Energy Infrastructure

Sources of Inequities and Policy Solutions for Improving Community Health and Wellbeing

April 29, 2020

Synapse Energy Economics, Inc.

Community Action Partnership
Helping People. Changing Lives.
America's Poverty Fighting Network

RAP®

Contributors

Regulatory Assistance Project

Nancy L. Seidman, Christopher James, Dara Torre, Donna Brutkoski, Janine Migden-Ostrander, Ken Colburn

Synapse Energy Economics, Inc.

Alice Napoleon, Jamie Hall, Jennifer Kallay, Max Chang, Philip Eash-Gates

Community Action Partnership

Kathryn Maddux, Denise Harlow, Meg Power

For further information

Nancy L. Seidman: nseidman@raponline.org
Alice Napoleon: anapoleon@synapse-energy.com
Kathryn Maddux: kmaddux@communityactionpartnership.com

Disclaimer

Support for this study was provided by the Robert Wood Johnson Foundation. The views expressed here do not necessarily reflect the views of the Foundation.

Cover Photo Credits

Clockwise from top left: Utility tower—Giuseppe Famiani on Unsplash; doctor with patient—Bigstock; solar installation—Bigstock; forest fire—Marcus Kauffman on Unsplash.

CONTENTS

1. Executive Summary

Energy is necessary for human survival and prosperity. We rely on energy for many functions that were once considered conveniences but are now integral to the health, economic, and social well-being of individuals, households, and communities in the 21st century. We use energy in countless ways every day: heating and cooling our homes; accessing the internet; powering our computers, cell phones, home appliances, and lights; and increasingly, new uses such as charging cars. Energy is a key contributing factor to the social determinants of health. It is integral to providing a healthy community environment by minimizing air and water pollution, influencing healthier housing conditions, and improving economic prosperity with added clean energy jobs and affordable energy options.

Photo by Zach Lucero on Unsplash.

Energy equity (or energy justice) applies justice principles to energy policy, energy production and delivery systems, energy consumption, and energy security.[1] Energy equity requires that all households and communities have reliable access to and can afford the quantity of energy needed to keep their homes and neighborhoods safe and healthy, to communicate and access information, and to have mobility to reach jobs, family, food and other necessities. But energy equity is not currently a reality for many Americans, particularly low-income households, communities of color, and those in many rural areas and small towns. Almost one-third of American households have difficulty paying energy bills or adequately heating and cooling their homes, and over 20 percent of households—roughly 25 million households—report reducing or forgoing necessities such as food and medicine to pay an energy bill.[2] Communities of color experience energy insecurity, for example having difficulty paying energy bills or sustaining adequate heating and cooling in their homes, more than other groups: in 2015, 50 percent of African American families reported characteristics of energy insecurity, compared to less than 30 percent of whites.[3] Rural households also spend more on energy than other Americans.[4]

Energy production using fossil fuels often pollutes the air, water, and soil in these communities, leading to disproportionate and negative health impacts. Fine particulate matter air pollution emitted by power plants, motor vehicles, and other sources, is estimated to cause more than 100,000 deaths per year in the United States.[5] Exposure to air pollution from power plants varies by race, income, and geography, with African Americans facing the highest mortality rates.[6] Access to clean energy resources (renewable energy and energy efficiency) which can deliver energy without emitting air pollution, remains out-of-reach for rural and low-income communities and communities of color. Collectively, our decisions about

The electricity grid is becoming cleaner. This change offers tremendous opportunities for improving equity in a variety of ways: strengthening local economies with jobs in the growing clean energy industry, reducing public health burdens from fossil power plants, and ensuring access to new, clean technologies in communities burdened by existing energy infrastructure and environmental hazards.

how to build and maintain our energy infrastructure and price its services will affect the health and wellbeing of all our communities.

While equity may seem far off, the power sector is changing rapidly. New and evolving clean energy technologies—energy efficiency, energy demand management, and customer-sited renewable energy like solar—are becoming economically favorable relative to existing fossil-fuel infrastructure and hence becoming mainstream. In addition, states are increasingly encouraging electrification—replacing technologies that run by combusting fossil fuels, like gasoline vehicles and natural gas heating and cooling, with alternatives that run on electricity, like electric vehicles and heat pumps. At the same time, coal power plants are being shut down in growing numbers as they become unaffordable to operate. As a result, the electricity grid is becoming cleaner. This change offers tremendous opportunities for improving equity in a variety of ways: strengthening local economies with jobs in the growing clean energy industry, reducing public health burdens from fossil power plants, and ensuring access to new, clean technologies in communities burdened by existing energy infrastructure and environmental hazards. But there are risks too: as energy markets and regulations shift towards greater consumer dependence on electrical service (and internet access) for their fundamental needs, consumer costs need to decline in order to maintain or alleviate high cost burdens. Purposeful, effective interventions by policymakers, philanthropies, and community advocates are needed to ensure that vulnerable communities receive the health and economic benefits of innovation in the power sector.

This report provides the results of a national study of the disparate impacts of electric and natural gas systems and infrastructure on economic, social, and health outcomes. We group the impacts and our findings on the most promising points of intervention into four overarching categories: energy access, energy affordability, environmental hazards, and employment. We include four case studies to illustrate our findings.

Our research finds that opportunities for addressing equity abound, especially as the transformation of the power sector is underway and proceeding rapidly. The most promising points of intervention include the following:

Improving affordability

- Facilitating cooperative utilities' transition away from the use of coal
- Addressing ratemaking practices that put disproportionate cost burdens on low-income customers
- Ensuring that new and cleaner technologies—energy efficiency, renewable energy, battery storage, and efficient electrification—are affordable, accessible, and provide benefits to frontline communities

Improving access

- Expanding shut-off protections and arrearage management programs
- Implementing policies and initiatives to increase targeted investment in distributed or customer-sited electric resources (e.g., combined solar and storage systems) that can improve reliability in remote areas, avoid the need for expensive distribution system investments, and/or avoid expanding natural gas pipelines that may become unnecessary well before the end of their useful lives

Reducing environmental hazards

- Investing program revenues from cap-and-invest programs (where those exist) in disadvantaged communities, and promoting those programs elsewhere
- Aligning energy and environmental regulatory processes to ensure that clean technologies are appropriately valued and implemented quickly
- Incorporating community resilience as a goal and allocating funding for energy-related resilience and access efforts, such as pairing solar and storage to ensure that essential services are available if the power from the grid goes out

Promoting employment

- Directly addressing the need for increased diversity in clean energy employment with targeted job training
- Providing a transition path for communities and workforces that are economically dependent on coal and other fossil fuels

Implementing cross-cutting measures

- Aligning utility incentives and business models to reflect equity policy objectives, such as promoting a diverse workforce, improving energy affordability and access, and discouraging utilities from pushing a large portion of the cost of service into fixed charges on bills that disproportionately affect low-income consumers
- Improving effective public engagement and equity goals by building connections between government agencies, between agencies and advocates, and between different advocate organizations
- Building the capacity of community and non-profit advocates to intervene in energy decision-making processes and opening up regulatory processes to more input
- Building cooperative (co-op) utility members' capacity to encourage a transition to clean energy resources, ensuring diverse community representation on co-op boards, and giving members access to new clean and lower cost technologies

Four case studies showcase innovations in these areas			
The Regional Greenhouse Gas Initiative illustrates how energy and environmental regulators throughout the Northeast have cooperated over the past 10 years to reduce carbon dioxide from power plants by over 50 percent, improving community conditions and health outcomes.	Ohio's arrearage management program enables low-income ratepayers to avoid service shutoffs by managing their debt to the utility over time in a way that works for many consumers.	Stemming the flow of dollars out of the community and reducing costs for its residents, Bloomfield, Iowa,is using better resource planning and investments in solar and energy efficiency to take charge of its energy future, reducing energy costs and spurring local economic development.	The Minnesota Public Utilities Commission is guiding Xcel Energy using performance-based regulation to improve affordability and reduce residential arrearages and disconnections--and also pursuing ways to incorporate equity-related reliability, customer service quality, and workforce diversity into the regulatory framework.

The problems facing these communities are complex, and no single solution will address all the inequities stemming from the energy sector. With all these solutions, it will take years of sustained effort to overcome challenges, including high mistrust of government and of utilities. Further, efforts beyond the edges of the energy sector are needed. For example, leveraging broadband infrastructure to expand data access and energy management capabilities in rural communities will enable consumers to manage and lower their energy bills.

This report includes a section on future research. Knowledge and implementation gaps include how to improve resiliency and lower environmental impacts in low-income communities, rural areas, and communities of color at a greater scale than projects currently in the works. We see potential for promoting the increased use of integrated resource planning to ensure thorough consideration of non-fossil energy alternatives when utilities and others make decisions regarding resource options. (Integrated resource planning is a regulatory process that examines in detail environmental, cost, and other issues such as the risk of increased heat waves or windstorms.) Additional research on the intersection of energy infrastructure with water, broadband, and transportation infrastructures could provide many promising points of intervention. For example, providing broadband in rural areas can facilitate access to new clean energy technologies (e.g., renewable energy and storage) that require two-way communications with the electric grid. Better broadband service also provides benefits such as improved access to services, job opportunities, and online learning and commerce.

Fortunately, this period of rapid change in the energy sector is accompanied by growing awareness of the need to address the sector's disparate impacts. Many communities are speaking up about current and future impacts from energy on their health and the environment. And in some parts of the country, state legislatures and regulators see the changes underway in the energy sector and are taking steps to build equity into the picture. These bright spots can be leveraged in other places to ensure that clean energy infrastructure is available to everyone. The time has never been better to ensure the energy transition does not leave rural and low-income communities and communities of color behind—instead, they can be partners in creating more affordable and healthier outcomes.

2. INTRODUCTION

Energy is essential to human health and well-being.[7] Energy also has a central role in household and community stability, mobility, and connectivity, and it can build economic and social opportunity. Access to energy is not codified as a basic right in this country, and energy access and affordability can affect communities with low incomes, communities of color, and communities in rural areas and small towns more than others. A variety of environmental impacts arise throughout the life cycle of electricity (generation, transmission, distribution, and consumption) and natural gas (extraction, processing, transport, and use).[8] These activities can cause pollution of air, water, and land, as well as problems with solid and hazardous waste. But in seeking to avoid these impacts, these communities face considerable challenges in advocating for themselves within the energy decision-making process. All of this points to the need to elevate energy infrastructure as an important community condition for social and economic opportunity—one that leads to better health equity.

There is increasing understanding and evidence that where we live and the conditions in our neighborhoods and communities—our economic, social, and built environments—have a profound impact on our health and well-being. This is true now and for future generations. Decisions about where and how to build energy infrastructure—especially how new, cleaner technologies are included—play a major role in shaping these environments. This decision-making process needs to be approached from the perspective of energy equity or energy justice. Energy equity applies justice principles to energy policy, energy production and delivery systems, energy consumption, and energy security.[9] Energy equity requires that households and communities of all incomes, races, geographies, and ethnicities have reliable access to and can afford the quantity of energy needed to keep their homes and neighborhoods safe and healthy. It also requires that everyone be able to communicate and access information, and to have mobility to reach jobs, family, food and other necessities. It emphasizes that communities and regions participate in and benefit from decisions that shape the places where they live. This report seeks to apply these ideas to the energy sector and the decision-making and policy processes that characterize it.

Disadvantaged communities face unequal economic burdens from energy. Photo by Josh Appel on Unsplash.

Disadvantaged communities face unequal health burdens from energy. Photo from Big Stock.

The report describes our national study of disparate impacts of electric and natural gas public and private infrastructure on low-income people, communities of color, and smaller communities (rural communities, towns, and small and midsize cities). Our research included in-person meetings, web forums, and

interviews with 49 respondents representing a wide range of stakeholders from community action agencies, key public decision-makers in the electric and gas utility space, non-government organizations active in this topic, and others. We also conducted a literature review and interviews for our case studies. For a description of the study's methodology, see Appendix A.

The first section of the report describes how the electricity and natural gas sectors currently work, including key influencers, decision-makers, policies, financing flows, and practices within the natural gas and electric ecosystem. It describes the widespread, rapid changes these sectors are currently experiencing and will experience in the future. We then discuss four overarching challenges to health, social, and economic equity (i.e., energy access, energy affordability, environmental hazards, and employment), and promising points of intervention for each, including cross-cutting solutions. Finally, we provide key areas for future research.

3. Connection to Health and Equity

There are many pathways through which energy affects health and equity. The following table shows a subset of known impacts. We group these impacts into energy access, energy affordability, environmental consequences of power generation on community conditions, and employment. These impacts, and promising points of addressing them, are discussed in Section 5.

Energy affordability	Energy burden	Energy burdens are critically high for many Americans, particularly for low-income and rural communities and communities of color.
	Utility business model and regulation	Traditional utility regulation favors large investments that push up electricity rates.
		Construction cost overruns are common for large new generation facilities (e.g., nuclear) and are often partially or totally included in rates.
		Regulatory framework in many states focuses on reasonable rates rather than on affordability.
	Barriers to managing energy use	Some utility rate structures do not support managing energy use and penalize low-usage and low-income customers.
		Energy efficiency is not funded adequately (or focused enough) to reach all who would benefit.
		The public lacks awareness of how to reduce energy use and programs that are available to help them better afford their bills.
		Costs of serving rural areas are higher than in urban areas and are reflected in rates.
Access to energy	Barriers to clean distributed generation and energy efficiency	Rates of home ownership for low-income populations and communities of color are low; renters, face additional barriers to installing measures to reduce energy costs.
		Low-income populations often live in poor-quality housing; managing energy use safely is difficult, and repairs may be needed before measures to reduce energy costs can be installed.
		Rapid changes in the energy sector make it difficult for communities and regulators to ensure equal access to new technologies.
	Account shutoffs	Account terminations are common for low-income populations and contribute to energy insecurity.
	Rural access	The reliability of the power grid is poor in some rural areas.
		Natural gas distribution systems are not present in many rural areas.
Environmental Consequences of Power Generation on Community Conditions	Air quality	Criteria and toxic pollutants emitted from power plants create serious and disproportionate public health impacts.
	Water and Solid Waste	Resource extraction can have large water and solid waste impacts. In the absence of federal policy, many states do not have adequate regulations on gas extraction.
		Fossil and nuclear power plants create waste (e.g., coal ash, radioactive waste) that can leak into waterways and groundwater.
	Climate-related health impacts	Carbon dioxide emitted by power plants contributes to climate change, which scientists believe will have severe and disproportionate negative impacts on health of low-income populations (e.g., increased asthma, diseases, impacts from exposure to extreme heat).
	Regulatory authority	Regulators face or perceive constraints on their authority to address equity issues.
Employment	Energy sector jobs	Clean energy (renewable and efficiency) is a good and growing source of jobs compared to employment in conventional fuels, but the workforce is less diverse than the overall population.
	Plant retirements	Power plant closures can result in reduced tax base and loss of employment in surrounding communities.
	Aggregated data	Employment analyses often lack attention to demographic and local impacts.

4. How the Electricity and Natural Gas Sectors Work

This report considers the infrastructure and systems that provide electricity and natural gas for use in homes and businesses, with a focus on residential customers. Below, we describe how the electricity and natural gas sectors work currently, and changes that are disrupting and improving the way energy can be provided.

4.1. What Is Included in the Sector?

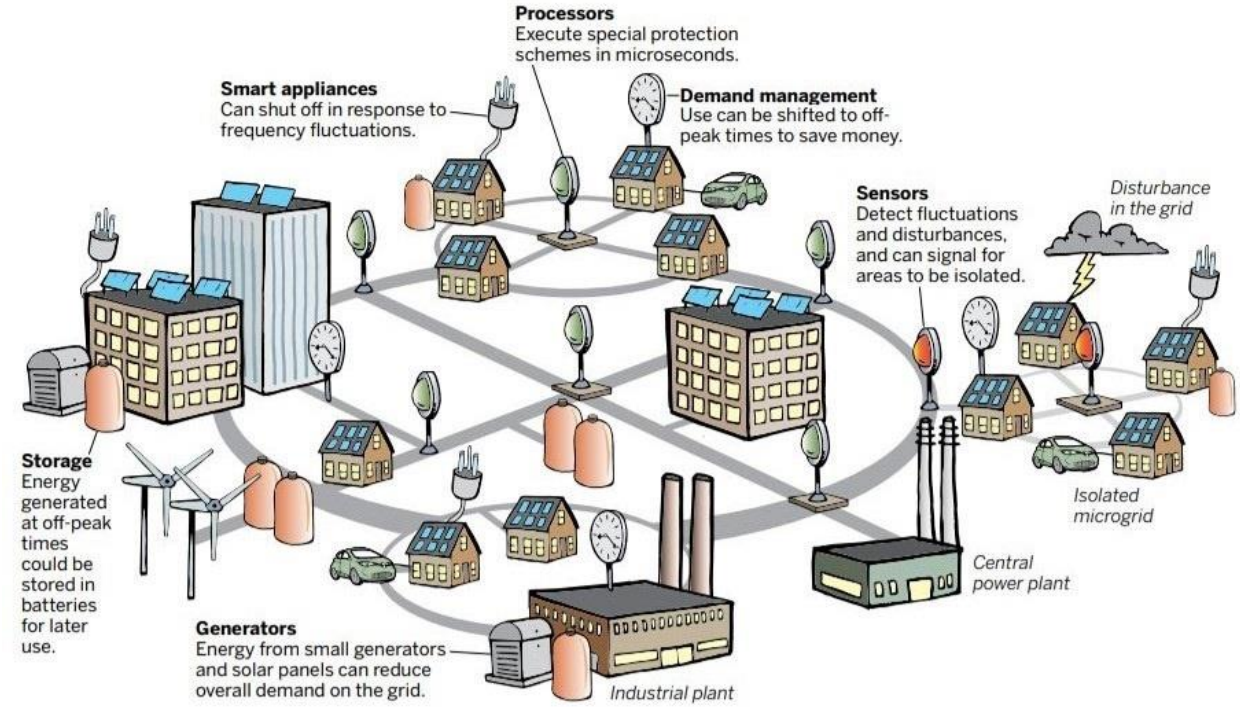
Electricity

Electric infrastructure includes three components of the power grid: generation, transmission, and distribution. Generation consists of the boilers, steam turbines, engines, photovoltaic cells, wind turbines, and fuel cells that generate electricity; the fuel consumed by this equipment; and their supporting systems (such as cooling, air and water emissions control, and solid waste handling). Transmission includes high-voltage wires, transformers, and substations. Distribution generally includes neighborhood-level utility poles or underground wires, physical connections to buildings, and utility meters.[10]

Electric infrastructure also includes equipment and systems that are on the customer side of the electric meter—i.e., "behind-the-meter." These consist of the electrical wiring within the home, the connected devices and appliances, and any distributed generation such as rooftop solar. Programs that encourage customers to install energy-efficient measures (also "behind-the-meter") create benefits for their participants through energy bill savings and health and safety improvements, as well as for all ratepayers by reducing the need for new generation, distribution, and transmission infrastructure. Rooftop solar and other distributed resources produce many of these same benefits.

Today's power sector is in a time of rapid transformation, from a system that was centralized and large-scale to a system with more distributed resources and more active participation by consumers, as shown in Figure 1. Accordingly, utilities and other energy service providers are shifting their business models.

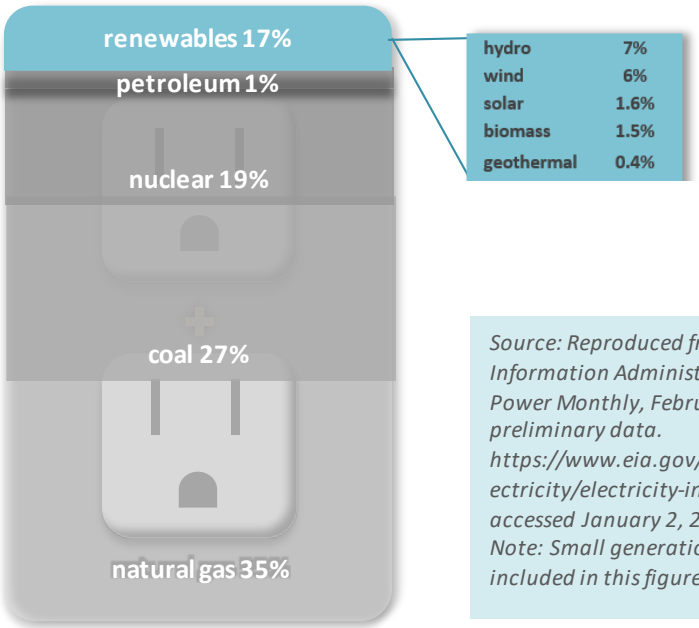
Figure 1. Illustrative modern electric system



Source: Adapted from U.S. Department of Energy. (2015). *United States Electricity Industry Primer*

As shown in Figure 2, there are five main utility-scale generation sources of electrical energy: natural gas, coal, nuclear, petroleum, and renewables (hydro, wind, biomass, solar, and geothermal).[11]

Figure 2. Sources of U.S. electricity generation from utility-scale facilities, 2018



Source: Reproduced from U.S. Energy Information Administration, Electric Power Monthly, February 2019, preliminary data. https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed January 2, 2020.
Note: Small generation resources are not included in this figure.

Currently, renewable sources (predominantly distributed solar, and utility-scale solar and wind) and natural gas generators account for most new electricity resource development. The costs of utility-scale and small-scale renewable resources[12] and storage[13] have fallen quickly, and policymakers have set state goals and implemented other policies to spur private investment. As a result, installations of these resources have flourished. In the category of fossil fuel power plants, natural gas represented the largest increase in generation capacity in 2017.[14] Meanwhile, coal is becoming less cost-competitive against renewable energy sources. Sixteen gigawatts of coal plants retired in 2017 and another 10 gigawatts retired in 2018, with many more announced for 2019–2024.[15,16] As a result, coal's percentage of the electricity generated in the United States dropped from 50 percent of electricity generated in 2008 to only 17 percent in the first quarter of 2020.[17] As coal use declines, renewable energy is ramping up.

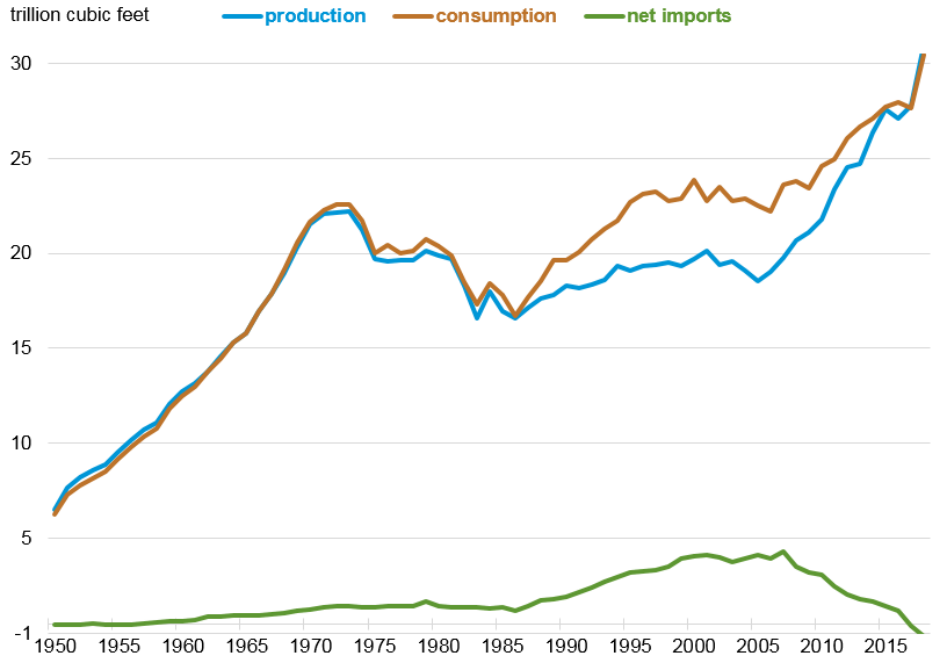
Natural Gas

Natural gas is a fuel used for many purposes in the United States. In 2018, residential uses (primarily for heating air and water and for cooking food) constituted about 17 percent of total U.S. natural gas consumption. Natural gas is also a significant source of energy for commercial and industrial applications and for electricity generation: In 2018, power plants consumed about 35 percent of natural gas energy.[18]

Natural gas infrastructure encompasses a vast network needed to bring the gas to end-users. Natural gas is extracted using drills, pumps, water, and chemicals; processed in plants; transported via pipelines, trucks, ships, and ports; and distributed to consumers by a network of compressor stations and local pipelines.[19] At each of these steps, there are potential environmental and human health impacts, and people who live near the sites of these activities are exposed to chemicals and poor air quality.[20]

In recent years, natural gas extraction has seen large technical advances in drilling, including a technique known as hydraulic fracturing, or fracking. As fracking enabled more production of natural gas, shown in Figure 3, the availability of natural gas within the United States increased dramatically.[21] The emergence of fracking led to a steep drop in the price of natural gas that has fueled a push for new pipelines and electric generation using natural gas. But over the next 10 to 30 years, potential or existing environmental policies at the federal, state, and local levels are likely to require a decline in natural gas consumption. Jurisdictions are paying more attention to the problems associated with investing in natural gas infrastructure given the emissions, health, and environmental impacts that occur throughout the extraction and distribution process.[22] These problems (e.g., water use and contamination and methane leaks) have not been well accounted for to date.[23] Decisions about building new natural gas projects—and about extending the life of existing infrastructure—must account for the risk that such projects could become "stranded assets," or uneconomic to operate, before the end of their physical lives and become a burden on ratepayers.[24]

Figure 3. U.S. natural gas consumption, production, and net imports



Source: U.S. Energy Information Administration, Monthly Energy Review, Table 4.1, April 2019.

