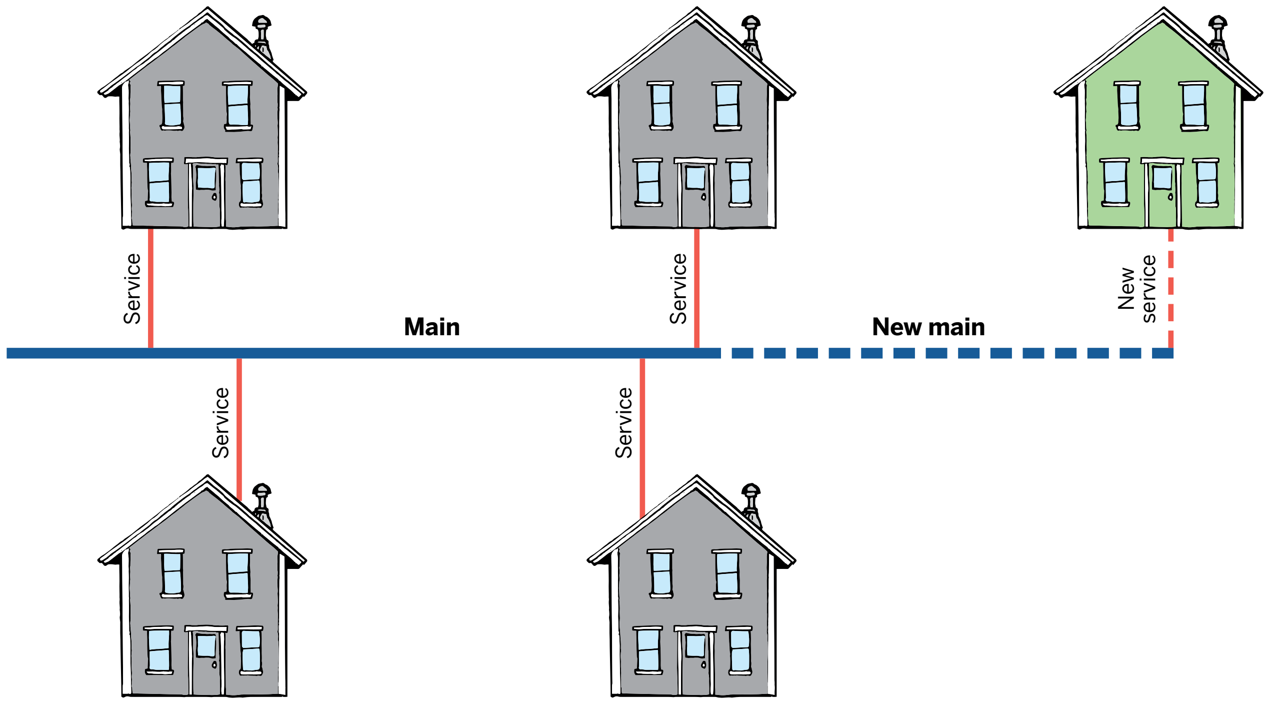
Lay of the Land

As mentioned, various aspects of the existing regulatory paradigm for gas systems may heighten the risk that those assets will eventually be stranded — leading to higher costs for customers, especially those who stay on the gas system longer. Current line extension cost recovery policies and the obligation to serve have the potential to create an unfair barrier to electrification.

Today, the cost of gas line extensions is typically shared between the utility and the new customer. The utility's portion is recovered from all ratepayers. In utility regulation, this portion is commonly referred to as "economic" for the utility to pay for because, over time, new customers will contribute additional funds through their bills to the utility's capital costs and eventually pay back the other ratepayers for this portion of their line extension and service line costs. This portion of the costs is sometimes referred to as the costs that are socialized among all ratepayers. Any costs beyond the economic portion are charged directly to the new customer (paid up front or spread over a few years).

There are no commonly accepted standards for how to calculate the economic portion. This calculation depends on the number of years over which the cost would be recovered and the amount of gas sold each year. Rather than conduct a

Figure 7. Gas distribution system, with added main and service to connect new customer



special calculation for each customer, utilities often rely on assumptions about typical consumption. In some cases, state law simply establishes a length of new service line that must be provided at no cost to the customer. New York law, for example, requires that customers can only be asked to pay for new services over 100 feet.[70] The New York utility regulator has extended this requirement to direct the utility to socialize the cost of up to 100 feet of residential service line and 100 feet of main line if the customer will be a heating customer[71] (and thus make a larger contribution toward the new piping costs through their bills).