Employment

The energy efficiency industry is a large, local source of employment (2.35 million in whole or in part in 2018), and the field is growing. In 2018, energy efficiency added 76,000 net jobs in the design, installation, and manufacture of energy efficiency products and services.[25]

The electric power generation sector employs workers in construction, utilities, manufacturing, and other industries. In 2018, the sector as a whole employed more than 875,000 workers, with roughly a third in construction. Currently, most new jobs in electric generation are related to solar and wind.[26] Roughly 242,000 workers spend most of their time on solar, with an additional 93,000 employees spending less than half their time on solar-related work. Wind energy firms employed about 111,000 workers in 2018.[27]

The fuels sector employed over 1.1 million people in 2018.[28] On the natural gas side, in 2018 there were more than 270,000 workers employed in related industries, including mining and extraction, manufacturing, and professional and business services.[29] During parts of the gas development process, companies often need to bring in non-local workers to fill jobs.[30]

In 2018, roughly 1.3 million Americans worked in transmission, distribution, and storage—including the infrastructure that links electric power and fuel supplies to intermediate and end-users.[31]

4.2. What Is the State of the Infrastructure, and Which Communities Don't Have Basic Energy Infrastructure?

While access to electricity is pervasive in the United States,[32] the reliability of service varies. The average U.S. customer experiences slightly more than one power outage per year with an average duration of four hours.[33] Both lower population densities (i.e., rural areas) and high wind are correlated with more frequent power interruptions.[34] Outage duration tends to be longer in rural areas as well. For example, Avista Corporation in Washington State reported that three-quarters of all customer outage hours in 2018 were on rural parts of its system.[35]

The average duration of power outages doubled between 2016 and 2017, driven by major events such as storms.[36] As severe weather events increase in frequency and magnitude due to climate change, outages may become endemic.[37]

In many states and regions, electric rates are used to support improvements and maintenance of outdated electric transmission and distribution systems. Much of the country's electricity infrastructure was built in the middle of the 20th century—some even in the 19th century. U.S. energy infrastructure receives a rating of D+ from the American Society of Civil Engineers, who point to the following problems:[38]

- Lack of a federal energy policy leading to no national strategy to transition to more sustainable energy sources;
- Sporadic local investment in "storm hardening" to make systems more resilient in the face of natural disasters, pointing to a need for federal guidance; and
- Cumbersome permitting processes (with high levels of local opposition) that slow down construction of physical transmission lines that help bring renewable sources online.

The locations of fossil fired power plants depend on many factors: access to transmission lines, access to fuel supply, and access to water for cooling. Today, many new gas plants are being built where old coal plants once stood because of access to transmission lines.[39] Some coal plants are being directly converted to gas. For a number of reasons, the populations surrounding these plants are disproportionately low-income and communities of color.[40] When operators are not required to operate pollution emissions controls, these plants emit harmful nitrogen oxides and other toxic pollutants.[41]

The state of natural gas pipelines and distribution infrastructure varies widely around the United States. Some pipelines have been in place for 75 years or more and require additional maintenance. Explosions and other accidents in the past few years have led to calls from governors, legislators, and communities for improved maintenance and more stringent oversight of pipelines at the state and federal levels.[42]

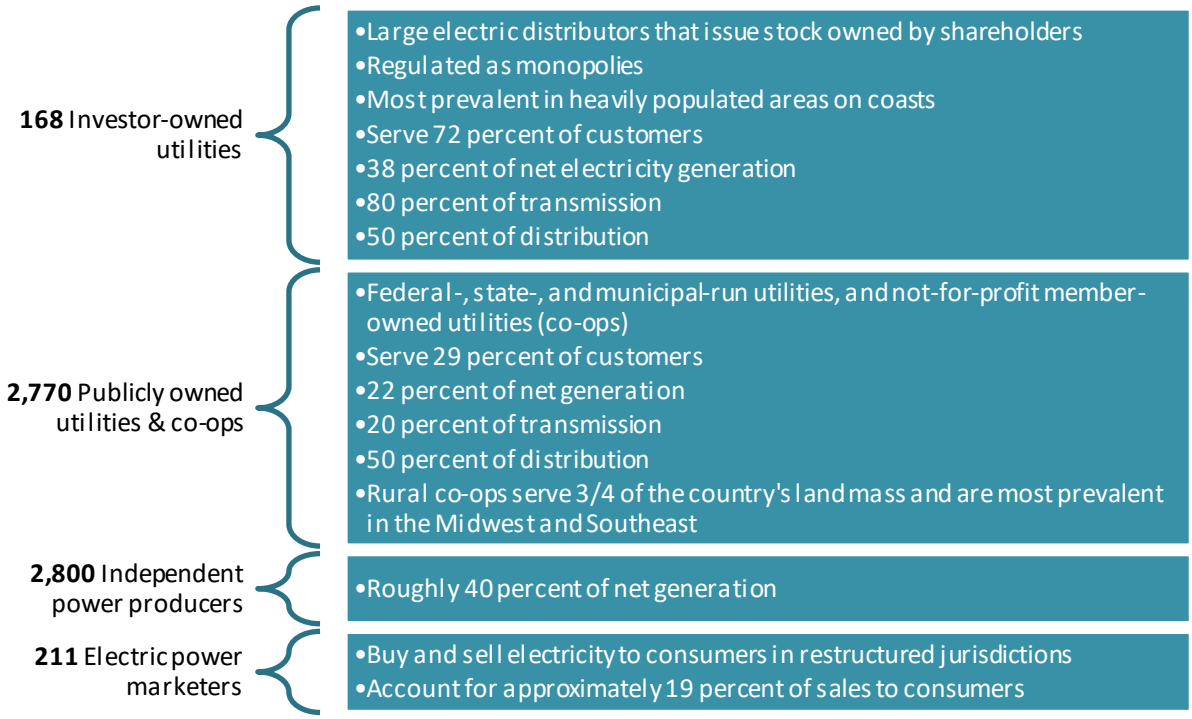
Although gas pipelines are present in all the lower 48 states, there are many rural areas without access to natural gas for residential use. People in these areas face higher costs for space and water heating because they must use oil, propane, or wood. Some rural homes use older electric heating systems, which are inefficient and costly to operate.

The location of natural gas extraction infrastructure depends on where reserves are located underground.[43] Often this is in rural areas. These areas obtain economic benefits (i.e., jobs, tax revenue) from the gas industry but often bear a disproportionate environmental and human health burden. When natural gas is transported by trucks, there is substantial wear and tear on roads, straining local government budgets that could otherwise be spent on providing services to at-risk populations.[44]

4.3. Who Provides Electricity and Natural Gas?

In some areas of the country, the same "vertically integrated" utility owns generation, transmission, and distribution infrastructure. In other areas, states have "restructured" utility regulation to allow ownership of these parts of the sector to be broken up. The figure below shows the current makeup of electricity providers in the United States.

Figure 4. Electricity providers in the United States



Net generation refers to the total amount of electricity produced less the electricity used in the power plant, e.g., to operate fuel handling equipment, water pumps, combustion and cooling air fans, and pollution control equipment. (U.S. Energy Information Administration, Frequently Asked Questions. https://www.eia.gov/tools/faqs/faq.php?id=101&t=3, accessed December 31, 2019.)

Sources: U.S. Energy Information Administration 2019. Today in Energy: Investor-owned utilities served 72% of U.S. Electricity customers in 2017. https://www.eia.gov/todayinenergy/detail.php?id=40913. Lazar, Jim. (2016). Electricity Regulation in the US: A Guide. Second Edition. Montpelier, VT: The Regulatory Assistance Project. Retrieved from http://www.raponline.org/knowledge-center/electricity-regulation-in-the-us-a-guide-2.

Rural areas are more commonly served by electric cooperatives, or co-ops. Today, 812 co-ops serve 20 million customers in 47 states.[45] Co-ops have fewer customers per mile of transmission and distribution than investor-owned utilities.

Natural gas utilities, also known as local distribution companies, are regulated utilities that deliver natural gas to end-users (residential, industrial, and commercial customers, also called ratepayers) in a region. Some gas utilities are investor-owned, while others are municipal-owned. These utilities transport natural gas from a main delivery point on a transmission pipeline to individual customers.[46]

RURAL CO-OP CHALLENGES

Co-ops, which tend to serve rural areas, maintain more distribution lines with less revenue. The isolation of these systems can make infrastructure construction and maintenance more expensive, as well as make it more challenging to maintain a reliable power supply. Furthermore, lack of broadband access in rural areas can make it difficult to install various technologies that can improve the operations of the grid.

4.4. Who Pays for Improvements and Maintenance?

The owners of a given component of energy infrastructure (such as a power plant, electric transmission and distribution, or gas distribution systems) pay for its construction and maintenance. Ultimately, the funds come from ratepayers—owners either directly recover the costs in rates, or they recover costs plus financing over an extended period of time, also via rates.[47,48] For both electricity and natural gas, the impact on equity depends on how the rates are designed for residential customers (e.g., how much is assessed in a fixed monthly charge versus a charge that is dependent on usage)[49] and how costs are apportioned among different rate classes (residential, commercial, and industrial).[50]

Existing transmission and distribution systems are maintained by individual utilities and under certain circumstances by independent system operators. The costs of maintaining and replacing aging infrastructure can be high. Private utilities often build maintenance and upgrade costs for transmission into rate increases—but because some regulators limit these increases, their utilities often do not adequately maintain and upgrade their systems.[51] If utilities do propose to address potential weak spots on their systems, they tend to focus on assets that earn a larger profit (e.g., poles and wires) rather than less costly energy efficiency and other distributed energy resources *(see page 26).* Some regulators have countered this tendency by establishing quality standards and utility incentives for service performance, including reliability and customer service.[52] This performance-based regulation can be a useful tool for other purposes as well: It can be designed with metrics to assist low- and moderate-income customers and better ensure affordability.

New transmission infrastructure is being developed through state policies to connect large-scale renewable resources in remote areas to urban areas with high demand. New utility-scale installations of renewable resources, particularly wind and solar, are burgeoning. Smaller-scale individual solar installations, often paid for or leased by the individual customers/owners, are also skyrocketing. The growth of rooftop solar, as with energy efficiency, results in lower electricity sales.[53] This creates a challenge for utilities to pay for the maintenance and management of the grid. But it also creates opportunities such as improving resiliency in neighborhoods (particularly if combined with storage).

4.5. Who Has Oversight?

Energy utilities provide essential services to the public, and the physical, technological, and economic aspects of how they do business naturally lead to the formation of monopolies. For these reasons, regulation of electricity and natural gas utility systems has evolved to ensure systems are reliable, safe, and fairly priced.

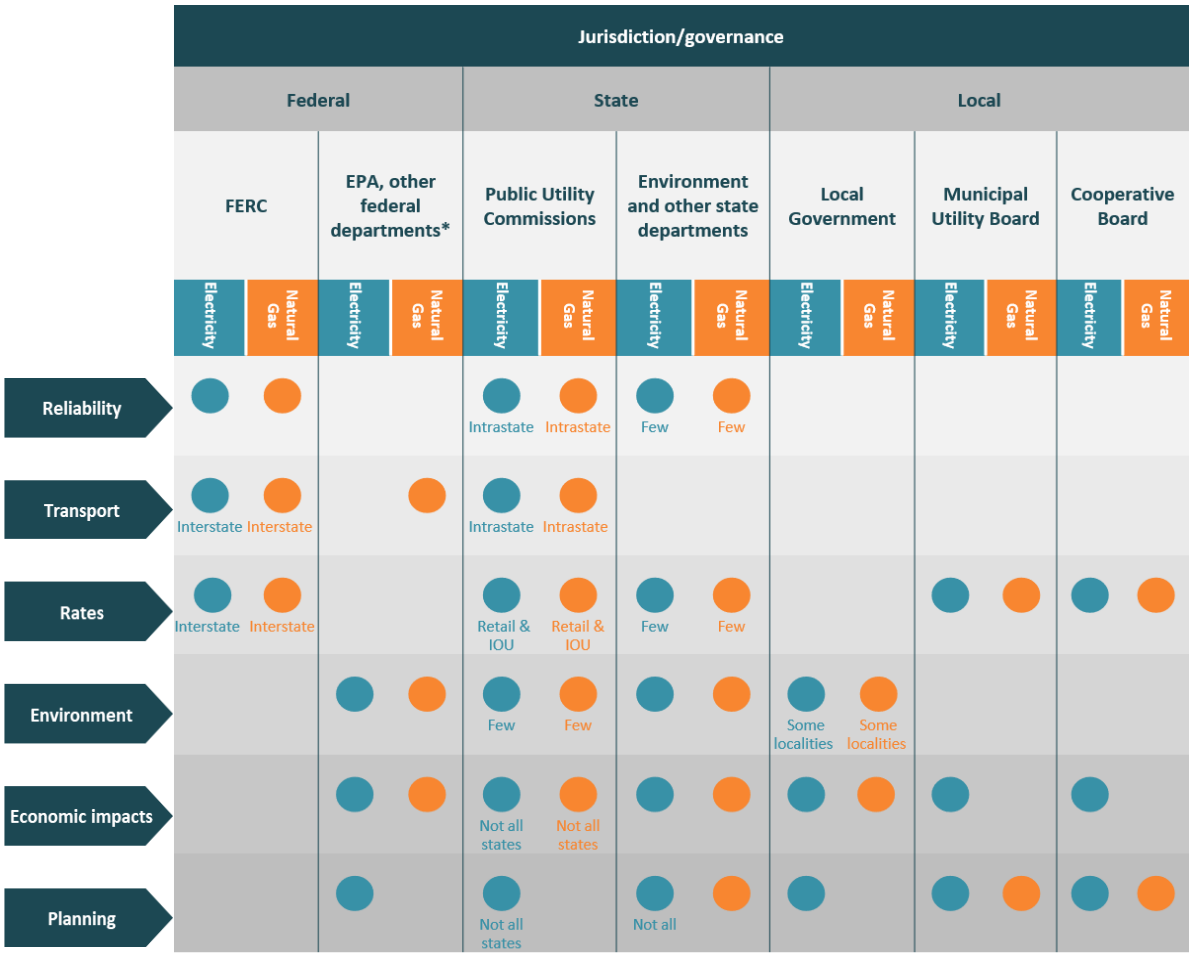
Regulation primarily occurs at the federal and state levels. Federal regulators have overall responsibility for reliability and oversee interstate power sales and service through the Federal Energy Regulatory Commission (FERC).[54] Each state has a public utilities commission (PUC, also sometimes known as a public service commission or corporation commission) with appointed or elected members who regulate facilities and the retail sales (including rates) of private utilities.[55,56] Resources that are behind-the-meter (residential solar and energy efficiency programs) are generally overseen by the jurisdiction that sets rates for that electricity or natural gas provider.

Consumer-owned utilities—municipal utilities, utility districts, and cooperatives (co-ops)—are not generally regulated by state PUCs. Municipal utilities are typically governed by city councils or independent boards, utility districts are governed by an elected body, and co-ops are governed by a board elected by members (i.e., customers/ratepayers of the co-op).

Local governments in some states have a degree of authority over transmission siting, power plant siting, pole and utility line siting, and coordination with construction. But in most states, permitting for transmission and power plant siting is handled by the state (i.e., local regulations and legislation may be preempted). In addition, there are regulations governing the many health and environmental impacts associated with electricity generation, such as those related to air and water pollution, solid and hazardous waste, and water discharge. These regulations stem in part from the federal Clean Air Act,[57] Clean Water Act,[58] and Resource Conservation and Recovery Act.[59] The U.S. Environmental Protection Agency (EPA) enforces these regulations or delegates its authority to state or local environmental protection offices. Environmental regulators at all levels of government have some jurisdiction over power plant emissions. Some states have a requirement that fossil-fired plants obtain a "certificate of need" from the utility commission, an environmental impact statement, or a wetlands permit depending on the location of the facility and state authority. Many states also have an energy office that manages state energy planning, which guides utilities in their procurement and addresses the state's environmental and energy goals, such as reducing harmful emissions. As shown in Figure 5, much decision-making happens at the state and federal levels.

All of these layers lead to a diverse set of requirements, timelines, and oversight that make access to decision-making difficult for citizens and community leaders, as discussed more below.

Figure 5. General framework for regulation of electricity and natural gas in the United States



Notes: This represents the general framework in place in most parts of the country.
Other federal departments include Department of Energy, Council on Environmental Quality, Office of Management and Budget, and others with portions of energy and environmental regulation or oversight of those regulations. Other state departments include agencies like transportation, housing, and public health.

Natural gas production is regulated by various federal and state regulations for air, water, and solid and hazardous waste impacts.[60,61,62,63] These statutes govern various aspects of the environmental impacts of natural gas infrastructure. The "fracking" of natural gas has impacts on air quality, water quality, and solid and hazardous waste levels. Among the primary concerns are the chemicals and water used to force natural gas from the ground so it can be captured and used.[64] Per the 2005 Energy Policy Act, regulation of fracking is under the purview of the states, yet many states do not require any disclosure of the chemicals used in fracking.[65] Implementing regulations on the use of chemicals and water in fracking has played out differently in different states.[66] All of these factors have implications that affect equity in areas where fracking occurs, which is primarily rural areas.

Natural gas pipelines are regulated by FERC when they are being sited under the Federal Power Act.[67,68] The related infrastructure, like compressor stations along the pipelines, may require state or local

This mismatch in regulatory oversight—the federal government intervening in air and water quality matters, while leaving energy decisions to the states—leads to inconsistent and unequal consideration of concerns important to the populations discussed in this report.

permits for air, water, and waste impacts.[69] The federal Department of Transportation regulates natural gas transported by barge or truck, and the Coast Guard regulates transports by fuel barges.[70,71] Where natural gas and oil wells are located on public lands, the Bureau of Land Management (BLM) has oversight of the rights and leases to minerals and fuels.[72]

Government agencies dealing with energy, health, and the environment generally do not coordinate among themselves, so decisions are made without sufficient discussion across agencies. These decisions suffer from a lack of forward-thinking about how multiple agencies working together could make more equitable decisions. This problem is highlighted by issues that affect multiple facets and levels of government and the public, like the intersection of energy and health. Given the extent of existing federal and state programs and regulations, the implications and inefficiencies are large. To counter these difficulties and promote coordination, several states (e.g., Arkansas, Connecticut, Kentucky, and Massachusetts) enacted legislation that placed their energy and environmental agencies under one cabinet official. As another example, the Board of Directors of the Regional Greenhouse Gas Initiative consists of commissioners from environment and energy agencies in each member state.

Because the United States lacks a national energy strategy, decisions regarding energy policy and services occur separately in each of the 50 state PUCs (or their equivalent) and state energy offices.[73] In contrast, while the primary implementation of environmental law and policy also occurs at the state and local levels, specific federal regulations such as the Clean Air Act and Clean Water Act require national-level standards. EPA oversight generally helps to ensure that laws are consistently implemented and enforced across states and localities, regardless of economic status or population size.[74] This mismatch in regulatory oversight—the federal government intervening in air and water quality matters, while leaving energy decisions to the states—leads to inconsistent and unequal consideration of concerns important to the populations discussed in this report. For example, in federal energy decisions like those related to building new pipelines, environmental regulators who might seek to mitigate a project's negative impact have little influence until the project is far along and difficult to change. Also, while there is a National Environmental Policy Act (NEPA) for projects that are of a certain size or receive at least a certain amount of federal funding (e.g., projects on federal highways), not every state has an equivalent state environmental policy act, or SEPA. Where SEPAs exist, their scope varies by state. Finally, as revealed in interviews conducted for this report, neither NEPA or their equivalent SEPAs have fully utilized the broad scope of these acts to integrate equity concerns and to require alternatives to a proposed project that would improve public health and the environment.[75]

Sometimes permitting processes at the state and local levels can be pre-empted by a federal authority. For example, FERC has primacy over natural gas pipeline procedures and permits, and it can override

local concerns on permitting a compressor station or pipeline location or route.[76] States may pre-empt local decision-makers as well, for example in decisions on the locations of energy facilities.

State governors and high-level officials (such as agency commissioners) can have considerable influence on energy policy. However, these officials turn over every four years or so. Short political timelines result in inadequate attention to longer-term issues in energy decision-making, including ongoing community education and engagement. While many federal and state regulators have longer terms, they face other constraints—such as access to the resources needed to launch effective public awareness campaigns on how to influence the decision-making process.

4.6. Who Participates in the Decision-Making Process?

In addition to the federal and state regulators whose roles are described above, various players influence the decision-making process.

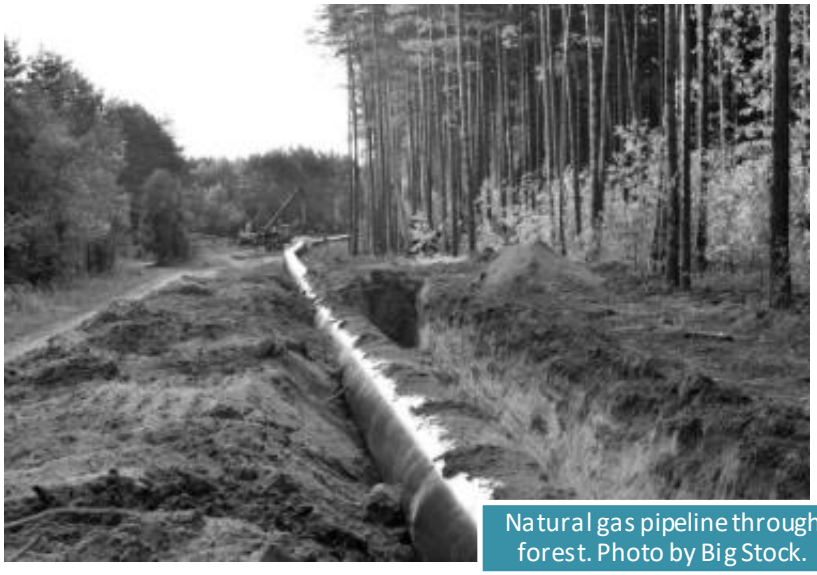
Utilities and their trade associations have strong voices in ongoing policy discussions. These entities bring to bear a wealth of resources—in the case of utilities, largely funded by ratepayers—to build persuasive arguments in favor of their business interests. In addition, the fossil fuel and clean energy industries influence policy decisions related to power generation and the transition to renewables. In many cases, utility responsiveness to customer concerns has been slow or non-existent, leading to consumer mistrust of utilities. To ensure more voices are heard, some state PUCs have formed stakeholder collaboratives that include various interest groups to informally discuss and make recommendations to the PUC.

More than 40 states have a consumer advocate who represents the public in rate hearings and negotiations. This role may reside in the attorney general's office, within the PUC, or within another agency.[77] The level of their funding for advocacy and the amount of resources at their disposal vary a great deal. The job of those offices is generally to represent the interest of all classes of consumers, from industrial to residential. When groups of consumers have conflicting interests (or, in the case of low-income consumers, could benefit from more focused attention) these offices are constrained in their ability to respond.

Community action agencies or legal aid groups sometimes intervene if they get funding specific to a particular issue or decide to focus on some aspect of energy (such as a rate case). While municipal utilities and co-ops may be better aligned with customer and community priorities and needs, given they are managed by and report to local representatives, disadvantaged consumers may not have an adequate voice in decision-making. Municipal utilities may not have the resources to educate their board members about new technologies or lower cost alternatives to their business-as-usual approach.

Communities of color and low-income communities have long been left out of decision-making. People of color are underrepresented in energy leadership and in agencies addressing energy issues, according to our interviews. A 2016 study by the Labor Neighbor Research and Training Center and ACORN International for the Rural Power Project looked at the composition of governing boards of cooperative

electric utilities in the South. This study concluded that 95.3 percent of board members were white, while only 4.4 percent of the members were African American.[78]



Natural gas pipeline through forest. Photo by Big Stock.

Information asymmetries are a real barrier to greater community participation in energy sector decision-making. While communities may be aware of the health impacts of local facilities (e.g., power plants or pipelines), they may not understand the total impacts of all facilities in their area, the cumulative impacts over time, or the contributions of different types of energy use.[79] Further, host communities sometimes only learn that infrastructure is being planned for their area once the project has already met a number of regulatory requirements. The costs of overbuilding energy facilities or the risk of cost overruns are generally not obvious to communities when investment decisions are made.

The implications of poor investments may take years to become public. Nonetheless, ratepayers are often on the hook. The resulting rate increases may have large impacts on low-income customers.[80]

Advocates and community groups also face major logistical barriers to intervening in energy decision-making processes. Frequently, regulatory rate cases before PUCs occur during weekday working hours, effectively limiting participation. Other energy decision-making processes, like permitting for electricity and natural gas infrastructure (such as new pipelines), happen at the federal level. In these cases, intervention effectively requires attendance at meetings or hearings in Washington, D.C., and therefore is limited to national non-government organizations with staff dedicated to these issues. Other energy infrastructure permitting processes, such as for transmission lines, generally occur at the regional or national level and likewise offer limited access for community-based advocates. Disjointed proceedings or lack of access to information about the processes and timing make it difficult for advocates and affected communities to participate.[81]

Energy and environmental proceedings and processes each come with their own terminologies, boundaries, requirements, and regulatory cultures that intervenors must navigate to influence the outcome. To be effective, information presented must be consistent with the scope of the proceeding and the definitions and authorizing legislation and regulations. This requires specialized skills. Those

proposing projects hire consultants and legal representatives[82] at market rates that can be hundreds of dollars per hour. The general public—and especially customers who are low-income, rural, and on a fixed income—not only cannot afford to hire consultants, but they are also unfamiliar with the nomenclature and procedures. When members of these groups submit comments or attend public hearings, their interventions are usually broad ("we don't want this plant") and general ("we have too many facilities in our town now"). As a result, they are easily dismissed by the agency since it may be too late in the process or the comments are not specific enough to be addressed.

As a result, low-income communities, communities of color, and especially rural communities (where most fracking occurs) may be excluded from the energy decision-making process. Although tribes have special rights to consult on federal projects that might affect Native historical sites under the National Historic Preservation Act,[83] many feel that their input is not adequately considered, particularly in natural gas and oil extraction decisions.[84] In some parts of the United States, these are significant concerns for tribes who may not be consulted about developments on land within or adjacent to their jurisdictions.[85] As an extreme example of the time-sensitive and high-stakes energy decisions impacting disadvantaged communities, energy companies and utilities may use eminent domain to acquire private land needed for planned oil and gas pipelines and transmission lines. Such instances are often controversial and contentious.

The environmental justice movement is fighting to lessen the negative impacts from siting decisions, improve access to new clean technologies, and enhance the oversight of existing facilities. Yet resource constraints make sustained, in-depth, long-term intervention very difficult. Section 5 discusses opportunities for making energy infrastructure decision-making more inclusive.

5. Barriers and Promising Points of Intervention

We rely on energy for many functions that were once considered conveniences but are now integral to health, economic, and social well-being in the 21st century. Modern activities of daily life, such as public and private transportation, cooking, and work and pleasure that is reliant on the internet, require reliable, affordable, and resilient energy infrastructure. Energy allows us to heat and cool our homes, be connected socially, and work effectively and search for work.

In this section, we discuss key sources of inequity and challenges preventing equitable outcomes in the energy sector. We describe the most promising points of intervention for policymakers, advocates, and philanthropy to improve energy affordability, expand access to energy, reduce community environmental hazards, and create employment and economic opportunities, all of which are important social determinants of health.

5.1. Affordability of Energy

Key Barriers and Problems

Many low-income households face the "heat or eat" dilemma on a regular basis.[86] Yet despite the frequency of these events, our interviews revealed that the health, social, and economic benefits of avoiding energy-related crises (e.g., shutoffs and associated health impacts) are not widely recognized by the industry and analysts of energy markets, and data on these crises are lacking.

High energy burdens. Low-income households and many communities of color struggle to afford energy, causing health, economic, and social instability.[87] Households with high energy burdens (i.e., that spend a high percentage of household income on energy) may face stark choices, such as choosing between necessities like home heating or cooling, food, and healthcare.[88] Energy insecurity[89] may lead to challenges managing chronic medical conditions due to lack of refrigeration for medications or electricity to run medical devices, and in some cases the inability to afford energy bills may lead to housing instability or even homelessness.[90] Energy insecurity is also associated with food insecurity among children, and households with children are more likely to experience energy insecurity.[91]

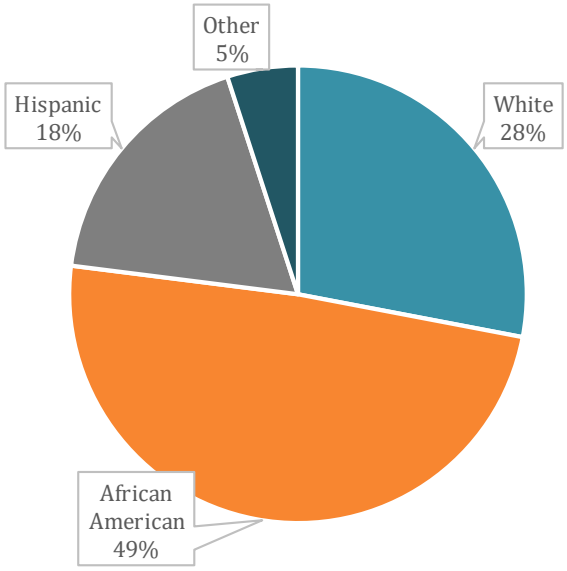
Energy insecurity in the United States in 2015		
Almost one-third of U.S. households (31 percent) reported difficulty in paying energy bills or adequately heating and cooling their homes.	11 percent of surveyed households reported keeping their home at an unhealthy or unsafe temperature (in winter or summer) to try to save money.	Over 20 percent of households—roughly 25 million households—reported reducing or forgoing necessities such as food and medicine to pay an energy bill.

Source: U.S. Energy Information Administration. September 2018. Today in Energy: One in three U.S. households faces a challenge in meeting energy needs.

Reducing energy burdens can help address other challenges that low-income households face. It can enable individuals and families to redirect funds towards food and medicine, and to reduce their dependence on other federal programs.

High energy burdens are particularly acute for low-income communities and many people of color. Unsurprisingly, households classified as low-income report experiencing more frequent energy insecurity events, such as receiving a disconnection notice or forgoing necessities to pay energy bills, than those with higher income levels.[92] Communities of color experience energy insecurity, for example having difficulty paying energy bills or sustaining adequate heating and cooling in their homes, more than other groups: in 2015, roughly 50 percent of African American families reported characteristics of energy insecurity, compared to less than 30 percent of whites.[93] Households in predominantly minority neighborhoods experience higher energy cost burdens, as much as 27 percent higher, than households with similar income levels in predominantly non-Hispanic white communities.[94] African American families are more likely than other groups to spend a high percentage of household income on energy and on rent, as shown in the figure below. [95]

Figure 6. Percent of families facing economic energy insecurity



Poor housing conditions. People living in older homes (built before 1990) are more likely to experience energy insecurity, sometimes related to deteriorating building conditions.[96] In addition to income levels, poor housing conditions and high upfront costs of upgrades are major contributing causes of high energy burdens. Low-income families are more likely to live in housing with heating and electrical problems and without adequate insulation and heating capacity.[97] Other problems—such as missing or broken windows and doors and holes in floors, walls, and roofs—pose critical barriers to making energy

efficiency improvements. Some of these issues, such as old heating equipment and outdated electrical wiring, present fire safety and indoor air quality issues that require medical treatment and costs to address as well. Many low-income households are renters, and as a result they face additional challenges to making home improvements to reduce their energy burden.[98]

High energy burdens are particularly acute for low-income communities and many people of color. Photo by Big Stock.

Insufficient support for renters. Another factor undermining access by low-income populations and many communities of color is their lower rate of homeownership. Utility-run comprehensive energy efficiency programs generally target homeowners, and either are not offered to or are not marketed to landlords. Often, landlords do not benefit from energy efficiency upgrades in the short run because their tenants pay the energy bills (electric and heating). In the long run, landlords may benefit from increased property value, but evidence that this is a compelling enough reason to do the upgrades is lacking.[99]

Higher costs in rural areas. The percentage of household income spent on energy use in the home (i.e., the home energy cost burden) is higher for rural populations than for non-rural populations. The American Council for an Energy-Efficient Economy's 2018 national study found that, on average, energy bills amount to 4.4 percent of income in rural tracts. Rural households' median energy burden (4.4 percent) is higher than the median energy burden of 3.1 percent in metropolitan areas and higher than the median energy burden of 3.3 percent for all households in the United States.[100] According to the study, rural energy burdens are highest in New England, East South Central, and Mid-Atlantic regions.[101] Since electricity is also needed to pump water to and within homes served by wells, high costs in remote areas can also lead to rationing of water used for cooking and hygiene.[102]

Lack of regulatory focus on affordability. Many PUCs are charged with setting "reasonable" rates. As generally applied, the reasonable rates standard reflects supply- and demand-side considerations. However, the definition of reasonable applied by commissions usually does not consider the portion of a household's budget that is spent on energy. Further, the impacts of utility investment decisions on specific groups are only considered in practice to the extent that data on these groups are available and they are required to do so. In some areas, utilities do not collect the data to enable decisions that might improve the services for low-income customers, and as a result decision-makers often do not consider impacts on this segment of the population when weighing investment and cost-recovery decisions.

The lack of focus on affordability applies to all types of investments, including conventional and transformational clean energy investments, and investments that are targeted to disadvantaged

communities. Defining the fair share of transformative investment that consumers (in particular low-income consumers) should pay in rates is much debated. For example, it poses individuals' long-term benefit from investments to slow climate change against their capacity to pay for daily necessities. This debate splits energy policy along multiple stress lines, as per the example noted above. There are ongoing debates about how to balance increases in energy cost burden on lower income households with the up-front costs of policies to address climate change. This is an area where additional discussion and research could bring about more equitable solutions.

Rigid requirements for federal weatherization assistance. Energy efficiency and weatherization can provide long-term savings on energy bills, and low-income energy efficiency programs can also reduce energy assistance program costs over time. Yet in states with a greater proportion of low-income residents, utilities spend less on low-income energy efficiency.[103] Many utilities do not offer any low-income programs at all, despite having larger low-income populations.[104, 105, 106, 107] Where programs exist, the offerings vary widely in comprehensiveness. For example, electric utility energy efficiency programs, with the exception of those in Massachusetts and few other states, are generally limited to measures that operate most of the time unless a home is electrically heated.

FEDERAL WEATHERIZATION ASSISTANCE PROGRAM

The Federal Department of Energy Weatherization Assistance Program influences almost all of the other low-income energy efficiency expenditures that the public sector funds and many of the programs run by utilities. In 46 states, the designated community action agencies that install weatherization measures also receive funding from the state LIHEAP programs. In a few states, these community agencies obtain funding from state-funded programs. Many utility programs are designed to use the same agencies to bundle together the delivery of all appropriate measures. These community action agencies have unique access to so-called "hard to reach" consumers, including low-income households, and offer a wide range of family-supporting and senior care services.

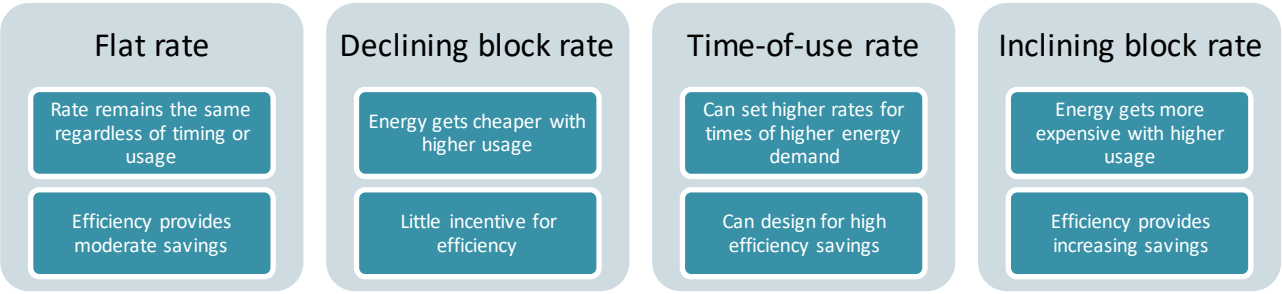
Energy efficiency and weatherization can provide long-term savings on energy bills. Photo by BigStock.

The Department of Energy's Weatherization Assistance Program (WAP) has a formal and strict regulatory framework: WAP requires that all investments made in eligible homes meet a savings to investment ratio of 1:1 or better, based solely on the projected avoided bills to the household over the life of the measures. As a result, some measures that would be useful aren't installed. Also, households with incomes up to 200 percent of the fderal poverty guideline are eligible, but, in practice, priority is given to households with an elderly or disabled member or a young child.

Other funding sources permit additional investments. Funds transferred from the Low Income Home Energy Assistance Program (LIHEAP) for WAP in most states can be used for health and safety measures beyond those allowed by the federal WAP, such as replacement home heating equipment and mitigation of other hazardous conditions.

Ratemaking and billing practices. Energy unaffordability is influenced by state or utility ratemaking practices and policies. There are two types of considerations:

- Cost apportionment between residential and commercial users: There are several ways that costs can be allocated to different types of customers or customer classes. Costs can be allocated based on the number of users, peak demand usage, or energy used. Cost allocation based on the number of customers or peak demand usage will favor larger commercial and industrial users, while apportionment based on overall energy use will distribute costs more evenly across types of customers.
- Residential rate designs: Residential rates can be designed as flat, inclining block, declining block, or time-of-use.[108] Over time, rates have transitioned away from declining block rates with the realization that these rates provided a disincentive for customers to pursue energy efficiency. However, more can be done to encourage a move from declining block or flat rates to time-of-use or inclining block rates. Low-income households tend to have lower energy usage. Therefore, an inclining block structure, where the rates increase with higher usage, will be more favorable than a flat (one rate regardless of usage) or a declining block rate (discounted rate for higher usage).[109]



Electricity service charges vary by jurisdiction but almost always include fixed charges (e.g., a monthly or customer fee) in addition to volumetric ones (i.e., per kWh of use). Utilities are increasingly proposing to recover more of their costs through mandatory monthly fixed charges rather than through rates based on usage. This is perceived to reduce the utility's risk that its revenues will go down if sales decline (e.g., as a result of energy efficiency, distributed generation, weather, or economic downturns). *However, shifting cost recovery to fixed charges is very problematic for low-income customers, because it reduces these customers' ability to manage their bills.* Higher fixed charges tend to increase bills for low-usage customers, including low-income customers, while decreasing them for high-use customers.[110] For co-ops, the high ratio of infrastructure to customers means they have high fixed costs that are often passed through directly to customers as high fixed charges on electricity bills (in some cases as high as $48 per month).[111]

LIHEAP participants can get discounted rates from investor-owned utilities in most areas, but these discounts do nothing to address the overdue bills that these customers have often already accrued and do not reduce energy rates enough to make them affordable for many consumers. To address these issues, arrearage management programs forgive overdue balances if participants pay their bills regularly, and payment plans that set bills relative to income for eligible customers improve energy affordability. See the case study on Ohio Arrearage Management (Section 6.2).

HELP FOR LOW-INCOME RATEPAYERS IN OHIO

About one-third of eligible low-income electric and gas customers in Ohio are served by the state's Percentage in Income Payment Program, which helps them avoid utility shutoffs and obtain energy efficiency and weatherization improvements for their homes. Enrollment in PIPP makes the "eat or heat" question less urgent for families at or below the 150 percent federal poverty rate. Among the model aspects of this program are that it is run at the local level by community action agencies with a deep understanding of the people they serve, and it suspends cost-effectiveness tests for the energy efficiency measures installed for these customers. For more on the PIPP program, see Section 6.2.

Traditional economic incentives that drive utilities to invest in large capital projects rather than distributed resources. Traditional regulatory practices may provide financial incentives that hinder utilities from addressing today's challenges: changes in state or local policies, rapidly changing technologies, and consumer expectations, as well as aging infrastructure. Traditionally, the primary decisions facing utilities were related to how much and what type of utility-owned and operated generation, transmission, and distribution to build to meet growing customer demand.[112] Because shareholder profit is based on capital investments and sales increases, utilities prefer to invest in large capital projects such as new power plants. Some utilities that operate under traditional regulation are pushing for financial assistance to extend the life of uneconomic coal plants and/or seek PUC approval for the construction of new, large coal and nuclear plants, often with heavy costs to ratepayers. For example, costs for the Vogtle plant in Georgia have grown from $14 to $21 billion, and ratepayers there are being asked to cover $4.6 billion of these overruns.[113] At the same time, energy efficiency or distributed energy sources or large-scale solar and wind are not being implemented in these areas due to lack of state policy, lack of information, or political pressures, to name a few barriers.

Public knowledge of energy use and programs. Many consumers do not know what they pay for energy, how much energy they use, or what avenues they might have to influence how—and how much—they are charged for energy use. That lack of knowledge hinders people's ability to understand the implications of the energy transition or to visualize a different energy future for themselves. There is also a lack of awareness of programs that can help households with high energy burdens better afford their bills. Utilities with low-income rates find that many low-income residents who are eligible do not sign up to receive these rates, due to lack of awareness and general mistrust of the government and of utilities.

Promising Points of Intervention

A number of policies can reduce energy burdens for low-income and rural communities and communities of color, including: targeting cooperatives; offering energy assistance and reducing fixed

charges; expanding the depth and reach of energy efficiency and distributed renewable energy; and fostering partnership and coordination between housing, healthcare, and energy sectors.

Directing efforts at co-ops to invest in renewables and energy efficiency. Co-ops historically have embraced coal as a default fuel in the belief that it is the cheapest means to provide their customers with electricity. This is changing as co-ops develop programs that link renewable energy with storage and boost energy efficiency investments. As an example, the Tri-State Generation and Transmission Association (Tri-State) serves 43 co-ops in the western United States and has long advocated for coal-powered electricity. Two Colorado co-ops, Kit Carson and Delta Montrose, left Tri-State recently. The co-ops stated that their exit was motivated by concerns about the costs of coal plants and dealing with stranded assets as these plants close before the end of their useful lives due to poor economics. Further, they were concerned about Tri-State's failure to embrace less expensive renewables. A new Tri-State CEO promises change and investment in renewables and energy efficiency, but this needs to be monitored to ensure that Tri-State follows through.[114] Rural electric co-ops, including Tr-State, have over $8 billion in potential stranded coal and natural gas plants.[115] Accelerated depreciation of existing power plants owned by co-ops can avoid the rate shock that would occur from a sudden, unpredictable plant closure and will allow for planning to meet future needs with clean energy resources. As another strategy, smaller, rural utilities and co-ops can partner with larger generation and transmission co-ops to spread out costs of programs and customer services.[116]

Offering reduced rates and making rates fairer. Some states already require utilities to offer discounted rates to low-income customers. The low-income rates might eliminate the fixed monthly charge but charge the customer according to the normal per-unit rate. In other cases, there is a discounted rate for the lowest tier of usage.[117] States without such programs can require utilities to offer them. Where such programs are offered, changes in program enrollment processes can extend their reach. For example, the Northern Indiana Public Service Company automatically enrolls customers receiving LIHEAP in its Customer Assistance for Residential Energy program, which offers bill reductions between 11 percent and 26 percent.[118]

Aside from bill discounts, PUCs can discourage or stop utilities from pushing a large portion of the cost of service into fixed charges. Lowering fixed charges allows customers to manage a larger portion of their energy bills. PUCs can also reach out to key stakeholders to encourage better stakeholder representation in proceedings and require inclusion of certain types of participants, such as low-income advocates, in working groups. Additionally, stakeholders or groups of

LOOKING TO OTHER INDUSTRIES FOR FAIRER RATE DESIGN

Rather than recovering a large portion of costs via fixed charges, a more equitable rate design would apply examples from the gasoline or food distribution systems. Grocery stores and gasoline stations also have fixed costs, in terms of infrastructure, energy, and labor costs. But rather than charging the customer a dollar (for example) to enter the store or for the privilege of buying gas, these businesses recover their fixed costs one tomato or one gallon at a time. Improved rate design would design the rates needed to cover fixed and variable costs, and also include rates for high users. Low-income households tend to use less electricity than higher-income households, so they would benefit from both the reduced fixed charges and from lower electricity rates overall.

stakeholders can intervene in utility proceedings or appeal to their representatives, such as consumer advocates, attorneys general, or low-income advocates, who can better attest to their positions on these and other issues. Philanthropy can play a role by training and supporting advocates and conducting public outreach on these issues.

Enacting state standards and mandates for low-income energy efficiency. Energy efficiency can help consumers manage their electric and natural gas bills. It has other benefits such as creating local jobs and improving home environmental conditions that can result in improved health outcomes, reduced healthcare costs, and fewer missed days of work and school.[119] States have adopted a range of policies to expand funding for energy efficiency, such as resource standards or all-cost-effective energy efficiency mandates.[120] However, these standards and mandates do not necessarily result in more funding and savings for low-income customers. Low-income households face additional barriers to accessing and implementing energy efficiency and require targeted approaches to program delivery.[121] Regulators in some states are requiring utilities to allocate a minimum percentage of program funds to low-income customers, and in many cases these minimums could be increased. States and PUCs can enact funding and savings carve-outs for low-income customers or set customer class-specific requirements or goals to reduce energy burdens and improve energy affordability.[122]

Incorporating non-energy benefits into decision-making on energy efficiency measures. Utilities, governments, and third parties administer and offer electricity and natural gas energy efficiency programs. These programs are typically reviewed for cost-effectiveness and approved by regulators.[123,124] Federal low income-energy programs, as well as many utility ones, do not account for the health and emission reduction benefits. Particularly at the state level, regulators can realign cost-effectiveness practices and requirements to better serve marginalized communities. For energy efficiency programs targeting low-income consumers, non-energy benefits are generally high and can make the difference between passing or failing a cost-effectiveness test.[125] Some states (Arizona, Colorado, Vermont, Washington, and others) include external benefits like reduced health care costs, fewer missed work or school days, and other ancillary benefits of energy efficiency measures when calculating cost-effectiveness for making resource decisions.[126] In addition to accounting for external benefits, Illinois, Nevada, New Hampshire, and Pennsylvania have specific energy savings goals for low-income customers.[127] State PUCs and federal programs can follow this example by recognizing the non-energy benefits that energy efficiency resources confer within cost-effectiveness testing.[128] Tools from the U.S. EPA can help with quantifying the health benefits of replacing fossil fuels with renewable energy and of installing energy efficiency measures.[129] *Using cost-effectiveness tests that account for more benefits to participants and society when designing programs or making funding decisions will result in a more robust energy efficiency portfolio and improved equity.*[130]

Auditing using a fuel-neutral, "whole-house" approach for energy efficiency. States and utility regulators should also require energy efficiency program administrators to take a fuel-neutral approach. This allows them to reach more low-income households, which are more likely to heat with oil, propane, and wood, as well as households in rural areas, which do not commonly have access to natural gas. Also, states and utility regulators should encourage gas and electric utilities to work together in a "whole-

house" approach, where the cost of an audit is split and the costs of measures are allocated amongst the utilities. This can enable utilities to tap into savings that might otherwise not have been realized and to provide more assistance to low-income households. Good examples of this include American Electric Power and Columbia Gas in Ohio,[131] and the electric and gas utilities in Massachusetts.

Supporting partnership and coordination among key organizations. Coordination of energy, housing, and health care programs/sectors can expand the reach of energy efficiency programs.[132] Participants in our convening identified the need for more coordination from utilities as they develop low-income weatherization programs, as they have generally not made major efforts to coordinate across these sectors.[133] While community action agencies are already bridging the divide, more could be done, for example by securing Medicaid and Medicare financing for the health benefits of certain efficiency and safety measures. Decent, safe, and affordable housing should be a national priority, including ensuring homes are up to code and energy efficient. In light of the heat or eat dilemma and the correlation between adequate indoor temperatures and health outcomes, the health care industry can take a more preventive approach by funding energy efficiency measures.[134] Health care providers and associations could start by investing in vulnerable households, such as the homes of seniors, families with young children, and those with frequent emergency room visits. Utility low-income energy efficiency programs should consistently address structural and safety issues during home visits.[135]

Adopting other approaches to expand energy efficiency to current non-participants. Communities or states with building codes that require energy measures for new and retrofitted housing lead to lower energy bills and have resulted in "net zero" energy housing. Appliance standards such as EPA's Energy Star program have led to dramatic decreases in energy use in refrigerators and other appliances that save households large amounts of money.