The calculation of what portion of line extension costs is economic is the critical calculation to determine whether the costs presented to customers are fair and reflective of risks. For example, if the pipe lifetime included in the calculation of economic line extensions is longer, or the usage is lower, than the actual lifetime or usage, then some portion of the costs has been misassigned, and there is a risk of stranded costs. Differences between the actual and expected lifetime or usage could result from public policy, from improving customer economics or performance of nongas options or from other drivers that change customer behavior and desires regarding appliances in their home.

Regulators have an obligation to review the calculations that utilities perform to determine cost allocation; however, line extension cost calculations are not generally a high priority for regulators and do not undergo regular review. When they are reviewed, typical utility tariffs filed before regulators state only the logic of the calculation, rather than the specific assumptions and coefficients used in the calculations. As a result, calculation of economic line extension costs may have inherent biases, and regulators, utilities and other stakeholders

70 Consolidated Laws of NY § 31.4, Applications for service. https://www.nysenate.gov/legislation/laws/PBS/31

71 NY Codes, Rules and Regulations, 16 NYCRR § 230.2, Provision of gas service. https://govt.westlaw.com/nycrr/Document/I505bd382cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

may all lack understanding of the calculations' implications.

In addition, gas utilities typically have an obligation to serve new customers, provided that the socialized portion of the costs doesn't exceed the economic amount. (If a customer wants to pay the excess and get service, they can do so.) One implication of this obligation is that customers can force utilities and, by extension, other ratepayers to take on the risk that the costs of new main and service lines will in fact be recovered. At the same time, the customer or utility has no obligation to evaluate whether gas is the right choice or whether other fuels may be preferable.

Finally, traditional utility planning processes exacerbate the challenge of properly evaluating gas network expansion. Gas utility planning focuses on procuring sufficient supply to meet demand, with little or no consideration of potential alternatives, such as demand-side reductions.[72] These processes have historically not addressed the impacts of gas network expansion on the ability of states to meet climate goals, nor have they analyzed the changing market dynamics that may lead to stranded assets.

Gas line extensions in context

Reconsidering line extension policies and practices takes place within the context of numerous changes in the gas utility industry, driven by changes in both policy and technology. These changes include the market introduction of highly efficient and affordable heat pump water heaters and cold climate air source heat pumps, which present new competition for gas appliances and could spark competition between regulated electric and gas utilities. At the same time, cities and states are establishing ambitious climate change mitigation targets, plans and policies, including numerous jurisdictions that have adopted bans on some or all new kinds of gas service. Utilities have also increased study and discussion of alternatives to both fossil gas and building-level electrification, including hydrogen, renewable gas and creation and operation of district heating or shared geothermal heat networks.

These changes occur at a time when concern about the safety and climate implications of gas leaks is increasing. Older gas utilities that have extensive cast iron pipe networks are pursuing accelerated pipe replacement programs that have the dual effects of reducing leaks and increasing rate base with assets that could function well for many decades. Low gas commodity prices have made expansion of gas service an attractive economic proposition for many customers, and this has resulted in both the construction of new gas transmission and the advent of capacity constrained areas where availability of new service is limited. Nonpipe alternatives, including both electrification and transport of gas by truck, have entered the utilities' and regulators' toolkits.

Regulators considering the implications of decarbonization for gas utilities should consider opening a broad proceeding that can examine the interplay of these issues, including line extensions.[73] When they do so, equity concerns should be a key component of their scope. Reductions in gas utility sales would increase per-unit gas delivery costs, as utilities raise rates to recover the revenues required to receive their allowed return of and on invested capital. Electrification and falling gas consumption mean lower overall gas bills but only for customers who electrify some or all end uses. Customers who do not electrify are left paying higher gas bills for the same service. This raises substantial equity concerns because low- to moderate-income customers with less access to capital, especially renters who cannot control the fuel they use for heat, could be particularly hurt financially.

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72 Valova, R., Hart, C., Bourgeois T., & O'Brien-Applegate, J. (2020). *Zero net gas: A framework for managing gas demand reduction as a pathway to decarbonizing the buildings sector.* Pace Energy and Climate Center. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B36D3AA36-EACB-40B1-9A67-EBD2CE6BE8E7%7D

73 See Hopkins, A., Napoleon, A., & Takahashi, K. (2020). *Gas regulation for a decarbonized New York: Recommendations for updating New York gas utility regulation.* Synapse Energy Economics. https://www.synapse-energy.com/project/gas-regulation-decarbonized-new-york

A Renovation Toolkit

We have identified some steps that regulators can take to begin addressing the challenges laid out above.