Pay-as-you-save programs that allow households to pay for energy improvements over time, like those in Connecticut discussed below, have allowed moderate-income households to finance energy improvements and sometimes renewable energy that they might not otherwise be able to afford.[136] Support from philanthropy has allowed this program to reduce participant contributions even further to target to low-income customers.

Whatever approach or combination of approaches is used, decision-makers should consider increasing access to energy efficiency and other resources for current non-participants—whether they be low-income populations and those who cannot or are not willing to participate in programs. Also, it is important to consider whether future reward of avoided costs and reduced bills compete with participants' ability to meet their essential daily needs.

Expanding access to renewable energy resources. State or local initiatives to provide low-income and marginalized communities with access to distributed generation and opportunities to electrify and improve the efficiency of their heating energy uses have the potential to further reduce energy bills. For instance, efforts to offer creative financing for rooftop renewable energy or to implement community-based renewable energy programs can improve energy affordability for participants. These initiatives

Rural rooftop solar installation. Photo by Big Stock.

allow these communities to reap the benefits of the energy sector transformation and could break the cycle of fossil fuel use in these communities, which contributes to poor air quality and environmental conditions.

California's Multifamily Affordable Solar Housing program, which involves training the local workforce to install solar panels on multifamily buildings, is a particularly innovative example.[137] Another example is the Connecticut Green Bank, which uses public funds from the state's energy efficiency fund and auction revenue from the Regional Greenhouse Gas Initiative (or RGGI, which caps greenhouse gas emissions and trades allowances in 10 participating Northeast states) to help leverage private capital.[138] These combined funds are directed, through private firm PosiGen, to work with community action programs to provide services to low-income customers. One project combines a 20-year lease of photovoltaic panels with energy efficiency upgrades to the home. No credit check is required to access the benefits of this program. Job training for local workers is an integral part of the Green Bank's mission.[139]

Community solar programs offer a simple means for low-income residents to achieve energy bill savings while bypassing many of the barriers they face in installing solar PV on their own roofs. As with energy efficiency, the energy regulator (e.g., PUCs) should require that solar energy's societal benefits be included when determining their cost-effectiveness and when conducting system planning.

Utilities and non-profits across the country operate small-scale renewable and storage projects involving solar, hot water heaters, and Tesla batteries at people's residences. These projects serve a dual purpose of lowering energy costs for participants while reducing pollution. Green Mountain Power (Vermont) combines an energy-efficient manufactured home with solar panels and storage. This project specifically addresses the barrier that many manufactured homes depreciate in value over time, are poorly insulated, and create energy poverty through high electricity bills.[140] Co-ops in Michigan and Minnesota

give free hot water heaters to customers in return for investments in community solar systems. [141] One such effort, the Sunna project by the Steele-Waseca co-op in Minnesota, allows customers to reap the economic benefits of renewable energy without having to invest substantial sums of money and without having to worry about the integrity of their own buildings. The Sunna project allows the co-op to manage load by controlling the cycling of electric hot water heaters.[142] With all of these projects, participating customers benefit economically, and society benefits with improvements in local air quality and reduced greenhouse gas emissions. The challenge is offering these programs at greater scale and in more communities.

5.2. Access to Energy

Key Barriers and Problems

Shut-off practices. Some utility business practices are particularly harmful to low-income customers. Customers who lapse in bill payment face disconnections, and reconnection fees can be a barrier to reinstating service. Some utilities require credit checks to open new accounts. In areas where utilities have shut down bill payment offices, consumers who lack credit cards or checking accounts must pay their bills at businesses like grocery stores or payday lenders that charge fees for each payment processed.[143] Interviewees for this study noted that some cooperative utilities—which are usually outside of the jurisdiction of public utility commissions—have particularly harsh billing practices and high rates. Protections against these policies and practices are often inadequate.

Lack of investment in rural areas. In sparsely populated areas, the cost of building and maintaining infrastructure to distribute electricity and natural gas can be very high. For this reason, for-profit companies lack interest in installing new technologies and maintaining existing infrastructure in rural areas and marginalized communities. Historically, government intervention was needed in order to bring electric service to rural areas.[144] But decades after the gains achieved by the rural electrification project, funds for maintaining distribution infrastructure are generally lacking, and the electric service can be unreliable.[145] Gas service by pipeline is usually absent from rural areas, so households may buy high-priced bottled propane, heating oil, or wood for space and water heating. Providers of these fuels are often small businesses and generally not regulated. As a result, there are far fewer customer protections. For example, there are no programs for avoiding service disruption or establishing extended payment plans or budget billing. Propane providers typically insist on full payment upon delivery. Where they have to travel long distances to serve a single customer, they may insist that the tank be near empty and fully refilled to make it worth their while. This requires the customer to come up with a large sum of cash in advance.[146]

Pace of technological change and lack of accessibility to lower-income populations. The rapid rate of technological change in the power sector affects the already lengthy process of resource decision-making, which needs time in order to weigh facts and to allow opportunity for the public to participate.

In recent years, the cost of renewable energy, batteries, and energy storage have declined. Photo by Jack Sloop on Unsplash.

But in recent years, the cost of renewable energy, batteries, and energy storage have declined, while these resources' capabilities and availability of data have increased tremendously. Communities and regulators have difficulty keeping abreast of these technology and policy developments and figuring out how to respond. In addition, public policy may fail to recognize that these new resources are undervalued compared to alternatives and to accurately account for their societal benefits. In addition to these decision-making challenges, ensuring equal access to new technologies is not easy. Even where policies and programs take the benefits of new technologies into account, low-income populations face high barriers to implementing them (due to, e.g., lack of information, high transaction costs, and lack of access to capital). Often new technologies reach low-income populations last; in some cases, all consumers are paying for the costs through rates. Rooftop solar installation commonly requires the homeowner to have a high credit score in order to lease equipment.[147] As a result, the movement toward distributed solar is leaving low-income communities and communities of color behind. Households in African American- and Latino-majority census tracts are significantly less likely to have rooftop solar than white-majority census tracts, even when adjusted for home ownership and household income. For example, census tracts with an African American racial majority have installed 69 percent less rooftop PV compared with tracts that do not have a racial majority.[148,149]

Promising Points of Intervention

Improving shut-off protections. States generally have various regulations related to service termination and reinstatement for non-payment, but consumer protections could be shored up in many places. Some states, such as Oklahoma and Massachusetts, have legislation or regulation that provides increased protections against shutoffs for vulnerable populations (such as households with children, the elderly, and those with certain medical conditions). Other states, such as Maine, Missouri, and West Virginia, prohibit service disconnections for non-payment during certain times of the year (winter or summer).[150]

Increasing renewable energy and energy storage in areas with poor reliability or lacking natural gas infrastructure. States and PUCs can support projects to improve access to energy without investing in infrastructure that could be unused well before the end of its useful life. Distributed, behind-the-meter

solutions such as renewables paired with storage and energy efficiency can reduce the need for expensive utility-scale electric and natural gas infrastructure. New natural gas infrastructure can be avoided by electrifying homes with renewables and storage for example. This avoids the expense (and stranded costs) of large infrastructure. It also reduces air pollution and other infrastructure impacts on land use. Alternatively, in areas without natural gas infrastructure, electrification and storage can reduce dependence on high-cost fuels like propane leading to lower heating bills for homeowners. Hawaii provides an example for the electric system. A collaborative of public and private organizations is testing battery storage near a key distribution substation—and adding solar meters, in-home energy usage displays and smart meters, remote control of water heaters and central air conditioners, and advanced data analytics—to improve service quality and reliability and avoid the need to build very expensive electricity peaking generation units on Maui.[151]

5.3. Environmental Consequences of Power Generation on Community Conditions

Key Barriers and Problems

Local impacts of pollution. The air pollution emitted by power plants, motor vehicles, and other sources, is estimated to cause more than 100,000 deaths per year in the United States.[152] Exposure to fine particulate air pollution from power plants varies by race, income, and geography, with African Americans facing the highest mortality rates.[153] Yet the fine particulate matter air pollution is disproportionately caused by consumption of goods and services mainly by non-Hispanic whites.[154]

Low-income communities suffer more environmental burdens associated with coal plant pollution and natural gas infrastructure than other communities, impacting health equity. These impacts stem from air pollution, as well as degradation in water supply and solid and hazardous waste from coal ash, natural gas fracking chemicals, and pipeline leaks. Fossil fuel power plants, such as coal and natural gas plants, have long plagued communities of color and low-income areas with pollution that increases risks of a range of poor health outcomes and health inequities, and these have been a target of environmental justice advocates.[155] While reducing dependence on coal will eliminate a large amount of air and water pollution, our continued reliance on fossil fuels and some other types of generation resources may create new environmental and health burdens for some communities of color and low-income communities. Natural gas extraction, biomass and municipal waste incineration, and nuclear energy production can create pollution

Low-income communities suffer more environmental burdens associated with coal plant pollution and natural gas infrastructure than other communities. Photo by Dominik Dancs on Unsplash.

that disproportionately burdens low-income communities and communities of color.[156]

Risks associated with natural gas extraction. Natural gas extraction jobs (whether associated with fracking or conventional extraction) can pay well, but workers run occupational and health risks such as the inhalation of chemicals.[157] Extraction also poses environmental risks to local communities. In the absence of legislation or regulation on the federal level on one type of extraction, state policies on fracking may be slow in coming. Many states are limited by state legislation in that they can be "no more stringent" than federal requirements. This illustrates the constraints that pre-emption puts on states, who are limited in their ability to try innovative approaches or to adopt more stringent standards than federal regulation. Given the EPA's slow pace for implementing new regulations, many issues that affect equity remain unregulated.[158]

Fossil fuel use driving changes in extreme weather and climate risks. Climate change affects everyone's health, but it disproportionately affects those who already suffer from high energy burdens and energy insecurity.[159] These challenges are expected to continue and worsen with rising temperatures: Higher temperatures are a precursor to health hazards such as the formation of ozone, fires such as the ones experienced in California, the likelihood and severity of hurricanes like the ones experienced in Puerto Rico, and disease. An international study reviewed the literature on health effects of power outages caused by natural disasters in a three-month period. The authors generated a typology of health effects due to power outages, summarized below:[160]

- Loss of public health infrastructure: clean water, sewer treatment, food refrigeration, air conditioning, heating, traffic lights, fire suppression systems
- Many physical and mental health effects as a result of failure of home health and mobility equipment (e.g., oxygen systems, dialysis machines, elevators, hoists), lack of refrigeration of medications and food, loss of access to services, and isolation
- Use of backup generators and resulting air pollution (fine particles, carbon monoxide, etc.)

A study of power outage preparedness in New York City found that households with at least one person who is electricity-dependent (needing medical devices) were more likely to be low-income and live in a multifamily house. Households with at least one person who needed assistance with daily activities were more likely to be Latino, low-income, and in multifamily housing.[161]

Older adults are most at-risk in power outages because of dependence on others for assistance and/or needing medical devices. Being without light can also make them more vulnerable to falls. Living in multifamily housing can also create greater challenges during outages because of dependence on elevators and water-pumping systems.

Extreme weather can also destroy homes and leave neighborhoods or entire communities uninhabitable for lengthy periods of time. The impact of Hurricane Maria in Puerto Rico is one example with dire health and economic consequences across the Island.[162] The effects of the wildfires in California in the past months and years are still under evaluation, but cost estimates are expected to reach billions of dollars.[163] The impacts on low-income and on many communities of color are likely to be severe given

their lack of resources to rebuild homes, as well as the loss of job opportunities in affected areas. However, these have not been documented to date.[164] Further, low-income residents are less mobile, meaning they have limited ability to evacuate in advance of severe storms or relocate in the aftermath.

Perceived lack of regulatory authority to address equity in state or federal permitting of energy facilities. Regulators face or perceive constraints on their authority to address equity issues. Our conversations with air quality regulators from around the United States brought this idea to the forefront.[165] While discussing permitting, they noted that air quality is frequently one of the last permits an applicant for a new power facility must obtain. Five or six other permits may have come earlier at the federal, state, or local level. Air quality regulators see their role as being "at the end of the pipeline" of the decision-making process, and often see little choice but to proceed. These regulators may perceive constraints on their ability to affect the size and scope of a project. Many environmental impact statements are filed and accounted for, perhaps without considering community improvements or mitigation that could be requested as part of the process. Some states lack a policy which looks at overall issues surrounding the siting of large facilities, and the public may get frustrated with the limited scope of air permit decisions.[166]

Promising Points of Intervention

Investing program revenues in disadvantaged communities. Revenues from emissions trading programs can be invested in low-income communities to ensure these communities experience the benefits of the clean energy transition. California's Assembly Bill 617 (enacted in 2017) requires facilities to install best available retrofit technology to reduce emissions of so-called "criteria" pollutants, or pollutants for which the Clean Air Act requires air quality standards to be set. Each affected facility must submit a plan that includes how public health and air quality will be improved in the local community.[167] The California Air Resources Board has developed a blueprint to implement this legislation.[168] Also in California, Senate Bill 535 (2012) requires that at least 25 percent of the revenue from the state's greenhouse gas auctions be directed into investments that benefit disadvantaged communities.[169] In the Northeast, a portion of the auction revenue from the RGGI program is directed to low-income energy efficiency and billing assistance programs.[170] The RGGI program is discussed in more depth in Section 6.

PUTTING RGGI'S REVENUES TO WORK

The Regional Greenhouse Gas Initiative has been groundbreaking in its cooperative approach and in the health and economic gains seen in its northeastern member states. RGGI takes a "cap and invest" approach to greenhouse gas emissions, allowing states to make use of revenues from auctioning emissions allowances they do not need. The program is marked by collaboration between state energy and environmental officials, and it has achieved air quality improvements for the region that are valued at a running total of $5.7 billion. More than 100,000 economically vulnerable households have benefitted from bill assistance and energy efficiency investments paid for by RGGI. For more on RGGI's design and benefits, see Section 6.

Combining energy and environmental regulatory processes. State environmental agencies are primarily responsible for issuing permits for new or modified energy generation facilities. Combining and coordinating environmental and energy regulatory processes could

optimize all relevant goals.[171] Examples include coordinating utility integrated resource planning for energy supply and distribution systems with environmental impact statements, air quality planning, and permitting. This would reduce the need for advocates to intervene in multiple proceedings about the same facility and lead to improved overall planning for energy supply. For instance, such a process would enable state environmental agencies to determine that a combination of new storage plus renewable generation qualifies as the best available technology for reducing emissions, thus avoiding installation of additional fossil-fired generation.

Community protest against Massachusetts natural gas pipeline. Photo: BigStock

Supporting initiatives to improve community resilience during extreme weather events. States and PUCs can support projects to improve resilience. Examples include the development of microgrids to support municipal facilities and emergency services, as well as designated community centers (e.g., senior centers and public schools) that can provide shelter and services to residents in extreme weather situations if their power is out or heating or air conditioning is not available at their house. States can explicitly identify resilience as a goal and allocate funding for energy-related resilience efforts. PUCs can direct utilities to invest more in resilience, including backup power solutions and systems that can be isolated from the rest of the grid in the event of a power outage. Distributed, behind-the-meter solutions such as renewables paired with storage and energy efficiency should be expanded to improve communities' ability to "ride out" severe weather events by reducing dependence on electric and natural gas infrastructure. Other benefits of these resources include lower long-term energy costs, emissions reductions, avoiding maintenance and expansion of natural gas infrastructure that may not be usable in the long term, and reducing dependence on high-cost fuels like propane. Storage battery systems, whether paired with renewable resources or not, are now a key strategy for states and communities to improve resilience. The California PUC aims to link energy storage with climate resilience and disadvantaged customers. It proposes to invest $100 million to help low-income households and customers with medical needs pay for the costs of solar-plus-storage as a means to maintain electricity service during wildfire events. [172] On a more local scale, the Bloomfield, Iowa case study in Section 6 demonstrates how one city is taking this initiative.

Implementing performance-based regulation to incentivize a transition to clean, equitable energy. State energy and environmental agencies need to work to align their regulatory structures with new utility business models. Regulations should be reformed to align utility motives to facilitate a transition to clean, equitable energy infrastructure through mechanisms such as decoupling or performance-based

regulation. In Washington, Senate Bill 5116 (enacted in 2019) requires the state's electricity supply to be carbon-neutral by 2030 and carbon-free by 2045. The comprehensive bill also moves the state's utilities to performance-based regulation and prioritizes the creation of family-wage jobs and protection of low-income and vulnerable populations.[173] This legislation is considered groundbreaking in its reform of the utility sector, as utilities will shift from a "return on capital" model to a model based on their actual performance to meet goals like reducing greenhouse gases and increasing equity among low-income and vulnerable customers. The bill also requires utilities to fund low-income energy assistance, which includes not only energy efficiency and weatherization, but also "direct customer ownership in distributed energy resources."[174] Washington's legislation offers an excellent regulatory model for other states to adopt as they implement programs to decarbonize the electricity sector. Explicit language to protect labor and prioritize low-income households broadens constituent support and the ability to accelerate greenhouse gas reductions. In Burlington, Vermont, the municipal utility is partnering with its community to achieve the most ambitious climate goal established in the United States to date: net zero energy (not just electricity) by 2030. Equity is a key priority in this effort.[175] The framework for reporting key metrics and progress towards goals is currently being developed.

Building campaigns and supporting collaboration. Advocates and communities should work together on campaigns to influence utilities' (especially cooperative utilities') resource planning practices and to appoint or elect board members to municipally owned utilities and co-ops whose goals align with health and equity objectives.[176] Advocates could be a part of the energy decision-making process well before the permitting stage. This would allow them to question how the utility should serve electricity load and the lowest-cost ways of doing so. Groups could also start to intervene at earlier stages of environmental impact or siting processes to question the need for additional generation (versus additional efficiency programs) or the type of additional generation that is being suggested—renewable vs. fossil-fuel. As suggested earlier, the tools for advocates to engage in utility planning discussions include a knowledge of the processes and levers of influence as well as of energy sources, reliability needs, distribution system issues, modeling tools used by utilities, and the alternatives available for providing all these services at lowest cost.[177] Philanthropies should encourage more established organizations – whether Community Action Agencies or other nonprofits focused on justice issues or neighborhood development – to nurture and support those organizations that are emerging and in need of greater support and infrastructure.

5.4. Employment

Key Barriers and Problems

Employment is a key social determinant of health. Increasing access to well-paying jobs is an effective way to address health inequity, while also fueling local economies and creating more vibrant and healthy communities. The energy sector is facing a decline in traditional jobs associated with fossil fuel generation. At the same time, the growth of energy efficiency and renewable energy is creating opportunities for many new jobs. This transitional period poses opportunities as well as challenges to addressing equity.

In 2018, clean energy employment added 110,000 net new jobs and grew 3.6 percent nationally. Photo by Science in HD on Unsplash.

Lack of diversity in workforce. As states and industries in the United States work to decarbonize their economies, the energy sector is likely to experience continued job growth in the fields of clean energy production and energy efficiency.[178] In 2018, for example, energy efficiency businesses in the United States accounted for approximately half of the broader energy sector's job growth.[179] The renewable energy sector has also experienced significant job growth. In 2018, clean energy employment added 110,000 net new jobs and grew 3.6 percent in the United States.[180] These sectors frequently pay higher than average wages and often generate local jobs, in part due to the on-site nature of the work in constructing, installing, operating, and maintaining renewable energy and efficiency technologies.[181] But while employment in the clean energy and energy efficiency fields are, on average, more representative of the country's population than the broader energy sector,[182] they are far from fully representative of the population. In fact, less than 20 percent of workers in clean energy production and energy efficiency are women, and less than 10 percent of workers are African American. However, the share of Hispanic workers in clean energy production and energy efficiency are higher than the share in the national economy.[183]

Plant retirements and job losses. While job growth continues in clean energy and energy efficiency, jurisdictions are grappling with jobs reliant on uneconomic fossil fuel plants, especially coal-fired generators.[184] Many fossil fuel plants (especially coal plants) are retiring, and with those retirements come job losses.[185] Communities and regions that were once heavily reliant on fossil fuel companies face economic hardship as those companies close their plants and workers lose their jobs.[186] In rural areas, the electricity and natural gas industries provided some of the better paying jobs.[187] The loss of these jobs creates economic impacts on rural workers and on the communities where they spent their paychecks. Even though fossil fuel plants generally have fewer jobs than clean energy and energy efficiency,[188] it is important to ensure that transition planning occurs to assure workers at fossil fuel plants that they have access to jobs in growing subsectors. Unfortunately, there is currently an unmet need for local, state, and federal entities that can support the transition from jobs at fossil fuel plants to jobs in clean energy production and energy efficiency.[189]

Lack of attention to demographic and local impacts. There are many analyses that attempt to quantify the job impacts of energy shifts such as fossil fuel plant retirements, the development of clean energy resources, and policies related to energy efficiency. These analyses often do not disaggregate the impacts by individual communities.[190] This makes it difficult to assess local and regional impacts of policies related to the ongoing energy transition. And since the underlying data generally do not have demographic descriptors such as race, these analyses also do not identify the individuals most affected by these policies and transitions. To better identify local employment challenges and opportunities, these analyses could be done at more refined geographical granularities and with results that are

broken out by key demographic information. To facilitate this, the U.S. Bureau of Labor Statistics could improve or expand data collection and provide public access to the more granular datasets.

Promising Points of Intervention

Creating local jobs and a diverse workforce with efficiency and distributed energy job training. Spurred by environmental policy and superior economics to traditional fossil fuel plants, clean energy and energy efficiency present an opportunity to provide higher-paying jobs with fewer educational barriers than the national average. States, local governments, and commissions are well-positioned to implement changes that can facilitate an equitable and robust transition to a diverse clean energy workforce.

As noted above, clean energy and energy efficiency are in the midst of substantial growth. Jobs in these fields have average hourly wages that are higher than the average U.S. wage by 8 to 19 percent, and low-income workers at the 10th percentile in these fields earn between $5 and $7 more per hour than the U.S. average.[191] In some cases, wage levels of union workers in wind energy are roughly equivalent to those of coal-fired power plant maintenance workers.[192] Furthermore, many occupations in these fields have fewer educational requirements, which mitigates a common barrier to employment in certain industries: the lack of a degree in higher education.[193]

- **State legislatures and localities.** While many of these jobs are based locally, state legislatures and localities can implement policies to promote or require that more jobs are local and are filled by members of disadvantaged communities. These can include ensuring that community-based vocational training is directly tied to locally available jobs; making local building codes more stringent in their energy efficiency requirements, thereby increasing local energy efficiency construction jobs; and implementing clean energy policies that ensure quality jobs are accessible to those most in need.[194]
- **Commissions.** Commissions can also require utilities to track the diversity of their workforce and suppliers, as our case study on a Minneapolis docket describes. Policies like these are emerging in various places in the United States, but they are far from common.

Policies to increase penetration of these resources can help communities that are dependent on coal (especially areas served by co-ops) to transition away from fossil fuels while maintaining a local source of jobs. There are opportunities to support the development of an equitable transition, and examples are already in place. The City of Austin, Texas issues grants to organizations to help people who live in low-income communities to train for green energy jobs.[195] As another example, California's Multifamily Affordable Solar Housing (MASH) and Single-Family Affordable Solar Homes (SASH) programs seek to increase the adoption of solar power while also providing job training and employment opportunities in clean energy and energy efficiency.[196] The SASH program has created over 74,500 installation workday positions since its inception, and over 16,500 of those positions were filled by students from California-based job training programs.[197] Still, these programs may have a challenge in reaching disadvantaged populations, and there may be high costs associated with doing so.[198] Additionally, these programs rely in part on volunteer labor, which poses a financial barrier for low-income individuals who cannot afford

to forego their wages.[199] However, as the solar sector grows, these volunteers will have the experience to land themselves jobs.

Supporting workers moving from traditional energy jobs to opportunities. As the transition to a decarbonized energy sector continues, there will be additional and perhaps increasing levels of fossil fuel plant retirements. As this happens, there are opportunities to support a "just transition" for workers at retiring fossil fuel plants such that they are not left unemployed and without skills training programs. Colorado recently passed HB19-1314, "Just Transition From Coal-based Electrical Energy Economy," which attempts to facilitate such a just transition.[200] It creates a Just Transition Office that aims to support workers in coal-related jobs and their families.

There are also opportunities to implement alternative economic growth strategies in regions with shrinking fossil fuel-based economies. Some regions that once relied on an "extraction economy" are able to foster a new attraction economy that is based on, for example, ecotourism or agri-tourism.[201]

Our interviews identified other promising solutions, including more transition assistance for people and communities that were dependent on forms of energy that we are transitioning away from. In addition, tax incentives could spur appropriate development—solar and wind for example—on strip mine benches.

Energy jobs are changing. Coal-fired power plants are labor-intensive to operate, while wind generation is less so, especially after facilities are built. But the manufacturing and construction of wind turbines could offer real opportunities for local jobs at good wages in host communities and throughout the wind turbine supply chain. That said, one cautionary note we learned through our interviews is that advocates should avoid directly comparing these types of jobs, because often wages and benefits are not the same. When possible, communities and renewable energy developers should work together with labor unions to ensure a just transition for workers, and advocates in states such as Minnesota have worked to achieve this and get companies to prioritize local and union hiring.[202]

Providing more granular data and analyses to assess local impacts of new energy choices. Finally, it is important to reiterate that many job analyses are currently conducted at the state or even national level. The lack of granularity of employment analyses makes it difficult to parse the community-level impacts, and it is therefore difficult to identify the challenges and opportunities that exist regionally to encourage a just transition or a shift to a new economic growth strategy. The availability of more granular data and analyses of fossil fuel plant retirements would make it easier for stakeholders and policymakers to identify ways to support workers who lose their jobs while the grid decarbonizes.

5.5. Cross-Cutting Interventions

A number of policies address more than one equity problem. Such cross-cutting interventions include facilitating and supporting public input, regulatory reform, targeting cooperative and municipal utilities, and improving data collection to shed light on where interventions are needed and whether interventions are successful.

Facilitating and supporting public and stakeholder input

Supporting and building partnerships. Utilities and regulators can address trust issues by coordinating with trusted community organizations when implementing any these solutions. Such organizations may include community action agencies, legal aid organizations, unions, and other community or faith-based groups. Funding could be provided directly to these existing community organizations to support utility offerings. Another approach is to hire and more formally establish new environmental or low-income coordinators in tribal and other areas to work on energy efficiency program outreach, access to energy alternatives, and education on energy and health issues.[203]

Opening up existing regulatory processes to more input. Modifications to state and federal regulatory processes, such as making early-stage permitting processes accessible to a broader audience, could facilitate input from affected communities. At the most basic level, this means making it easier for communities to know when and where energy decision-making and related events are happening. As another example, holding comment sessions at various times of the day and evening can help address participation barriers faced by those who work full-time. Providing translators at community meetings can also facilitate participation by isolated immigrant populations. Some processes are led by stakeholder working groups, such as energy efficiency collaboratives. In these cases, utility regulators can expand representation by adding new stakeholders. Given the funding constraints facing many agencies, they will likely need additional resources (funding, personnel) to make these changes happen.

Integrated resource planning (IRP) provides another regulatory framework under which communities can provide input on power plants and potential alternatives. Thirty-nine states have requirements for an IRP or an equivalent plan to be completed.[204]

Providing funding for intervenor training and cross-sector collaboration. Intervenor training for community, social justice, and environmental justice groups to build legal, energy, and environmental expertise can facilitate citizen and advocate participation and improve their effectiveness in rate cases, IRP processes, and permitting decisions.[205] Also, increased and improved collaboration between these groups and consumer and environmental advocates can increase awareness of affordability, access, and health issues and give rise to mutually beneficial solutions. Collaborations can be helpful to proactively plan for fossil fuel facility retirements, mitigate negative labor impacts, and line up opportunities to transition workers. Availability of funding for these efforts is currently very limited; philanthropy can play a big role in expanding funding, facilitating connections, and providing space for these collaborations and trainings.

INTEGRATED RESOURCE PLANNING

An IRP offers opportunities for public input into the overall planning of what energy resources will be needed, and their costs, over a short- to long-term period. Some states, such as Connecticut, require one joint plan to be submitted that represents all utilities in the state. Others require plans to be completed by individual utilities. Some states require IRP to be completed every two years, others every five years, and still others upon demand or need. State PUCs are responsible for overseeing the IRP process, while utilities have a large role in developing methodologies, assumptions, projections, and proposals for addressing any forecast need.

While the IRP concept is commendable, its execution and implementation are uneven. Many PUCs hold meetings only during the day, and the IRP meetings themselves can get into detailed modeling that requires technical knowledge generally not present in the general public or advocacy groups. Some IRPs treat energy efficiency and renewable resources casually and seem to have pre-ordained conclusions that a new power plant is the "best" option.

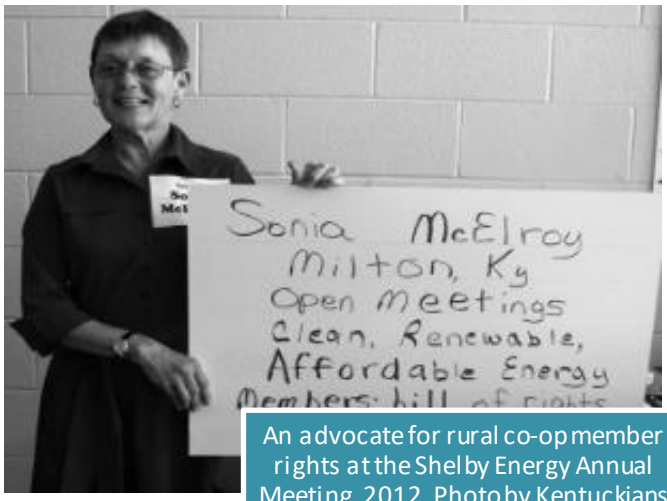
To ensure that the IRP process is transparent and open, members of the public can request that the PUC and/or the utility hold an informal public meeting to discuss the IRP process, and consumer advocates may be willing to provide training to community groups on IRP. The benefits to equity of these recommendations include:

- Increased PUC attention to low-income stakeholders' concerns and interests;
- More robust and comprehensive plans that account for air and water quality impacts, access to clean energy resources, and stable energy rates; and
- Improved low-income stakeholder trust in the PUC, which could improve low-income residents' participation in energy efficiency programs and help develop and promote renewable energy programs such as community solar.

Some states, such as California and Washington, require project proponents and the decision-making agencies to address environmental justice issues and issues that affect low-income and disadvantaged communities. California awards funding for intervenors who provide useful input.[206]

Environmental and social justice requirements in states such as California and Washington have led to increased coordination between local community action groups and environmental advocates, especially related to proposed energy-related projects. An example of this is environmental justice comments made during the public review period of a proposed bulk coal terminal in Longview, Washington.[207]

Advocating for new regulatory processes for community involvement. As states adopt energy policies that move away from fossil-fuel generation, utility regulators should provide more opportunities and more flexible opportunities for communities to participate in regulatory processes. They can do this through new venues such as grid modernization, power sector transformation, and distributed energy resources/non-wires alternatives planning. Utility regulators can hold informal proceedings, including technical sessions, with a focus on low-income community-centered issues such as: job training for former power plant workers, including in the energy efficiency or renewable energy fields, and customer



An advocate for rural co-op member rights at the Shelby Energy Annual Meeting, 2012. Photo by Kentuckians for the Commonwealth on Flickr.

Photo by Neonbrand on Unsplash.

empowerment initiatives such as community choice aggregation. Further, community involvement in energy decision-making can be facilitated by greater adoption of consumer choice and aggregation.

Conducting energy education and outreach. School and community-based education initiatives can teach about how energy is produced, distributed, and used as well as the impacts of each step of the process. This would enable everyone to understand their bills, the impact of their use in their homes (what contributes to their bills), and solutions to lowering their home energy and water costs through efficiency.[208] Better education of all consumers (starting with children in primary schools as part of STEM programs) about their local energy resources and the climate and health impacts of their energy choices is necessary to allow citizens and local community-based organizations to participate in permitting and regulation processes. Education on renewable energy choices and storage options can be incorporated into the efforts that some states are making to improve access to energy efficiency programs for low-income households and communities of color.

Regulatory reform

Reforming existing environmental regulatory processes to consider a wider range of alternatives and community impacts. As mentioned earlier, facility siting and integrated resource planning processes could be expanded to consider analysis of alternatives (e.g., whether the proposed facility is needed or whether a renewable option with storage should be considered). Also, state air agencies and the public can take advantage of the SEPA (or equivalent) processes to ensure that Environmental Impact Statements comprehensively consider and address equity and public health concerns. These impact statements routinely include

ALTERNATIVES ANALYSIS

A federal appeals court in Virginia recently broke new ground in overturning a permit for a gas compressor station planned for a historic African American neighborhood after environmental justice advocates there argued against its siting. The decision was based on Virginia's specific permitting regulations that require a broader analysis of alternatives.

only the primary air pollutants like nitrogen oxides and sulfur dioxides, whereas significant public health and environmental impacts occur from secondary pollutants, such as nitrates, sulfates, and organic gases. Modeling conducted by consultants is equally narrow and often does not evaluate all the various operating conditions that may occur during the operation of a power plant.[209] Regulators can be supported in expanding these processes to consider a broader set of health and environmental impacts of proposed infrastructure, as well as alternatives that could achieve the same objectives with lower or no burdens to the local community.

Reforming utility regulation to reflect equity policy goals. There is growing recognition that utility business models need to evolve to be relevant in a new energy world with distributed and renewable resources, and some states have launched efforts to align utility incentives with policy objectives. Shifting utilities' focus to providing a much wider range of energy services and data in an integrated fashion (instead of just supplying electricity or natural gas) will yield multiple benefits for low-income communities. The government, energy providers, and communities have a role in ensuring that bills are affordable and new technologies are installed and used appropriately. For example, state policymakers (legislatures and PUCs) can realign incentives to utilities for investing in energy efficiency and distributed renewable energy through performance-based regulation.[210] A performance-based regulation framework is a holistic attempt to align a utility's reward structures with policy goals and is being used in jurisdictions throughout the United States, including in Rhode Island, New York, Hawaii, and Minnesota (see sidebar). Public utility commissions can open dockets exploring and ultimately implementing performance-based regulation. A core component of performance-based regulation is the development of metrics to track a utility's performance on a specific issue, and performance incentive mechanisms—commonly taking the form of financial incentives—to encourage the utility to reach targets for the metrics.[211] With or without performance-based regulation, state legislatures and PUCs can implement a decoupling mechanism to sever the link between utility rates and sales. Under decoupling, a utility's revenue is not lowered as a result of reductions in sales due to energy efficiency or distributed generation. If well-designed and implemented, these reforms can shift utilities' priorities towards access by low-income and marginalized communities.

In rural areas, where a co-op may be providing energy services, the focus needs

PERFORMANCE-BASED REGULATION IN MINNESOTA

The Minnesota PUC opened a performance-based regulation docket to identify and develop performance metrics and potential performance incentive mechanisms to incentivize the state's sole investor-owned utility to help meet policy goals. These goals related to affordability, reliability, customer service quality, environmental performance, and the cost-effective alignment of generation and load. Docket stakeholders helped develop metrics and incentives that would push the utility to better address equity, environmental, and diversity concerns (such as arrearages and disconnections, greenhouse gas and criteria pollutant emissions, and workforce diversity).

The metrics adopted in the PUC's resulting order included four affordability metrics related to equity. The order also directed the utility and stakeholders to develop reliability metrics related to equity and a metric to measure workforce and community development impact. By shifting utility attention to equity-related metrics, Minnesota's approach to performance-based regulation lays the groundwork for including equity in current and future energy decision-making.

to begin with their governance structures and community input to enable a conversation about a more diverse, less expensive, integrated, and resilient energy supply. Cooperative and municipal utilities are usually not under the jurisdiction of PUCs, and thus the approach will be different. Initiatives to increase cooperative member participation, educate board members, and encourage election of board members who represent low-income communities or communities of color can be effective. A toolkit created by New Economy Coalition member organizations can help communities with reforming rural electric co-ops.[212]

Improving data collection to understand needs and assess program effectiveness

Community groups and municipal governments do not have the data they need to understand inequities and advocate for change with energy-decision makers and regulators. Improved data collection can also inform state and local agencies about whether programs are effectively addressing access issues, or whether changes in regulations could be made to improve equity. Reporting on equitably designed utility program opportunities (including number of potential participants and current energy use and costs for these potential participants relative to income levels) and performance (number of actual participants and energy and cost savings) will be helpful. Addressing privacy and security issues associated with data sharing across key partners and data uses is critical; for example, rules should prohibit use of data for personal surveillance. Availability of aggregated data through publicly accessible interfaces such as a website can balance the utility of greater insight into improved affordability and other benefits such as improved air and water quality with customer-level data privacy concerns.[213,214] To the extent communities own behind-the-meter generation and backup power, they would then have access to data on the performance of these systems.

PUCs can require utilities to provide anonymized data to third parties, thereby enabling third parties to join what would be a more competitive process for satisfying grid needs. One of the principal changes in energy procurement under power sector transformation is the proliferation of smart devices along with improvements in communications of these devices and broadband connectivity. These devices provide data to customers, enabling them to directly manage their demand. These devices also can provide data to utilities and third parties, enabling them to manage demand on behalf of willing customers. Customers should be enabled to share their data to third-party providers. Lastly, with data from these devices in hand, utilities and third parties can better schedule and plan for managing electricity demand.

6. CASE STUDIES

6.1. Regional Greenhouse Gas Initiative

Primary equity impact	Climate change mitigation, working across silos in states—system level changes, state investments in energy efficiency and other mitigation
Secondary equity impact	Affordability and access
Geographic scope	Regional (Northeast, Mid-Atlantic): (CT, DE, MA, MD, ME, NH, NJ, NY, RI, VT); Prospective: VA (likely 2021), PA
Region	EPA regions #1-3
Energy type	Electricity and natural gas
Utility type	All
Target community	Lower-income communities

Summary

Over the last decade, a ground-breaking regional partnership among states in the Northeast has yielded immense health and economic gains. The Regional Greenhouse Gas Initiative or RGGI (pronounced "Reggie") is an innovative market approach to reducing pollution from power plants while raising billions of dollars for public investment. Successes of the RGGI model include:

- Dramatic reductions in carbon dioxide (CO_2) emissions and corresponding criteria pollutant reductions, leading to large public health benefits
- Large savings in energy bills
- Job growth for local and regional economies
- Benefits for the most vulnerable households
- Transferability to other regions and transportation

The key to improving and replicating this initiative is to understand what makes RGGI so different. This case study explains its innovative features and discusses ways to enhance its impact in vulnerable communities.

Background

RGGI was the first "cap-and-invest" program in the country. Instead of the conventional practice of giving pollution allowances to power plant owners for free, RGGI developed a market mechanism to auction off CO_2 emission allowances. This ensures that power plant owners have to pay to pollute, encouraging a switch to cleaner power generation. Second, RGGI requires that auction proceeds be reinvested into communities. Specifically, RGGI's 2005 Memorandum of Understanding requires that a

minimum 25 percent of proceeds be spent for "consumer benefit or strategic energy purposes." Other than this, states have flexibility in how to spend proceeds.

Unlike other air quality programs, RGGI's governance structure fosters collaboration by including state agencies from the energy and environmental sectors. RGGI, Inc. is governed by a board of directors comprised of environmental and energy agencies from each state, with day-to-day operations overseen by a working group made up of agency staff from each member state.[215] To measure and maximize its impact, RGGI requires program review every three years—a unique aspect of RGGI among air pollution programs.[216] These reviews offer an opportunity to tweak program features to improve the program. For instance, adjusting the emissions cap ensures optimal emission reductions and stable proceeds.

Findings and impact

A decade of clean energy and energy efficiency investments from RGGI has paid large health and economic dividends in the region.

A recent 10-year report shows the RGGI region has achieved 90 percent more reductions in power plant CO_2 emissions than the rest of the country, while its gross domestic product grew faster (47 percent versus 31 percent).[217] CO_2 emissions from power plants in the member states are roughly half 2005 levels.[218] A recent study correlated air quality improvements from RGGI investments with enormous public health benefits totaling $5.7 billion.[219]

An estimated $1.4 billion in lifetime energy bill savings has been distributed to nearly 300,000 households and 3,000 businesses that participated in RGGI-funded programs. Regional investment in energy efficiency and clean energy has also kept more energy dollars in the local economy by reducing the need for out-of-state fossil fuel purchases.[220] In addition, RGGI investment supports the region's rapidly growing energy efficiency job sector, described in Section 3. Notably, Massachusetts, New York, and Virginia are in the top 10 states for jobs in energy efficiency.

Although RGGI's program design lacks any defined equity goals, program reviews show that some RGGI investment has reached marginalized communities,[221] benefitting over 100,000 economically vulnerable households through direct bill assistance and efficiency programs targeted to low-income groups.[222] However, environmental justice groups have requested more thorough documentation of the benefits from RGGI and an increase in investment in environmental justice communities.[223] Stakeholder involvement during the upcoming program review could yield a better process for allocating investments to improve equity as part of the RGGI program.

Additional insights into RGGI's impact come from reports developed by the RGGI Project Series, an independent, science-based, nonpartisan, philanthropy-funded effort.[224] Rutgers University examined state equity approaches in a new report, *Field Notes: Equity & State Climate Policy.*[225] Although RGGI itself has no defined equity goals or metrics, the report shows some promising member state strategies:

- RGGI states use a variety of strategies to direct benefits to under-resourced communities, including utility mandates, a focus on rentals and multifamily housing, support for programs that address social determinants of health (SDOH) exacerbated by climate change (such as Rhode Island's Health Equity Zone Initiative),[226] innovative financing programs, and education in targeted communities.
- Interagency climate policy committees foster effective coordination of climate policies with other government support to disadvantaged communities and consumers, including transportation, health, social services, housing, and community development.[227]
- New York's Climate Leadership and Community Protection Act, which sets a target for the state to direct 40 percent, but not less than 35 percent, of state climate program benefits to disadvantaged communities.[228]
- Green banks in New York, Connecticut, and Rhode Island[229] enable more affordable housing remediation as well as financing for renewables. For example, a Connecticut project combines a 20-year lease of photovoltaic panels with household energy efficiency upgrades. A credit check is not required. Job training for local workers is also an integral part of the Connecticut Green Bank's mission.

Opportunities for improving RGGI

Although many states measure energy efficiency investment targeting low-income customers, specific benefits to environmental justice or socially vulnerable communities are not consistently tracked. At the most recent RGGI program review listening sessions and stakeholder hearings, public comments included requests for a regional environmental justice analysis as part of program review, investment of a majority of RGGI auction proceeds to benefit vulnerable populations, and establishment of a stricter cap designed to benefit vulnerable populations.[230] These discussions continue. A 2017 analysis of five years of public health effects suggests another key improvement would be to expand emissions tracking beyond CO_2 to include two other harmful pollutants, sulfur dioxide (SO_2) and nitrogen oxides (NO_X).[231] As discussed in Section 3, these pollutants exacerbate asthma, heart attacks, and premature death and present a disproportionate risk in low-income communities and communities of color.[232]

Applicability and replicability

RGGI's state programs are flexible, an attribute that makes them more easily replicated. As an example, RGGI's model has inspired another innovative regional effort with huge potential for improving health, the Transportation and Climate Initiative or TCI.[233] Transportation is the source of many of the pollution health hazards faced disproportionately by marginalized communities, and it is the largest source of GHG emissions in the Northeast. With lessons learned from RGGI, the TCI program design now under development has a strong focus on equity. Recent TCI stakeholder comments on the proposed program framework show strong support for considering equity at the outset and as a leading principle of program design. The TCI states include eight of the existing RGGI states (all but New Hampshire) as well

as New Jersey, Pennsylvania, and Virginia. The December 2019 TCI statement expresses a commitment to equitable outcomes by working with people and under-served communities disproportionately affected by climate change and transportation pollution.[234] TCI intends to foster development of: clean mobility options through the electrification of public transit and passenger vehicles; complementary policies and priorities that advance equity; transparency and information-sharing on changes in emissions over time; responsive program design informed by community feedback and impact data; and tailored outreach that meets the needs of individual communities.[235]

In addition to its replicability for transportation emissions, the initiative's impact is expanding geographically, with New Jersey having just joined in 2020 and Virginia slated to join the program in 2021. Pennsylvania is also showing interest. Virginia's adopted RGGI rule specifically addresses impact in vulnerable and environmental justice communities, opening the door to an enormous funding boost for consumer benefit programs that target low-income and marginalized communities.[236]

6.2. Ohio Arrearage Management Program

Primary equity impact	Affordability and access, improved indoor air quality, employment (for installers of energy efficiency measures)
Secondary equity impact	Improved outdoor air quality. Reduced greenhouse gas emissions
Geographic scope	State (Ohio), Counties (88. 37 have populations less than 50,000 and higher rates of poverty than the state average)
Region	Midwest, EPA region #5
Energy type	Electricity and natural gas
Utility type	Electric and gas investor-owned utilities with more than 15,000 customers
Target community	Low-income participants: income must be less than or equal to 150% of U.S. poverty guidelines

Summary

The Percentage of Income Payment Program (PIPP) is a mature Ohio program that reaches about one-third of eligible low-income electric and gas customers, many in rural areas. The Ohio program has many attributes that make it a useful model for other states:

- It is part of a one-stop shopping process for energy-related services that connects eligible customers through community action agencies (CAA);
- CAA are located in each county, know their customers, and have built up trust over time;
- Traditional energy efficiency cost-effectiveness tests are suspended, meaning more customers and deeper energy savings can be achieved; and
- Customers face less stress over the choice between paying energy bills or feeding their families.

The PIPP is undergoing a required once per five-year review now. Initial recommendations to allow third-party payment for a customer's bill and suspending minimum payment requirements for participants would make the program even more attractive as a model.

Background

The PIPP was created in the early 1980s by a Public Utility Commission of Ohio (PUCO) order following a stakeholder process involving mostly ratepayer groups.[237] The PUCO administered both electric and gas PIPPs until 2000. Legislation passed in that year transferred the authority to administer the electric PIPP to the Ohio Development Services Agency. The gas PIPP administration was unchanged, and today continues to be administered by the PUCO.[238]

The PIPP program allows eligible customers to pay 6 percent of their income, but not less than $10 each month, to each gas and electric service (for a total of 12 percent of income). The amount of unrecovered revenue is then recovered by all ratepayers through a PIPP rider on customers' bills. As amounts are

repaid from customers who "graduate" from PIPP, those amounts are credited back to ratepayers. The regulations also include a debt forgiveness program that allows graduating customers to reduce their PIPP payment by one monthly installment for every month they pay their current bill plus the percentage of the PIPP arrearage.[239]

About 395,000 customers (10 percent of the total state number) are presently enrolled in the PIPP. Of these, 230,000 are electric customers and 165,000 are gas customers, representing about one-third of the total number of eligible PIPP customers. Because the payment of bills is based on income, the incomes of those participating today are skewed towards those making less than 75 percent of the guidelines. This is because those customers who are near 150 percent of the federal poverty guidelines (FPG) pay more, and the differential between the income level and the actual bill may not be that significant.

Findings and impact

The electricity PIPP is administered by the Ohio Community Services Department, which is connected to the CAAs located in each county. To access the PIPP, customers work with their local CAA. These agencies help customers determine eligibility and qualification and complete the necessary enrollment process. CAAs also perform outreach to increase awareness of the PIPP and to educate potential customers about the program benefits. In effect, the CAA serves as a single forum where low-income customers can learn about all potential programs for which they may be eligible, including LIHEAP and Ohio's Home Weatherization Assistance Program (HWAP). This "one-stop shopping" is critical to ensuring that low-income customers get additional assistance for all programs for which they are eligible. Often the CAA has staff trained to provide the weatherization services, so the CAA serves as a forum to make customers aware of new energy efficiency services on offer. In Ohio, funds from utility energy efficiency programs are leveraged with the HWAP funds in order to provide deeper home weatherization to more households.[240]

The PUCO's 2019 PIPP review found that the requirements for all payments to be made in full each month and a minimum payment of $10 a month are not reasonable. Many participants have incomes less than 50 percent of the poverty guidelines, and some have no income. The minimum payment requirements also impose high administrative costs on the agencies responsible for their collection. The costs of resources required for collection can exceed the amounts collected. The current program review suggests that, in the future, PIPP should suspend minimum payment requirements, allow incomes to be considered over a rolling 12-month period, and allow for third parties[241] to make PIPP payments on behalf of a customer. According to the Ohio Consumers' Counsel, changes to the PIPP regulations are expected to go into effect during 2020.

The PUCO updates the total PIPP revenue requirement for electric utilities each year. For 2020, this value is $301 million. The revenue requirement for gas utilities is calculated separately and was not available at the time interviews were conducted. However, the revenue formula is periodically updated by the PUCO. Note that the uncollected revenues from PIPP customers that are collected from all customers creates a significant subsidy that is borne by all customers, including non-qualified PIPP customers who are at the margin. How these costs are allocated matters in terms of the impact on other

customers. In Ohio, all customer classes pay the cost and the surcharge is added to the energy (kWh) charge. This method minimizes the impact on other residential customers to the extent possible.