1 **Update the calculation of "economic" line extensions and new services** to include depreciation times consistent with state GHG mitigation targets. In other words, require new infrastructure to be paid for over fewer years than has been historically allowed. Doing so would require new projects to incorporate the cost of this faster recovery into overall cost estimates, meaning that alternatives such as electrification would be able to compete on a more level playing field. Similarly, lower the expected lifetime consumption to reflect the potential for early retirement or less use than historically expected, which would reduce stranded cost risk. This would require regulators to place a higher priority on requiring and reviewing detailed analysis of the costs and risks of line extensions and their expected useful lifetime, including the potential impact of public policy, improving customer economics of nongas options and other drivers that change customer behavior.

> Requiring new infrastructure to be paid for over fewer years than has been historically allowed would enable alternatives such as electrification to compete on a more level playing field.

2 **Expand future-focused infrastructure planning** through a requirement for gas utility integrated resource and distribution planning, which can build on and be consistent with revised regulatory treatment of line extensions and new gas services. Such proceedings should require a review of a full set of potential alternatives to gas network expansion, including demand reductions, and ensure that a fuel-neutral assessment of the most cost-effective solutions is conducted. In addition, such proceedings would be well suited to provide regulators a forum to comprehensively evaluate nonpipe solutions and to develop long-term strategies to ensure that low-income customers are planned for and protected.[74]

3 **Rethink the obligation to serve.** Consider whether gas utilities and their existing ratepayers should retain the obligation to cover the economic costs of connection for

74 For additional options and recommendations to consider when planning for an overall managed transition away from gas, see Valova et al., 2020.

all customers who request connection, including the risk of undercollection. Removing or adjusting the obligation to serve can begin to shift risks of stranded costs away from ratepayers. This could be pursued to varying degrees:

- Consider removing the allowance of any "free" line extension and service costs to new customers, and thereby make each customer who wants to extend the gas system pay the full cost up front. This would also have the effect of preventing new customer additions from adding to the utility's rate base and thus make the utility agnostic as to new customers' fuel choice.
- Over the longer term, consider the possibility that gas utilities could evolve into heating service providers, and alter the obligation to serve such that utilities and customers can evaluate all possible space and water heating options in the determination of the most cost-effective choice.

The electric utility obligation to serve could also be expanded by allowing electric utilities to socialize economic investments in customer buildings to support electrification, such as upgrades to the capacity of a home's electric service to support new electrified loads, when coupled with efficiency and weatherization as part of a comprehensive state policy approach.

4 **Make costs more transparent to customers.** If the obligation to serve is maintained, require customers requesting new service to be informed of their costs for both gas and electric options, including line extension costs for both fuels as well as the performance and cost of heating systems and other appliances. Utilities could be required to provide customers with a common and vetted set of assumptions and market data regarding cost, rates and performance.

5 **Consider adding a social cost of net lifetime GHG emissions to the calculation of the customer costs** so that all ratepayers are not paying for the social cost of the new customer's consumption emissions. This should include both combustion carbon dioxide and on-site methane leakage.

Takeaway

Current regulatory approaches to gas line extensions create a biased economic choice for consumers between gas and electricity and create stranded asset risk for ratepayers and utilities. Regulators have options for how to rethink line extension cost recovery policies and revisit planning and the gas utility's obligation to serve.

Conclusion

Regulatory frameworks need updating to enable the potential benefits of building electrification. We have discussed the ways in which many of our existing energy policies and regulatory structures create unnecessary barriers to electrifying buildings. Addressing these challenges will help realize the full potential of electrified, flexible, grid-integrated buildings.

Fortunately, regulators have options for how to renovate existing regulatory frameworks. We have laid out:

- Options that can help ensure building electrification is equitable.
- Ways to update and streamline energy efficiency policy, goals and programs to be more aligned with the benefits of electrification.
- Key considerations for capturing the full value of flexible, grid-interactive buildings.
- Essential updates to building codes and performance standards.
- Steps regulators can take to evaluate gas network and service expansion on a level playing field with electrification.

Action in these key areas will enable a transition to electrified buildings that minimizes cost, enhances equity and makes environmental policy goals achievable.

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50 State Street, Suite 3
Montpelier, VT 05602
USA

802-223-8199
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