Overall, PIPP is the sole program that provides unrestricted access for low-income customers to energy efficiency services in Ohio. The standard cost-effectiveness tests typically applied to such services are suspended for the measures installed as part of the PIPP. This is important as some weatherization measures do not pass cost-effectiveness screens when they are considered individually.[242]

Potentially working against the effectiveness of the PIPP, some of the fixed rate contracts offered by Ohio's natural gas companies provide a discount on rates (20 percent relative to variable rates) but require a 12–36 month term and have early termination charges as high as $199.[243] These requirements are burdensome on low-income customers, especially renters, who may have little certainty that they will stay in their residence for the duration of the contract term.

Applicability and replicability

Several states offer discounts on electric and gas bills and offer forgiveness for arrearages.[244] California, Maryland, Massachusetts, and New Hampshire are among the states that offer discounted rates to eligible low-income customers, typically at 30–35 percent off the monthly bill. However, income guidelines vary. Maryland has a complicated eligibility formula based on income, monthly usage, a "utility index," and the poverty index. In Colorado, Xcel initiated a pilot PIPP which enrolled about 7,500 electric customers. That program adjusts customer bills to no more than 3 percent of their income.[245] The Xcel program was expanded in 2011, and as of 2016, is serving 24,000 customers.[246]

New York's energy assistance program has an element that could prove useful if adopted in Ohio (and other states). Twice a year, Consolidated Edison (Con Edison, an investor-owned utility) provides a list of non-participating low-income customers to the New York Department of Health and Human Services (HHS). The HHS then "crosswalks" the Con Edison list with those names on an HHS list of customers eligible for means-tested services. Those names that appear on the Con Edison and HHS lists are notified that they are eligible for energy assistance. The HHS program costs less than $100,000 a year and covers hundreds of thousands of customers.[247] The New York program, however, continues to use cost-effectiveness tests for measures installed on low-income customers.[248]

The PIPP program in Ohio could be improved by providing incentives to encourage conservation by splitting any savings from reduced usage over the previous year, so that the customer would receive a further bill reduction. For example, if in November, the customer used the equivalent of $10 less energy, the customer would get an immediate $5.00 credit on the PIPP amount owed that month. At the same time, this would lower the amount that would need to be recovered from other customers in the PIPP rider by $5.00. This would help address the flaw in the PIPP program in which payments are based on income with no incentive to conserve usage.

Compared to the programs described above, Ohio's program has several attributes that make it a useful model for other states:

- It covers a higher percentage of eligible customers.
- It explicitly links customers with energy efficiency services.
- It suspends cost-effectiveness tests for energy efficiency measures installed on PIPP customers.
- It has straight-forward payment requirements.[249]

Revisions under consideration include suspending minimum payment requirements, allowing payments to be made over the course of a year, and allowing payments to be made by third parties on behalf of customers. These revisions could increase the effectiveness of the PIPP and its potential to be adopted by other states.

Adoption of a PIPP in other states would likely require the following:

- Authorizing legislation
- Use of decentralized, established community action agency network
- Utility support garnered through mechanisms allowing for full revenue recovery
- A receptive state consumer counsel
- A good working relationship between the consumer counsel and the public utility commission

6.3. Bloomfield, Iowa Municipal Utility Energy Transformation

Primary equity impact	Affordability and access
Secondary equity impact	Employment
Geographic scope	Local
Region	Midwest, EPA region #7
Energy type	Electricity and natural gas
Utility type	Municipal
Target community	Rural, low and moderate income

Summary

As a small city in rural Iowa, Bloomfield historically relied on wholesale electricity purchases to meet its energy needs. In 2015 the City began an initiative to achieve energy independence by aggressively pursuing ownership of renewable resources and improving the efficiency of its housing stock. Bloomfield's municipal utility has risen as a regional leader through initiatives that could make it the first utility in the Midwest to meet the majority of its energy needs through energy efficiency and renewable energy. To Bloomfield, energy independence is a community development issue that provides opportunities to break down silos between education and outreach programs, utility infrastructure planning, housing needs, and economic development. The City's energy plan focuses on equity challenges within the community by designing programs that address needs of low-income households, pair solar generation with energy efficiency, and improve affordability for homeowners and renters.

Background

The City of Bloomfield, Iowa is situated in a Midwest region that has had sluggish population and economic growth in the last decade. Fifty-one percent of Bloomfield's 2,694 residents have low to moderate income,[250] and the median household income is $42,411 as compared to the national median of $62,626.[251] The community has a scarcity of jobs and economic opportunities, making it hard to retain trained workers.[252] Compounding these issues, money leaves the local economy to bring in energy from outside the community. Community members face high utility costs in part because housing in Bloomfield is relatively old and inefficient, with an average age exceeding 80 years.[253]

Bloomfield has a municipal utility that provides electricity and natural gas. The City delivers natural gas to those living within city limits, while providing electricity to the city and the surrounding rural area.[254] The utility provides service to an estimated 1,140 residential customers and 240 commercial and industrial customers.[255] Forecasted electricity needs of the utility are 30,000 megawatt-hours each year and 7.5 megawatts of peak summer demand (winter peak demand is 5.3 megawatts) with an annual

cost of approximately $2.4 million.[256] Historically, the municipal utility purchased nearly all of Bloomfield's electricity through the Southern Iowa Electric Cooperative from regional wholesale suppliers.[257] In recent years costs have risen sharply due in part to closures of small regional coal plants facing economic and environmental pressures.[258] Between 2003 and 2013, the average customer's electricity bill doubled.[259] Carrol Ann Taylor, city clerk and treasurer of the City of Bloomfield, describes the affordability challenges: "We struggle trying to not shut their utilities off through the winter."[260] The rapid increase in cost of energy, coupled with price volatility, led City officials to consider how Bloomfield might meet its energy needs in a manner that is more affordable, economically resilient, and independent of market fluctuations.

In 2014, the City began to explore the concept of achieving energy independence and commissioned a technical and economic evaluation[261] of opportunities for energy conservation and local power production. The vision began to coalesce in 2015 when a team of local leaders participated in a workshop on electricity system innovation.[262] Since that time, Bloomfield has aggressively pursued energy independence by building renewable resources and improving the efficiency of its housing stock.

Findings and impact

Bloomfield's 2014 energy independence study identified six strategies to improve energy independence, including energy efficiency and renewable energy generation. Each strategy was found to result in a net reduction in energy costs within the community and simultaneously increase energy independence.[263] The study identified the following metrics and associated targets, which vary by scenario, for measuring energy independence:

1. Reduced retail electricity sales due to energy efficiency: up to 22.5 percent by 2029
2. Reduced net wholesale electricity purchase: up to 99.9 percent by 2029
3. Increased share of electricity produced locally: up to 99.9 percent by 2029

The study estimated that if only cost-effective programs were pursued, the potential reduction in electricity usage from energy efficiency would be 23 percent of the annual electricity needs. According to the study, the programs would generate greater cost savings than the cost to implement them. Estimated net savings for customers and the municipal utility would be $3.4 million and $2.6 million, respectively. Cost of avoided energy use is approximately one-third the cost to buy wholesale power. The evaluators suggested that the utility hire a full-time employee to implement the programs.

Achieving independence for natural gas supply would be challenging for Bloomfield. The city's baseline use is 120,000 thousand cubic feet per year, which is declining by 1.2 percent annually.[264] Bloomfield's feasibility study suggests it is possible to reduce systemwide use by 14 percent through efficiency efforts.[265] Converting residential space heat and water heating to electric heat pumps would reduce community natural gas use by approximately 50 percent, but this transition would likely require

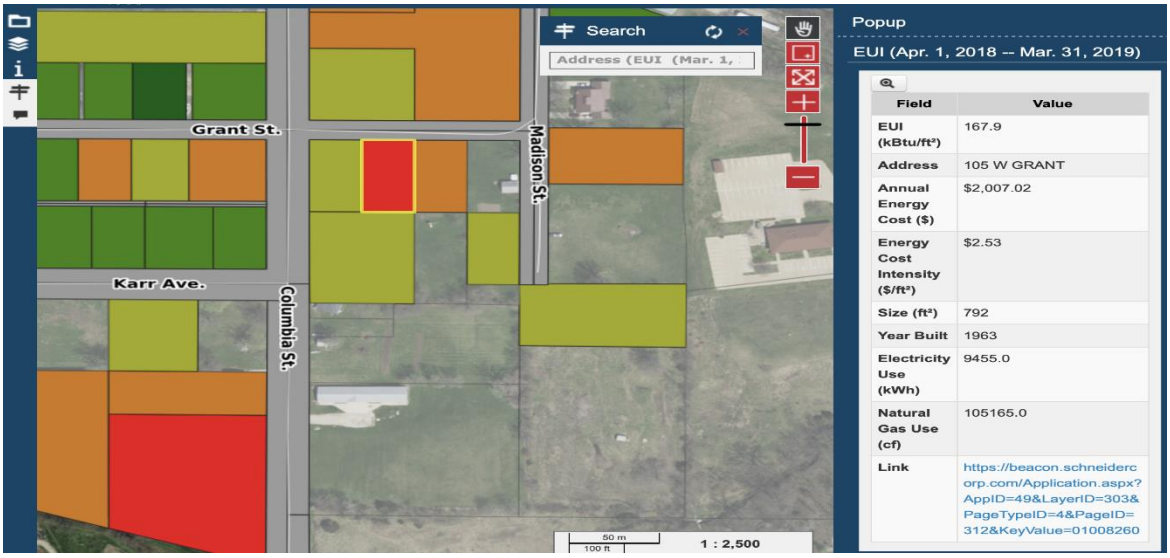
substantial incentives to influence household retrofit decisions.[266] The City is evaluating opportunities to utilize local bio-feedstocks, such as methane capture from hog lots, to offset local natural gas distribution.[267]

After completing the energy independence study, the City sought the input of the community. "We had four or five public meetings and engaged a lot of different groups, pulling ideas out of the community," noted Chris Ball.[268] Equipped with this feedback, the City resolved to decrease total community energy consumption by 25 percent and to reduce net wholesale energy purchases to zero by 2030.[269] These commitments place Bloomfield as the first utility in the Midwest to attempt to meet the majority of its energy needs through energy efficiency and renewable energy.[270] Seeking to shift from a net consumer to a net producer of energy, the City is targeting *net zero electricity* by sizing wind and solar plants to produce electricity equal to the post-efficiency demand.[271] By maintaining interconnection to the power grid, the City can sell excess power when renewable production is high and buy power when production is low. This achieves electrical energy independence in a practical manner, affording the reliability and economic benefits of the existing grid infrastructure.

Operational since December 2017, the City's 1.65 MW_{AC} solar PV array provides approximately 10 percent of the city's energy.[272] This project puts Bloomfield roughly on track reach its target of 8.0 megawatts of capacity by the year 2029, enough to reach a 100 percent reduction in net wholesale electricity purchases. In addition, the city is beginning to streamline access to solar for interested households, including working on a model for low-income households through a potential partnership with a local community action agency.[273] Despite wind power's favorable economics to solar, the City has yet to install wind turbines or procure wind power to date.[274]

Because it owns its energy utility, Bloomfield has access to property-level data that can be used to identify the least efficient buildings for targeted energy efficiency initiatives. The City analyzes, tracks, and shares publicly the energy use index and energy cost index of buildings within city limits, as shown in Figure 7.[275] The average home in Bloomfield was found to use 66 percent more energy per square foot than the Midwest average, indicating that there is great opportunity for homeowners and renters to save energy and money.[276]

Figure 7. City of Bloomfield map of residential energy use index



Source: The City of Bloomfield Iowa. 2019. Residential Energy Use Map. Available at https://www.cityofbloomfield.org. The interactive map identifies buildings by their energy use intensity, ranging from highest (red) to lowest (dark green).

Targeting both rental and owner-occupied properties, the City began a number of initiatives to improve the quality and efficiency of its older housing stock.[277] Bloomfield provided nearly $129,000 in 2015 to fund an AmeriCorps partnership program to provide energy audits, weatherization services, energy efficiency measures, and energy education within the city.[278] Program goals included energy audits of 400 low-income residences, weatherization of 200 residences and 5 public/nonprofit buildings, and 24 educational events.[279] As of June 2019, the partnership completed 250 energy audits.[280] The next step toward achieving the City's efficiency goals is to retrofit existing buildings with efficiency measures. For fiscal year 2020, the City committed $750,000 to an on-bill financing program that the municipal utility will use to improve the efficiency of residences.[281] A useful strategy for low-income households that lack access to capital, on-bill financing uses the utility bill as means for customers to repay a portion of their investments in their properties monthly while they save on their energy costs.[282] The City also considered adopting a model ordinance which would set minimum standards of energy efficiency for rental housing by requiring basic weatherization and setting minimum appliance efficiency standards.[283]

Bloomfield's energy independence initiatives can help solve the City's greatest economic challenges—brain drain and job scarcity. Achieving full energy independence would require an estimated $35 million investment in local solar and wind plants, which would create local jobs for construction, operation, and maintenance of the renewable assets.[284] The construction will generate an estimated 20 person-years of employment.[285] Together with energy efficiency upgrades, these new assets would create $4.6 million in new wages and employee benefits over the 15-year period studied.[286]

Applicability and replicability

City of Bloomfield is an example of how cities can successfully leverage utility ownership to improve or create resilient energy infrastructure, improve the existing building stock, address affordability challenges, and bolster the local economy.

6.4. Performance-Based Regulation in Minnesota

Primary equity impact	Affordability, climate change
Secondary equity impact	Civic agency
Geographic scope	State; service territory
Region	Great Lakes, EPA region #5
Energy type	Electricity
Utility type	Investor-owned
Target community	Xcel customers

Summary

Recognizing the imminent changes in the power sector and the need to guide this transformation to achieve state goals, the Minnesota Public Utilities Commission (MNPUC) opened a docket on performance-based regulation. The goal is to identify and develop performance metrics and potential performance incentive mechanisms for Xcel Energy (Xcel), the largest investor-owned electric utility in the state.[287] The proceeding included a facilitated stakeholder engagement process. Throughout the process, stakeholders considered performance metrics and, eventually, may consider incentives that seek to address five MNPUC-specified outcomes: affordability, reliability, customer service quality, environmental performance, and the cost-effective alignment of generation and load.[288] The successful implementation of performance metrics and potentially incentives will help to assess utility performance related to equity, environmental, and diversity concerns, and address any performance shortcomings if needed. These concerns include those related to arrearages and disconnections, greenhouse gas and criteria pollutant emissions, and workforce diversity. After several stakeholder meetings, stakeholders proposed performance metrics to the MNPUC. The MNPUC then issued an order adopting some of the metrics, including four metrics that relate to affordability. The order also directed Xcel and stakeholders to develop (a) reliability metrics related to equity, (b) a metric to measure workforce and community development impact, which may include workforce diversity, and (c) metrics relating to equity in customer service quality. By establishing equity-related metrics, Minnesota's approach to performance-based regulation lays the groundwork for including equity in current and future energy decision-making.

Background

At the culmination of a proceeding approving Xcel Energy's 2015 multi-year rate plan, the MNPUC—enabled by Minn. Stat. § 216B.16, subd. 19[289]—opened a docket to explore performance metrics and performance incentive mechanisms.[290] Within the newly opened docket, the MNPUC issued an order identifying five intended outcomes for the performance metrics: "affordability; reliability, including both customer and system-wide perspectives; customer service quality, including satisfaction,

engagement and empowerment; environmental performance, including carbon reduction and beneficial electrification; and cost effective alignment of generation and load, including demand response."[291] This order, issued in January 2019, also established a stakeholder engagement process, including several stakeholder workshops and opportunities for written comments.

The workshops were held from March to May 2019 and were open to all interested parties. The Great Plains Institute (GPI) advertised the meetings through an official notice in the docket and through direct outreach to a list of 200 stakeholders. At the first stakeholder workshop, GPI convened over 30 energy system stakeholders to discuss nearly 100 proposed performance metric topics, grouped under the MNPUC-specified outcomes.[292] Stakeholders were split into groups to discuss each category of metrics, with the goal of deciding which metrics to propose to the Commission.

Workforce diversity was not originally included under one of the five MNPUC-designated outcomes. The City of Minneapolis proposed in its written comments to require Xcel to track and report on the diversity of its workforce.[293] Its proposed metrics under this outcome area included:

- Demographics of utility workforce;
- Number of suppliers of energy and other utility contractors that are female-owned, minority-owned, veteran-owned, small businesses, and local, as compared to the total; and
- Funding for suppliers of energy and other utility contractors that are female-owned, minority-owned, veteran-owned, small businesses, and local, as compared to total.

At the end of the stakeholder engagement process, the stakeholders proposed dozens of metrics to the MNPUC, and on September 18, 2019, the MNPUC issued an order establishing metrics for each outcome identified in the January 2019 Order. Among the adopted metrics were several related to affordability:

- Average monthly bills for residential customer
- Total arrearages for residential customers
- Total disconnections for nonpayment for residential customers

The MNPUC notes in its Order that while "the Commission is not adopting an affordability metric specific to the topic of equity, affordability is a key indicator of equity and the four metrics it has adopted collectively address the issue." With one in three U.S. households facing a challenge in paying energy bills,[294] requiring Xcel to track and report these data sets up an opportunity for the utility, communities, and the MNPUC to identify ways to address this crisis. Solutions may include the development of performance incentive mechanisms that, if proven useful in Minnesota, could be replicated in other jurisdictions throughout the country.

Findings and impact

Through this docket, the Commission has adopted several metrics aimed at affordability that relate to equity. While the Commission did not adopt reliability metrics related to equity for implementation currently, it directed Xcel and stakeholders "to determine an appropriate method to measure and report on equity, which could include geography, income, or other benchmarks relevant to reliability."[295] Similarly, the Commission did not adopt metrics related to workforce diversity proposed by the City of

Minneapolis, but it has directed Xcel "to work with stakeholders to develop a metric to measure workforce and community development impact, which may include workforce diversity, safety, compensation, or other relevant factors" because "diversity and community engagement and impact are important topics that require additional stakeholder work."[296] Finally, the Commission directed "Xcel to propose, in consultation with stakeholders, metrics relating to equity in customer service quality."[297]

The Commission ordered Xcel to work with stakeholders to develop procedures for calculating, verifying, and reporting the metrics, and in October 2019, Xcel submitted its proposed metric methodology and process schedule.[298] Next, Xcel will begin tracking and reporting data on the adopted metrics, and the stakeholders will eventually reconvene to discuss the development of incentive mechanisms, if warranted.

Applicability and replicability

This docket is notable for the pace of the proceeding. While dockets on performance-based regulation in other jurisdictions have moved faster, this docket relied on a seven-step process proposed by the Office of the Minnesota Attorney General.[299] The seven steps are: (1) articulate goals; (2) identify desired outcomes; (3) identify performance metrics; (4) establish metrics and review; (5) establish targets, as needed; (6) establish incentive mechanisms, as needed; and (7) evaluate, improve, repeat. In the January 2019 Order, the MNPUC adopted this process with an initial focus on Steps 1 through 4. It further ordered that the stakeholder workshops and opportunities for written comments occur during Steps 3 and 4. This process allows stakeholders to extensively consider and debate the development of a wide range of performance metrics and lends itself as a model for developing incentive mechanisms elsewhere.

The deliberately slower seven-step process allows stakeholders to see what the utility reports during its initial tracking of the adopted performance metrics before stakeholders develop financial incentive mechanisms. It also allows time and attention to avoid unintended outcomes, such as setting incentives that are too easy for the utility to meet or that encourage the utility to overbuild or underspend.[300]

While the Minnesota docket to develop performance metrics is commendable in its efforts to make the stakeholder engagement process inclusive, there are inherent challenges with inclusivity in dockets on performance-based regulation. The topic of performance-based regulation is complex and requires a substantial base of knowledge. While actions like providing funding for resource-limited stakeholders can help make the docket more accessible to a wider range of stakeholders, the process requires substantial time and staffing commitments that many organizations may find difficult to meet.

Extending a performance-based regulatory framework to municipal utilities and cooperatives may prove challenging. Municipal utilities and cooperatives operate under a different business model than investor-owned utilities: They are community-owned and self-regulated, whereas investor-owned utilities like Xcel are regulated by the state. Nonetheless, public pressure to develop and track performance metrics could push municipal utilities and cooperatives to do so.

7. Future Research

Many opportunities for improving equity exist within the energy sector, as well as at the junction of energy with other sectors (broadband, transportation, and water). Below we discuss promising areas for future research.

- **Transportation and energy:** Transportation is the source of a large portion of air pollution that affects low-income and marginalized communities (especially in more urban areas). Electrifying the transportation sector holds tremendous opportunity for lowering exposure to harmful air pollution. RAP and others have written extensively about policies that can lead to improvements through transportation electrification.[301] The case study on RGGI discusses the TCI transportation initiative and the opportunities presented by TCI to reduce criteria and GHG pollution from transportation in low-income and rural areas. Future research could examine opportunities to build on the TCI experience, e.g., expanding to other states and regions. Other research should examine potential system changes in state transportation planning to promote community involvement in transportation electrification and expanded mobility options for rural areas. Or, another promising area for research is how to structure state energy infrastructure changes linked to transportation infrastructure (e.g., rate designs and electricity infrastructure, especially for EV charging) to improve outcomes for low-income communities and communities of color.

Photo by Luis Quintero on Unsplash.

- **Broadband and energy:** The transformation of the energy sector requires data collection on energy use and generation (if on-site renewable energy is part of a home or commercial or municipal building). Access to data on electricity and other fuel use in homes enables the occupants to manage their energy use and their bills. Further, access to information about usage enables consumers to lower their usage and bills during peak periods, which is key to lowering systems costs for all users. It also enables rate designs and energy management measures and tools to lower residential bills. There are many efforts underway to improve access for consumers to their energy data, and efforts to expand access to broadband would enable improved equity in rural areas through access to data and technology.[302] Many rural co-ops see this opportunity and are offering broadband to their customers as part of their service—Taos, New Mexico being one example.[303] The Institute for Market Transformation has worked with many communities on better data practices for commercial and residential buildings to enable energy efficiency and better building management to lower energy costs.[304] Building benchmarking, rating, and labeling policies are a good start and should be expanded from the commercial building sector to the municipal and residential building sectors as

soon as possible. Initiatives to further collaborations between co-ops and non-government organizations, with a focus on energy, broadband access, and equity would be fruitful.

A related project could research how deploying different technologies could reduce costs and improve maintenance of rural electricity infrastructure. These technologies might include: broadband; distribution assets that anticipate faults; and microgrids[305] that could help improve reliability of energy services through the use of storage, renewable energy, and energy efficiency. A pilot in its third year by Green Mountain Power to use batteries (some paired with renewable energy) for grid support in rural residences in Vermont provides one example that could be a starting point.[306]

- **Water and energy:** Pumping and treating water consume large amounts of energy at the municipal level—as much as a third of a community's energy budget—and that means less money is available for other community needs and services.[307] There are considerable opportunities for improving the efficiency of treatment facilities. Research assessing energy, water, and cost savings to municipalities as a result of implementing best practices in efficient water treatment and water supply facilities would be useful.

  For residents, the energy used by water-consuming appliances such as clothes washers or showers may be a large part of a household budget. For those without access to municipal water and sewage systems, energy costs to pump water to and within the home can be very high. Energy efficient appliances typically reduce water needs. For example, an Energy Star washer can use up to 40 percent less water and 25 percent less energy.[308] Campaigns to raise awareness of energy efficiency related to water use could free up money within household budgets and municipal funding for other purposes. Research is needed on the benefits (e.g. improvements in health, reduction in stresses, reduction in costs) for those with high energy burdens from public awareness campaigns on the relationship between water and energy use in the home.

Photo by CDC on Unsplash.

Other potential research projects include:

- **Rate designs:** How modifying rate designs from traditional rates (those that rely on a fixed charge and add-ons based solely on volumetric use) with more consumer protections for rural areas, low-income communities, and communities of color can improve equity. Time-of-use rates can help avoid the peak period consumption that increases system costs and rates, increases air pollution, and drives needs for additional generation at the system level.[309] More research is needed on how low-income

communities/communities of color fare under time-of-use rates and how education about those rates could affect their uptake in those communities.

- **Financing:** Alternatively, how offering renewable energy with alternative financing (pay-as-you-save, for example) in these communities along with revised rate structures can lower energy burdens. Working with electric co-ops on these issues could be especially fruitful.

- **Non-wires alternatives:** IRP processes should be advanced and updated to address resiliency and lowering environmental impacts in low-income communities, rural areas, and communities of color. IRPs do not always examine thoroughly how non-wires alternatives (demand reduction strategies like energy efficiency or distributed resources including storage) can lower environmental impacts to the targeted communities and reduce costs. A research project could consider the effectiveness of integrated resource planning with expanded scopes and alternatives analysis in ensuring that non-fossil fired alternatives are considered thoroughly when looking at upgrading energy infrastructure. Such expanded scopes would consider environmental issues in more detail, like the propensity for increased heat and wind events and the performance of different resources types under these conditions. Such integrated resource planning would be an alternative to improved environmental impact statements. It would allow regulatory agencies charged with permitting (e.g., air quality agencies) to be involved earlier in the process, rather than working with communities to mitigate the impacts of infrastructure imposed on the public without thoroughly investigating alternatives.

- **Education:** Expanding and examining the impact of advocates' public education efforts in low-income communities and communities of color, such as those being done by the Partnership for Southern Equity.[310]

- **Partnerships:** Encouraging and documenting collaborations between labor unions and environmental and environmental justice advocates (e.g., the Transportation Climate Initiative in the Northeast, Laborers' International Union of N. America (LiUNA) in the Midwest). These collaborations can promote local hiring standards for renewable energy construction jobs and for wage and benefit levels that were historically part of the energy infrastructure (as in mining jobs). They can also promote options for ensuring a just transition in mining areas and within Tribal communities who have benefited from coal infrastructure but are interested in transitioning to clean energy. Research in this area should document best practices in collaborations between labor and energy justice advocates and document their effectiveness in promoting enduring economic solutions, in particular for communities in transition away from fossil fuel dependence.

Appendix A. METHODOLOGY

This report describes our national study of: (1) how the electricity and natural gas sectors work—including key influencers, decision-makers, policies, financing flows, and practices within the energy/electric ecosystem; (2) connections/impacts to equity, opportunity, health, and wellbeing; and (3) promising points of intervention to improve equitable outcomes related to social and economic opportunity, health, and wellbeing for low-income people, communities of color, and smaller places (rural communities, towns, small and midsize cities).

The research included a literature review, in-person meetings, web forums, and interviews. The web forums, meetings, and interviews focused on addressing barriers to improving health equity, and the most critical decision points and policy options for doing so. Our respondents included a wide range of stakeholders, including those who have recently risen out of poverty and those with first-hand experience working with the populations of interest (Community Action Agencies), key decision-makers in the electric and gas utility space (Public Utility Commissions, Public Advocates, and Utilities; Air Quality Regulators), organizations active in this topic, and other key stakeholders and decision-makers. Appendix B provides the names of those interviewed and their organizations.

We also developed case studies using interviews and secondary research to address a range of energy sources, pathways, regions, demographics, and remedies. The subject matter for the case studies arose from the meetings and interviews. We chose case studies that collectively reflect a wide geographic distribution, a range of population densities, types of inequity, and various levels of government. In addition, the case studies highlight innovative approaches to creating greater health equity.

Appendix B. Interview, Web Forum, and Convening Participants

Below is a list of individuals who shared their broad insights and diverse regional perspectives with us for this report. No specific report content is attributed to any individual.

Air quality agencies

- Akron Regional Air Quality Management District: Sam Rubens, Administrator
- Arkansas Department of Environmental Quality: Will Montgomery, Policy & Planning Branch Manager, Office of Air Quality; Spencer Stuart, Associate Director, Office of Air Quality
- Colorado Department of Health: Megan McCarthy, Air Quality Planner
- National Association of Clean Air Agencies: Miles Keough, Executive Director
- Oregon Department of Environmental Quality: Ali Mizrakhalili, Administrator
- Puget Sound Clean Air Agency: Craig Kenworthy, Executive Director; Erik Saganić, Technical Analysis Manager
- Virginia Air and Renewable Energy Division: Mike Dodd, Director

Community action agencies

- Community Action Agency of Siouxland (IA): Jean Logan, Executive Director
- Community Action Agency of South Alabama: Kris Rowe, Executive Director
- Community Action Partnership of Oregon: Keith Kueny, Energy Policy Coordinator
- El Paso CAP, Project BRAVO (TX): Laura Ponce, Executive Director
- FiveCAP Inc. (MI): Mary Trucks, Executive Director
- Fresno Economic Opportunities Commission (CA): Brian Angus, Chief Executive Officer
- Fulton Atlanta Community Action Authority: Joyce J. Dorsey, President & CEO
- GLEAMNS HRC, Inc. (SC): Shunna Vance Jeter, CEO
- Greater Erie CAC (PA): Danny J. Jones, CEO
- I-CARE, Inc. (NC): Bryan Duncan, Executive Director
- Iowa Community Action Association: Lana Shope, Executive Director
- Little Dixie CAA (OK): Becky Reynolds, Executive Director
- NC Community Action State Association: Sharon Goodson, Executive Director
- Northeast Florida Community Action Agency, Inc.: Berneitha McNair, Executive Director
- Oakland Livingston Human Service Agency (MI): Heather Zeigler, Deputy Director for Health, Housing, and Nutrition
- Oklahoma Association of Community Action Agencies, Inc.: Michael Jones, Executive Director
- People Incorporated of Virginia: Robert G. Goldsmith, President & CEO
- South Central Community Action Partnership, Inc.: Ken Robinette, CEO

- Southeastern Community & Family Services, Inc. (NC): Dr. Ericka Whitaker, CEO
- York County Community Action Corporation (ME): Carter Friend, Deputy Director

NGOs and experts

- AARP: Bill Malcolm, Senior Legislative Representative, State Advocacy & Strategy Integration
- Cascadia Law Group: Dennis McLerran, Attorney (former EPA 10 administrator)
- Cliburn Associates: Jill K. Cliburn, Community Solar Value Project Manager
- Critical Consumer Issues Forum: Katrina McMurrian, Executive Director
- Democracy and Regulation: Jerry Oppenheim, Esq.
- Laborers' International Union of North America: Kevin Pranis, Minnesota & North Dakota Marketing Manager
- National Consumer Law Center: John Howat, Senior Energy Analyst
- Partnership for Southern Equity: Nathaniel Smith, Founder & CEO; Chandra Farley, Just Energy Director
- Public Utility Law Project of New York: Richard Berkley, Executive Director

Regulators, consumer advocates, and localities

- Hawaii Public Utilities Commission: Jennifer Potter, Commissioner
- Indiana Office of Utility Consumer Counselor: Bill Fine, Consumer Counselor
- Iowa Consumer Advocate: Mark Schuling
- Kentucky Public Utilities Commission: Andrew Melnykovych, Public Information Officer
- Maryland Office of People's Counsel: Paula Carmody, People's Counsel
- Maryland Public Service Commission: Odogwu Obi Linton, Commissioner
- Montana Office of Consumer Counsel: Robert Nelson, Consumer Counsel
- South Carolina Public Service Commission: Butch Howard, Commissioner

Utilities and utility organizations

- Great River Energy (electric generation & transmission cooperative): Gary Connett, retired executive; Chairman, Beneficial Electrification League

Large Public Power Council: John Di Stasio, President

Appendix C. END NOTES

[1] Jenkins, Kirsten, Darren McCauley, Raphael Heffron, Hannes Stephan, and Robert Rehner. "Energy justice: A conceptual review." Energy Research & Social Science. January 2016. Volume 11: 174-182.

[2] U.S. Energy Information Administration. 2018. "*One in three U.S. households faces a challenge in meeting energy needs*." Available at: https://www.eia.gov/todayinenergy/detail.php?id=37072.

[3] Ibid.

[4] Ross, Lauren, A. Drehobl, B. Stickles. 2018. The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency. ACEEE. https://aceee.org/.

[5] Goodkind, Andrew L., C. W. Tessum, J. S. Coggins, J. D. Hill, and J. D. Marshall 2019. "Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions." Proceedings of the National Academy of Sciences of the United States of America. Available at: https://www.pnas.org/content/116/18/8775.

[6] Thind, M., C. Tessum, I. Azevedo, and J. Marshall. 2019. "Fine Particulate Air Pollution from Electricity Generation in the US: Health Impacts by Race, Income, and Geography." Environ. Sci. Technol. 2019, 53, 23, 14010-14019. November 20, 2019. https://doi.org/10.1021/acs.est.9b02527.

[7] Jessel, Sonal, S. Sawyer, and D. Hernadez. 2019. "*Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature*." Frontiers in Public Health. 7:357.

[8] Extraction includes drilling, conventional extraction, and hydraulic fracturing a/k/a fracking. Fracking is defined by Merriam-Webster as "the injection of fluid into shale beds at high pressure in order to free up petroleum resources (such as oil or natural gas)." See: https://www.merriam-webster.com/dictionary/fracking.

[9] Jenkins, Kirsten, Darren McCauley, Raphael Heffron, Hannes Stephan, and Robert Rehner. "Energy justice: A conceptual review." Energy Research & Social Science. January 2016. Volume 11: 174-182.

[10] Bakke, Gretchen. 2016. The Grid: "The Fraying Wires Between Americans and Our Energy Future."

[11] U.S. Energy Information Administration. 2019. "Electricity in the United States - Energy Explained, Your Guide To Understanding Energy - Energy Information Administration," accessed March 15, https://www.eia.gov/energyexplained/index.php?page=electricity_in_the_united_states.

[12] Wind and solar have minimal operational costs, and their installed costs have dropped dramatically as the technologies have matured. The levelized cost of energy (LCOE) for wind, ranges from $32 to $62 per kWh; in comparison, the LCOE for new pulverized coal generation ranges from $55-97 per kWh. (Jeffrey Logan, *et al,* National Renewable Energy Laboratory, "Electricity Generation Baseline Report", NREL/TP-6A20-67645, January 2017. Retrieved from: https://www.nrel.gov/docs/fy17osti/67645.pdf)

[13] The term "storage" or "battery storage" is applied to technologies and appliances that can store electricity to be used later. Storage can be large-scale or customer-scale, and can be used to dampen high energy prices, to provide backup for emergency purposes, and/or to provide electricity when renewable generation is not operating (e.g., at night when solar is not generating,

or during periods of calm winds). Batteries (e.g., Tesla Powerwall), pumped hydro, ice, hot water heaters, and electric vehicles can be used as storage.

[14] U.S. Energy Information Administration. 2019. "EIA Monthly Survey Tracks U.S. Power Plant Additions - Today in Energy," accessed March 27. Available at https://www.eia.gov/todayinenergy/detail.php?id=36513.

[15] Bloomberg New Energy Finance. 2018. "U.S. Coal Plant Retirements Near All-Time High." Retrieved from: https://about.bnef.com/blog/u-s-coal-plant-retirements-near-all-time-high/

[16] Pfeifenberger, Johannes. "Investment Trends and Fundamentals in US Transmission and Electricity Infrastructure," n.d., 19.

[17] Vasquez, Christian. "Renewables beat coal for 1st time ever on quarterly basis" EnergyWire. April 2, 2020.

[18] Lawrence Livermore National Laboratory. 2019. Available at: https://flowcharts.llnl.gov/content/assets/images/charts/Energy/Energy_2018_United-States.png.

[19] This description includes liquified natural gas or LNG.

[20] Colburn, Theo, et al. 2011. For the public health impacts of chemical exposure from natural gas operations. "Natural gas operations from a public health perspective." *Human and ecological risk assessment: An International Journal* 17.5: 1039-1056. Colburn, Theo, et al. 2014. For an exploratory study of the air quality impacts of natural gas operations in a rural western Colorado area. "An exploratory study of air quality near natural gas operations." *Human and Ecological Risk Assessment: An International Journal* 20.1: 86-105.

[21] U.S. Energy Information Administration. 2018. "*The United States now produces nearly all of the natural gas that it uses*." December 3. Available at: https://www.eia.gov/energyexplained/index.php?page=natural_gas_where.

[22] One example of a jurisdiction implementing a policy to reduce reliance on natural gas is the City of Berkeley, California, which recently approved a law banning natural gas infrastructure in new low-rise residential buildings. Other California cities are considering electrification ordinances. (Musulin, Kristin. 2019. "*Berkeley sets historic law banning natural gas from new buildings.*" Utilitydive. July 18. Available at: https://www.utilitydive.com/news/berkeley-sets-historic-law-banning-natural-gas-from-new-buildings/559026/.) On the state level, New Jersey's draft Energy Master Plan seeks to end natural gas use in buildings by 2030, and clean electricity policies have sprouted up in eight states plus Washington DC and Puerto Rico. (See also: Myers, Amanda. 2019. "*As Cities Begin Banning Natural Gas, State Must Embrace Building Electrification Via Smart Policy.*" Forbes. 2019. Available at: https://www.forbes.com/sites/energyinnovation/2019/07/22/as-cities-begin-banning-natural-gas-states-must-embrace-building-electrification-with-smart-policy/#6cc826a76ce6.)

[23] The global warming potential of natural gas is 21 times higher than CO_2 in a 100-year timeframe: https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/global-warming-potentials.

[24] Henchen, M., and K. Kroh. "A New Approach to America's Rapidly Aging Gas Infrastructure." January 6, 2020. Rocky Mountain Institute. Available at: https://rmi.org/a-new-approach-to-americas-rapidly-aging-gas-infrastructure/.

[25] National Association of State Energy Officials and Energy Futures Initiative. 2019. The 2019 U.S. Energy & Employment Report. Available at :

https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5c7f3708fa0d6036d7120d8f/1551849054549/USEER+2019+US+Energy+Employment+Report.pdf.

[26] Ibid.

[27] Ibid.

[28] Ibid.

[29] Ibid.

[30] Christopherson, S., N. Rightor. 2015. Confronting An Uncertain Future: How US Communities are Responding to Shale Gas and Oil Development. Book chapter in Our Energy Future: Socioeconomic Implications and Policy Options for Rural America, Don E. Albrecht, editor. Routledge Studies in Energy Policy series. Oxford, UK and New York: Routledge.

[31] 1.3 million excludes employment in retail trade (gasoline stations and fuel dealers). National Association of State Energy Officials and Energy Futures Initiative. 2019. The 2019 U.S. Energy & Employment Report. Available at : https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5c7f3708fa0d6036d7120d8f/1551849054549/USEER+2019+US+Energy+Employment+Report.pdf.

[32] IndexMundi. Access to electricity (% of population – North America. https://www.indexmundi.com/facts/indicators/EG.ELC.ACCS.ZS/map/north-america, accessed April 3, 2020.

[33] U.S. Energy Information Administration. 2019. "Average Frequency and Duration of Electric Distribution Outages Vary by States - Today in Energy," accessed March 26, https://www.eia.gov/todayinenergy/detail.php?id=35652.

[34] Larsen, P., K. LaCommare, J. Eto, J. Sweeney. 2015. "Assessing Changes in the Reliability of the U.S. Electric Power System." Lawrence Berkeley National Laboratory. https://eta-publications.lbl.gov/sites/default/files/lbnl-188741.pdf.

[35] Avista Corp. 2019. 2018 Electric Service Reliability Report. https://www.utc.wa.gov/regulatedIndustries/utilities/Documents/190306-AVA-Elect-Svc-Reliablity-Rpt-04-26-2019.pdf.

[36] U.S. Energy Information Administration. 2019. "Average U.S. Electricity Customer Interruptions Totaled Nearly 8 Hours in 2017 - Today in Energy." Accessed March 26. https://www.eia.gov/todayinenergy/detail.php?id=37652.

[37] Kenward, A., U. Raja. 2014. "Blackout: extreme weather, climate change and power outages". Found at: https://www.ourenergypolicy.org/wp-content/uploads/2014/04/climate-central.pdf.

[38] American Society of Civil Engineers 2017. 2017 Infrastructure Report Card: Energy. Available at https://www.infrastructurereportcard.org/cat-item/energy/.

[39] Proximity to transmission lines is also a significant consideration for new, utility-scale renewable assets.

[40] Wilson, A., Patterson, J., Fink, K., Wasserman, K., Starbuck, A., Sartor, A., Fleming, J. 2011. Coal blooded: putting profits before people. National Association for the Advancement of Colored People: Baltimore, MD.

[41] There are also concerns downwind of the plant, as air currents can carry air pollution hundreds of miles away.

[42] See, as examples: Los Angeles Times. August 9, 2016. PG&E is found guilty of obstructing investigators after deadly 2010 pipeline blast. Available at: https://www.latimes.com/business/la-fi-pge-san-bruno-pipeline-blast-20160809-snap-story.html. New York Times. May 7, 2019. After Gas Explosions in Massachusetts, Gas Company Settles for $80 Million. Available at: https://www.nytimes.com/2019/05/07/us/massachusetts-gas-explosion-settlement.html?auth=login-email&login=email.

[43] For a map of shale gas plays, see: https://www.eia.gov/special/shaleplays/.

[44] The Conversation. 2017. *Trucks are destroying our roads and not picking up the repair cost.* Available at: http://theconversation.com/trucks-are-destroying-our-roads-and-not-picking-up-the-repair-cost-79670.

[45] U.S. Energy Information Administration. 2019. "Investor-owned utilities served 72% of U.S. Electricity customers in 2017." *Today in Energy.* Available at https://www.eia.gov/todayinenergy/detail.php?id=40913.

[46] NaturalGas.org. 2013. *Natural Gas Distribution*. Available at: http://naturalgas.org/naturalgas/distribution/.

[47] U.S. Department of Energy Office of Policy. 2015. Quadrennial Energy Review First Installment: "Transforming U.S. Energy Infrastructures in a Time of Rapid Change." Available at https://www.energy.gov/policy/downloads/quadrennial-energy-review-first-installment.

[48] In states where utilities both generate and distribute electricity, the link from customers (or ratepayers) to power plant owners is direct. In restructured states, however, the impact of development, construction, and maintenance on the rates that consumers pay can be less direct. Electricity prices in restructured states are determined in wholesale markets, in procurements for standard offer service by the utility or state (power supply offered by electric utility companies to a customer who does not choose an alternative, competitive electricity supplier) or in markets for retail power supply. For more information on restructuring, see National Regulatory Research Institute, "The Electric Industry at a Glance," William Steinhurst, PhD, Synapse Energy Economics, January 2011, available at https://pubs.naruc.org/pub/FA865C38-DBC4-D452-C275-A942F41A40CA.

[49] See, Regulatory Assistance Project. 2015. Smart Rate Design for a Smart Future, https://www.raponline.org/knowledge-center/smart-rate-design-for-a-smart-future/.

[50] Lazar, J., P. Chernick, W. Marcus, M. LeBel. 2020. Electric Cost Allocation for a New Era: A Manual. https://www.raponline.org/knowledge-center/electric-cost-allocation-new-era/.

[51] American Society of Civil Engineers. 2017. 2017 Infrastructure Report Card: Energy. Available at https://www.infrastructurereportcard.org/cat-item/energy/ *ASCE's 2017 Infrastructure Report Card* (blog), accessed March 25, 2019, https://www.infrastructurereportcard.org/cat-item/energy/.

[52] Lazar, J. 2016. "Electricity Regulation in the US: A Guide. Second Edition." Montpelier, VT: The Regulatory Assistance Project. Retrieved from http://www.raponline.org/knowledge-center/electricity- regulation-in-the-us-a-guide-2.

[53] In many places, ratepayers who own rooftop solar systems are credited for the excess solar energy they provide to the grid through net metering. Net metering refers to a process where consumers who install their own renewable energy generation are paid for that generation – though the amounts and how the process works (bill credits or cash payment) varies a great deal across locales. In many places, there is an ongoing conversation about how much consumers selling solar

energy back to utilities should be compensated. This is a particularly salient issue for investor-owned utilities that are facing decreased revenues and the potential for obsolescence as a result of small-scale power generation.

[54] U.S. Department of Energy. "Electricity 101." Accessed March 15, 2019. https://www.energy.gov/oe/information-center/educational-resources/electricity-101.

[55] Ibid.

[56] Nebraska has a public service commission, but it does not regulate electricity.

[57] U.S. Environmental Protection Agency. *1990 Clean Air Act Amendment Summary*. https://www.epa.gov/clean-air-act-overview/1990-clean-air-act-amendment-summary. Accessed December 31, 2019. Lazar, J. 2016. *Electricity Regulation in the US: A Guide. Second Edition.* Montpelier, VT: The Regulatory Assistance Project. Retrieved from http://www.raponline.org/knowledge-center/electricity- regulation-in-the-us-a-guide-2.

[58] U.S. Environmental Protection Agency. *History of the Clean Water Act*. https://www.epa.gov/laws-regulations/history-clean-water-act. Accessed December 31, 2019.

[59] U.S. Environmental Protection Agency. *Summary of the Resource Conservation and Recovery Act*. https://www.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act. Accessed December 31, 2019.

[60] U.S. Environmental Protection Agency. *Summary of the Clean Air Act*. Available at: https://www.epa.gov/laws-regulations/summary-clean-air-act.

[61] U.S. EPA. *Summary of the Clean Water Act*. Available at: https://www.epa.gov/laws-regulations/summary-clean-water-act.

[62] U.S. EPA. *Summary of the Resource Conservation and Recovery Act*. Available at: https://www.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act.

[63] U.S. EPA. *Superfund*. Available at: https://www.epa.gov/superfund.

[64] Elliott, Elise G., et al. 2017. "A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity." *Journal of Exposure Science and Environmental Epidemiology* 27.1: 90.

[65] Natural Resources Defense Council. 2018. *We Could Do a Lot More to Regulate Fracking*. Available at: https://www.nrdc.org/stories/we-could-do-lot-more-regulate-fracking. See also: U.S. EPA. 2019. "Unconventional Oil and Natural Gas Development," available at: https://www.epa.gov/uog.

[66] See, as examples: Pennsylvania Department of Environmental Protection. 2016. *Marcellus Shale.* Available at: https://www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/Marcellus-Shale/Pages/default.aspx. Reuters, October 7, "Pennsylvania adopts new fracking regulations." Available at: https://www.reuters.com/article/us-usa-pennsylvania-fracking-idUSKCN1272B3. New York Times, 2014, "Citing Health Risks, Cuomo Bans Fracking in New York State," December 17. Available at: https://www.nytimes.com/2014/12/18/nyregion/cuomo-to-ban-fracking-in-new-york-state-citing-health-risks.html.

[67] FERC. August 14, 2018. *What FERC Does*. Available at: https://www.ferc.gov/about/ferc-does.asp.

[68] FERC. August 15, 2018. *Federal Statutes*. Available at: https://www.ferc.gov/legal/fed-sta.asp.

[69] Importantly, the FERC can overrule state and local decisions. See Archibong, Miriam and Russell Kooistra. First Circuit Finds FERC Certificate Preempts Application of Local Ordinance to Deny Gas Pipeline Project Permit. Blog post: April 3, 2019. https://www.troutmansandersenergyreport.com/2019/04/first-circuit-finds-ferc-certificate-preempts-application-of-local-ordinance-to-deny-gas-pipeline-project-permit/.

[70] American Geosciences Institute. June 1, 2018. "Transportation of Oil, Gas, and Refined Products." Available at: https://www.americangeosciences.org/geoscience-currents/transportation-oil-gas-and-refined-products.

[71] U.S. Department of Transportation. February 26, 2018. "Fact Sheet: Marine Terminals." Available at: https://primis.phmsa.dot.gov/comm/FactSheets/FSMarineTerminals.htm.

[72] U.S. BLM. "Oil and Gas Leasing." Available at: https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing.

[73] The District of Columbia and Puerto Rico also have commissions.

[74] States have broad discretion for small air quality sources (some do not regulate them at all), and states with unhealthy air quality typically require more stringent emission standards and conditions than the federally required minimum.

[75] RAP conversations with air quality regulators, October 2019.

[76] See, for example: *The Boston Globe*. October 1, 2015. "In fight over local pipelines, US usually gets its way." Available at: https://www.bostonglobe.com/business/2015/10/01/fight-over-gas-pipelines-decsions-are-hand-feds/PCofcxSkG9UdcXlus6C5HP/story.html.

[77] There is currently no consumer advocate dedicated to matters before FERC, so those proceedings do not routinely include representatives of the public unless one or more state commissions or state consumer advocates intervene. (Lazar, J., 2016. *Electricity Regulation in the US: A Guide. Second Edition.* Montpelier, VT: The Regulatory Assistance Project. Retrieved from http://www.raponline.org/knowledge-center/electricity- regulation-in-the-us-a-guide-2.)

[78] This study considered participation by African-Americans in the governing process of the cooperatives for which information was available and verifiable in the southern United States, including the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. While the study does not appear to be peer-reviewed, it suggests an area that needs further investigation.

[79] The negative health effects of various pollutants, and the timeframe over which those effects occur, may likewise not be understood. For example, mercury emissions from a power plant build up slowly in human tissue, while fine particle pollution increases mortality over both the short and long terms. The research on the serious impacts of fine particle pollution dates back over 20 years. Harvard's "Six Cities" study was one of the first to show increased mortality and other health impacts from fine particles. Fine particles are created from combustion of any fossil fuel. Background at: https://www.hsph.harvard.edu/news/features/six-cities-air-pollution-study-turns-20/.

[80] The Vogtle plant in Georgia is one example which is being opposed by the Partnership for Southern Equity. See: Lynn Freehill-Maye. 2019. "Vogtle opponents get new chance to press case in court as plant manager reprimanded for firing whistleblower." *Utility Dive*, October 31. Available at: https://www.utilitydive.com/news/vogtle-opponents-get-new-chance-to-press-case-in-court-as-plant-manager-rep/566322/.

[81] Some materials provide guidance on effectively navigating the decision-making process. See, e.g., "Building an Effective Community Natural Gas Task Force," available at https://extension.psu.edu/building-an-effective-community-natural-gas-task-force.

[82] It is notable that many of the consultants hired by project proponents worked for the agency or commission previously. Government agencies and commissions cannot match the pay scales of the private sector, and attrition is common. This can result in undue influence on the PUC and on the outcomes of proceedings. For more on regulatory capture, see: https://www.scotthemplinglaw.com/essays/regulatory-capture.

[83] Energywire. July 16, 2019. "*Tribes accuse BLM of shutting them out on drilling decisions*." Available at: https://www.eenews.net/energywire/2019/07/16/stories/1060744797.

[84] In 2018, about 26 million acres of federal land were under lease to oil and gas developers. See: U.S. BLM. "*About the BLM Oil and Gas Program."* Available at: https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/about.

[85] For example, see: Earthjustice. December 7, 2018." *Ignored and Infuriated, Pawnee Stop Illegal Fracking Plans on Tribal Lands."* Available at: https://earthjustice.org/blog/2018-december/agency-nixes-fracking-leases-on-pawnee-tribal-land.

[86] Bhattacharya, J., et al. 2003. "Heat or eat? Cold-weather shocks and nutrition in poor American families." *American Journal of Public Health* 93.7: 1149-1154.

[87] Kontokosta, C., V. Reina, and B. Bonczak. 2019. "Energy Cost Burdens for Low-Income and Minority Households." *Journal of the American Planning Association*, DOI: 10.1080/01944363.2019.1647446.

[88] Drehobl, A., L. Ross. 2016. Lifting the High Energy Burden in America's Largest Cities: "How Energy Efficiency Can Improve Low Income and Underserved Communities." ACEEE. https://aceee.org/.

[89] Energy insecurity is the inability to adequately meet basic household heating, cooling, and energy needs over time. Hernandez et al. describe energy insecurity as a multi-dimensional problem, reflecting physical elements (deficient and inefficient housing structures), economic elements (disproportionate share of household income allocated to utility expenses), and coping elements (energy-related coping strategies that could potentially compromise the quality of the home environment and have negative health consequences). (Hernandez, D., Y. Aratani, Y. Jiang. 2014. *Energy Insecurity among Families with Children*. National Center for Children in Poverty.)

[90] One study of homelessness in Kentucky found that over 20% of homeless were made so because they were unable to pay their energy bills and had had their service disconnected. See: Woods, W. K., et al., "Homelessness and Low-Cost Housing in Northern Kentucky," Northern Kentucky Coalition for the Homeless and Applied Information Resources, 1990, cited in J. Howat and Jerrold Oppenheim, Analysis of Low-Income Benefits in Determining Cost-Effectiveness of Energy Efficiency Programs, National Consumer Law Center, p. 41, footnote 67, Boston, April 1999, available at http://www.democracyandregulation.com/attachments/18/C-E_of_DSM_paper_-_Final.doc.

[91] U.S. Energy Information Administration. 2018. "One in three U.S. households faces a challenge in meeting energy needs." *Today in Energy,* September.

[92] Ibid.

[93] Ibid.

[94] Predominantly minority neighborhoods are defined as census block groups where the percentage of non-Hispanic white population is less than the citywide average. (Kontokosta, C., V. Reina, and B.

Bonczak. 2019. "Energy Cost Burdens for Low-Income and Minority Households." *Journal of the American Planning Association*, DOI: 10.1080/01944363.2019.1647446.)

[95] This study defined high energy burden as spending more than 10 percent of income on utilities, and high rent burden as more than 30 percent of income on rent. (Hernandez, D., Y. Jiang, D. Carrion, D. Phillips, Y. Aratani. Housing hardship and energy insecurity among native-born and immigrant low-income families with children in the United States. J Child Poverty. 2016 ; 22(2): 77–92).

[96] U.S. Energy Information Administration. 2018. "One in three U.S. households faces a challenge in meeting energy needs." *Today in Energy.*

[97] Hernandez, D., Y. Aratani, Y. Jiang. 2014. Energy Insecurity among Families with Children. National Center for Children in Poverty.

[98] Carliner, M. 2013. *Reducing Energy costs in rental housing*, Joint Center for Housing Studies at Harvard University, research brief; found at: https://www.jchs.harvard.edu/sites/default/files/harvard_jchs_carliner_research_brief.pdf.

[99] Hernández, D., S. Bird. 2010. "Energy Burden and the Need for Integrated Low-Income Housing and Energy Policy," *Poverty & Public Policy* 2, no. 4 (November 2010): 5–25, https://doi.org/10.2202/1944-2858.1095.

[100] Ross, Lauren, A. Drehobl, B. Stickles. 2018. *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency*. ACEEE. https://aceee.org/.

[101] Ross, L. et al., 2018.

[102] Eichelberger, L. Palen. 2010. Living in Utility Scarcity: "Energy and Water Insecurity in Northwest Alaska." *American Journal of Public Health:* Vol 100, No. 6.

[103] Kallay, Jennifer, A. Napoleon, M. Chang. 2016. *Opportunities to Ramp Up Low-Income Energy Efficiency to Meet State and National Climate Policy Goals*. 2016 ACEEE Summer Study on Energy Efficiency in Buildings Conference paper.

[104] Ibid.

[105] Bird, S., D. Hernández, "Policy Options for the Split Incentive: Increasing Energy Efficiency for Low-Income Renters," *Energy Policy:* 48 (September 1, 2012): 506–14, https://doi.org/10.1016/j.enpol.2012.05.053.

[106] Hernández, D. "Sacrifice Along the Energy Continuum."

[107] Sabol, Patrick. From Power to Empowerment: Plugging Low Income Communities into the Clean Energy Economy. https://s3.amazonaws.com/groundswell-web-assets/documents/frompower_to_empowerment.pdf.

[108] In setting time-of-use rates, it is important to consider impacts on vulnerable populations to avoid negative health impacts on these groups. (White, L. and N. Sintov. 2019. "Health and financial impacts of demand-side response measures differ across sociodemographic groups." *Nature Energy*.)

[109] Lazar, J. 2016. *Electricity Regulation in the US: A Guide. Second Edition.* Montpelier, VT: The Regulatory Assistance Project. Retrieved from http://www.raponline.org/knowledge-center/electricity- regulation-in-the-us-a-guide-2.

[110] Whited, M., T. Woolf, J. Daniel. 2016. *Caught in a Fix: The Problem with Fixed Charges for Electricity.* Synapse Energy Economics: https://www.synapse-energy.com/sites/default/files/Caught-in-a-Fix.pdf.

[111] Power System Engineering, Inc. 2014. Survey: Electric Cooperative Fixed Cost Recovery. Available at https://www.powersystem.org/docs/publications/nreca-fixedcost_1407_email.pdf

[112] Whited, Melissa, Tim Woolf, and Alice Napoleon. 2015. *Utility Performance Incentive Mechanisms: A Handbook for Regulators.* Synapse Energy Economics. https://www.synapse-energy.com/project/performance-incentives-utilities.

[113] Utilities in Georgia, Mississippi, and South Carolina are allowed to request that ratepayers pay for construction costs before a plant is completed. This is referred to a "construction work in progress" or CWIP. Such practices are not consumer-friendly, as the PUC relies on the utility to determine what costs are justifiable. Steve Mufson, December 2017, "Georgia Regulatory Staff Calls the Last Nuclear Project in the U.S. Uneconomic." *The Washington Post.* Retrieved from: https://www.washingtonpost.com/business/economy/georgia-regulatory-staff-calls-the-last-us-nuclear-construction-project-uneconomic/2017/12/05/84086788-d9d4-11e7-b1a8-62589434a581_story.html

[114] Trabish, H. August. 2019. "As co-ops struggle with stranded fossil fuel assets, Tri-State may finally embrace the energy transition." *Utility Dive*. https://www.utilitydive.com/news/as-co-ops-struggle-with-stranded-fossil-fuel-assets-tri-state-may-finally/559670/.

[115] Gheorghiu, I. 2019. "Rural co-op transition to renewables impeded by coal financing obligations, NGOs find." *Utility Dive*. July 8. https://www.utilitydive.com/news/rural-co-op-transition-to-renewables-impeded-by-coal-financing-obligations/557666/.

[116] As an example of this, Sunflower Electric Power Corp. and Mid-Kansas Electric Company recently merged. "Sunflower Electric Power Corp. and Mid-Kansas Electric Company merge." https://www.sunflower.net/sunflower-electric-power-corp-and-mid-kansas-electric-company-merge/.

[117] Lazar, J. 2016. *Electricity Regulation in the US: A Guide. Second Edition.* Montpelier, VT: The Regulatory Assistance Project. Retrieved from http://www.raponline.org/knowledge-center/electricity-regulation-in-the-us-a-guide-2.

[118] LIHEAP Clearinghouse. "Energy Assistance Includes Utility Programs." Available at: https://liheapch.acf.hhs.gov/news/nov14/utilityprograms.htm.

[119] Tonn B., Rose W., Hawkins B., Conlon B. 2014. "Health and household-related benefits attributable to the weatherization assistance program." Oak Ridge National Laboratory. Env Sciences Division. ORNL/TM-2014/345. See also, E4TheFuture, "Occupant Health Benefits of Residential Energy Efficiency."

[120] All-cost-effective mandates require the utility or other program administrator to pursue all savings which the value of their benefits meets or exceeds their costs (as opposed to setting a budget first, and then determining how much savings are achievable for that funding amount).

[121] Natural Resources Defense Council. February 27, 2017. *Report: "Low-Income Renters Face Barriers to Clean Energy*." Available at: https://www.nrdc.org/experts/maria-stamas/report-low-income-renters-face-barriers-clean-energy.

[122] See RAP. 2013. "Recognizing the full benefit of energy efficiency." Available at: https://www.raponline.org/knowledge-center/recognizing-the-full-value-of-energy-efficiency/.

[123] Cost-effectiveness testing compares the value of a unit of energy saved to the cost of supplying that unit using conventional, grid-based resources.

[124] For example, in areas with Energy Efficiency Resource Standards, utilities are able to claim the savings toward their goals.

[125] Woolf, Tim, W. Steinhurst, E. Malone, and K. Takahashi 2012. *Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs.* Synapse Energy Economics. Available at: https://www.synapse-energy.com/sites/default/files/SynapseReport.2012-11.RAP_.EE-Cost-Effectiveness-Screening.12-014.pdf.

[126] ACEEE web portal on low-income energy efficiency programs: https://aceee.org/sector/state-policy/toolkit/supporting-low-income.

[127] Weston Berg *et. al.*, October 2018 "The 2018 State Energy Efficiency Scorecard." American Council for an Energy Efficient Economy. Retrieved from: https://aceee.org/sites/default/files/publications/researchreports/u1808.pdf.

[128] Non-energy benefits include externalities such as improvements in air quality, lower health costs, reduced arrearages and bad debt, reduced costs of shutoffs, higher productivity, and improved comfort. (RAP. 2013. "Recognizing the full benefit of energy efficiency," available at: https://www.raponline.org/knowledge-center/recognizing-the-full-value-of-energy-efficiency/, and Woolf, Tim, E. Malone, F. Ackerman. 2014. *Cost-Effectiveness Screening Principles and Guidelines for Alignment with Policy Goals, Non-Energy Impacts, Discount Rates, and Environmental Compliance Costs*. Synapse Energy Economics for Northeast Energy Efficiency Partnerships. Available at www.synapse-energy.com.)

[129] EPA's benefit per kilowatt tool: https://www.epa.gov/statelocalenergy/estimating-health-benefits-kilowatt-hour-energy-efficiency-and-renewable-energy.

[130] See RAP. 2013. "Recognizing the full benefit of energy efficiency." Available at: https://www.raponline.org/knowledge-center/recognizing-the-full-value-of-energy-efficiency/.

[131] Migden-Ostrander, RAP, personal communication.

[132] For example, Vermont's "one touch" program coordinates lower income families receiving energy upgrades with health and social services. More information is available at: https://onetouchhousing.com/locations/vermont/.

[133] See also, ACEEE web portal on low-income energy efficiency programs: https://aceee.org/sector/state-policy/toolkit/supporting-low-income.

[134] For more information on joint energy and health programs, see VEIC 2019. Energy-Plus-Health Playbook. Available at https://e4thefuture.org/wp-content/uploads/2019/07/Energy-Plus-Health-Playbook_VEIC.pdf.

[135] For example, the Philadelphia, PA/Wilmington, DE-based Energy Co-ordinating Agency (ECA) focuses on structural repairs to homes that then enable residents to take advantage of energy efficiency programs. Many low-income households (up to 65% in Philadelphia) live in dwellings that are structurally unsound such that they cannot be weatherized. The ECA projects also improve the health of residents, as leaky and structurally unsound buildings also are correlated with many

negative health effects. ECA also provides job training services for local residents. (Energy Coordinating Agency, main web portal. Retrieved from: https://www.ecasavesenergy.org)

[136] Financing programs are likely not a good option for the lowest-income Americans, whose debts typically exceed their assets and who generally have little liquidity.

[137] California Public Utilities Commission. CSI Multifamily Affordable Solar Housing (MASH) Program. Available at https://www.cpuc.ca.gov/General.aspx?id=3752, accessed January 3, 2020.

[138] Environmental Defense Fund. February 2018. *Low-Income Energy Efficiency*. Retrieved from https://www.edf.org/sites/default/files/documents/liee_national_summary.pdf.

[139] Zahra, February 2016. "Connecticut Program Makes Solar Affordable to Low-Income Families." *Inside Climate News*. Retrieved from: https://insideclimatenews.org/news/25022016/connecticut-program-solar-power-low-income-famiilies-freedom.

[140] Clean Energy Group, December 2016. "McKnight Lane: A Rural, Low-Income, Zero Energy Solar+Storage Housing Project." Retrieved from: https://www.cleanegroup.org/wp-content/uploads/rpp-webinar-slides-12.14.16.pdf.

[141] Michigan energy co-op http://www.mienergy.coop/content/water-heaters; and Steele-Waseca co-op, free water heater with solar panel: https://www.utilitydive.com/news/why-one-electric-co-op-is-offering-their-solar-customers-free-water-heaters/362898/.

[142] Steele-Waseca co-op, Minnesota. Retrieved from: https://www.utilitydive.com/news/why-one-electric-co-op-is-offering-their-solar-customers-free-water-heaters/362898/ and https://swce.coop/wp-content/uploads/2016/12/Community-Solar-FAQ.pdf.

[143] Personal communication with Janine Migden-Ostrander of Regulatory Assistance Project, former Ohio Consumer Advocate. February 8, 2019.

[144] Caperton, R., M. Hernandez. 2013. The Electrical Divide: "New Energy Technologies and Avoiding an Electric Service Gap." Center for American Progress.

[145] U.S. Energy Information Administration. 2016. "EIA data show average frequency and duration of electric power outages." *Today in Energy,* September 12. Available at: https://www.eia.gov/todayinenergy/detail.php?id=27892#.

[146] Personal communication with Janine Migden-Ostrander of Regulatory Assistance Project, former Ohio Consumer Advocate. December 17, 2019.

[147] "Frompower_to_empowerment.Pdf," accessed March 26, 2019, https://s3.amazonaws.com/groundswell-web-assets/documents/frompower_to_empowerment.pdf.

[148] Sunter, D. A., S. Castellanos, D. M. Kammen, 2019. "Disparities in Rooftop Photovoltaics Deployment in the United States by Race and Ethnicity," *Nature Sustainability* 2, no. 1 (January 2019): 71–76, https://doi.org/10.1038/s41893-018-0204-z.

[149] Some of these differences can be attributed to household income and lower rates of home ownership. However, one study found that these differences do not account entirely for the differences in solar adoption. Correcting for median household income, this study found that census tracts with an African American racial majority have installed 69 percent less rooftop PV compared with tracts that do not have a racial majority. Hispanic-majority census tracts have installed 30 percent less than no-majority tracts, while white-majority census tracts have installed

21 percent more. The authors find a similar result when correcting for home ownership: compared to no-majority census tracts, African American-majority census tracts installed 61 percent less rooftop PV; Hispanic-majority tracts have installed 45 percent less; and white-majority census tracts have installed 37 percent more. One theory to explain lower adoption among African American communities is that majority African American Census tracts are more likely to have no households with rooftop solar, and therefore there is less social exposure to the concept, leading to lower adoption. The researchers found that Latino tracts are about as likely as white tracts to have any solar installations, and therefore Latino tracts may be moving towards greater adoption. The researchers also hypothesized that fewer African American people employed in the solar industry may also be limiting adoption in these communities. (Sunter, D. A., S. Castellanos, D. M. Kammen, 2019).

150 For example, in Maine electric utilities cannot shut off any customer's power between Nov. 15 and April 15 without permission from the Maine Public Utilities Commission because of health and safety concerns during cold-weather months. (https://www.pressherald.com/2019/11/21/despite-billing-disputes-state-regulator-gives-cmp-the-ok-for-shutoffs/)

151 Maui Smart Grid Project. Managing Distribution System Resources for Improved Service Quality and Reliability, Transmission Congestion Relief, and Grid Support Functions. Available at https://www.hnei.hawaii.edu/sites/www.hnei.hawaii.edu/files/Final%20Report%20Presentation%20of%20MSGP.pdf.

152 Goodkind, Andrew L., C. W. Tessum, J. S. Coggins, J. D. Hill, and J. D. Marshall 2019. "Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions." Proceedings of the National Academy of Sciences of the United States of America. Available at: https://www.pnas.org/content/116/18/8775.

153 Thind, M., C. Tessum, I. Azevedo, and J. Marshall. 2019. "Fine Particulate Air Pollution from Electricity Generation in the US: Health Impacts by Race, Income, and Geography." Environ. Sci. Technol. 2019, 53, 23, 14010-14019. November 20, 2019. https://doi.org/10.1021/acs.est.9b02527.

154 Tessum, C., J. Apte, A. Goodkind, N. Muller, K. Mullins, D. Paolella, S. Polasky, N. Springer, S. Thakrar, J. Marshall, and J. Hill. "Inequity in consumption of goods and services adds to racial-ethnic disparities in air pollution exposure." PNAS March 26, 2019 116 (13) 6001-6006. https://www.pnas.org/content/116/13/6001#ref-2.

155 Yale University. June 2013. "Coal Pollution and the Fight for Environmental Justice, an interview with Jacquline Patterson of the NAACP." Yale Environment 360, available at: https://e360.yale.edu/features/naacp_jacqueline_patterson_coal_pollution_and_fight_for_environmental_justice.

156 Hernández, D. 2015. "Sacrifice Along the Energy Continuum: A Call for Energy Justice," *Environmental Justice (Print)* 8, no. 4 (August 18, 2015): 151–56, https://doi.org/10.1089/env.2015.0015.

157 Vollet K. 2015. "The health impact of fracking: occupational risks." *MOJ Public Health*; 3(1):219–225. Available at: https://medcraveonline.com/MOJPH/MOJPH-03-00052.php.

158 These constraints exist for water and air quality regulation. According to a report by the Environmental Law Institute, more than half of the states had "no more stringent" provisions in their laws – meaning they cannot be more stringent than the Federal Clean Water Act. (Environmental Law Institute. 2013. "State Constraints: State-Imposed Limitations on the Authority of Agencies to Regulate Waters Beyond the Scope of the Federal Clean Water Act").

[159] Reid, H., M. Alam, A. Berger, T. Cannon, S. Huq, and A. Milligan. 2009. "Community-based adaptation to climate change: an overview." *Community-based Adaptation to Climate Change*. International Institute for Economic Development.

[160] Klinger, C., O. Landeg, V. Murray. 2014. "Power Outages, Extreme Events and Health: A Systematic Review of the Literature from 2011-2012." *PLOS Currents Disasters*, January 2, available at https://doi.org/10.1371/currents.dis.04eb1dc5e73dd1377e05a10e9edde673.

[161] Ibid.

[162] Milken Institute School of Public Health. 2018. *Ascertainment of the Estimated Excess Mortality from Hurricane Maria in Puerto Rico*. https://publichealth.gwu.edu/content/gw-report-delivers-recommendations-aimed-preparing-puerto-rico-hurricane-season.

[163] Querolo, Nic and Brian K Sullivan. 2019. "California Fire Damage Estimated at $25.4 Billion." *Bloomberg*, Oct. 28. https://www.bloomberg.com/news/articles/2019-10-28/california-fire-damages-already-at-25-4-billion-and-counting.

[164] Del Valle, Gaby. 2018. "The fires in California highlight — and worsen — the state's income divide." *Vox*. Nov. 15. https://www.vox.com/the-goods/2018/11/15/18097092/california-fires.

[165] RAP webinar with air quality regulators, October 2019.

[166] Of the states that do consider broader issues with the siting of facilities, a few states, like Washington, also include smaller facilities for these reviews in sectors like power plants. See, https://www.efsec.wa.gov/council-information/laws-rules-and-policies.

[167] California Assembly Bill 617, 2017. Retrieved from: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB617.

[168] California Air Resources Board, "Community Air Protection Blueprint" web portal, https://ww2.arb.ca.gov/our-work/programs/community-air-protection-program/community-air-protection-blueprint.

[169] California Environmental Protection Agency, "California Climate Investments to Benefit Disadvantaged Communities" web portal, https://calepa.ca.gov/EnvJustice/GHGInvest/.

[170] The Regional Greenhouse Gas Initiative. 2018. "Investment of RGGI Proceeds 2016." Retrieved from: https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2016.pdf.

[171] James, Chris and Ken Colburn. 2017. Retooling Regulation: Integrating Environmental and Energy Planning through a Multi-Pollutant "E-Merge" Approach (presentation). https://www.raponline.org/knowledge-center/retooling-regulation-integrating-environmental-and-energy-planning-through-a-multi-pollutant-e-merge-approach/.

[172] St. John, J. 2019 "California Proposes $100M in Energy Storage Incentives to Boost Wildfire Resiliency." *Greentech Media*, August. Retrieved from: https://www.greentechmedia.com/articles/read/california-proposes-100m-in-energy-storage-incentives#gs.z19doa.

[173] Washington Senate Bill 5116, signed by Governor Inslee July 2019. http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/Senate/5116-S2.SL.pdf.

[174] Roberts, D. 2019. "A Closer Look at Washington's Superb New 100% Clean Electricity Bill." Vox, April (written before the bill was enacted, but only minor changes in language occurred between

when this article was written and when it was signed by the Governor). Retrieved from: https://www.vox.com/energy-and-environment/2019/4/18/18363292/washington-clean-energy-bill

[175] Synapse Energy Economics. 2019. *Net Zero Energy Roadmap for the City of Burlington, Vermont*. Burlington Electric Department. Available at: https://burlingtonelectric.com/sites/default/files/inline-files/NetZeroEnergy-Roadmap.pdf

[176] For an example of tools that are available to communities seeking to reform co-op practices, see: Rural Electric Cooperative Election Toolkit: https://www.electriccooporganizing.org/.

[177] Hodge et.al., *Legal review concerning the use of health impact assessments in non-health sectors*. The health impact project and ASU O'Connor school of law, www.healthimpactproject.org.

[178] E4TheFuture. 2019. *Energy Efficiency Jobs in America*. Available at https://e4thefuture.org/wp-content/uploads/2019/09/Energy-Efficiency-Jobs-in-America-2019-National-Summary.pdf.

[179] Ibid.

[180] Forbes. April 22, 2019. "Renewable Energy Job Boom Creates Economic Opportunity As Coal Industry Slumps." Available at: https://www.forbes.com/sites/energyinnovation/2019/04/22/renewable-energy-job-boom-creating-economic-opportunity-as-coal-industry-slumps/#314ad4ba3665.

[181] Environmental Defense Fund. 2018. "In Demand: Clean Energy, Sustainability, and the New American Workforce." Available at: http://edfclimatecorps.org/sites/edfclimatecorps.org/files/edf_in_demand_clean_energy_sustainability_and_the_new_american_workforce.pdf.

[182] Solar Foundation. 2019. https://www.thesolarfoundation.org/wp-content/uploads/2019/05/Solar-Diversity-Infographic.pdf, https://www.e2.org/reports/clean-jobs-america-2019/.

[183] Muro, Mark, A. Tomer, R. Shivaram, J. Kane. April 2019. *Advancing inclusion through clean energy jobs.*

[184] Forbes. December 3, 2018. "Plunging Prices Mean Building New Renewable Energy Is Cheaper Than Running Existing Coal." Available at: https://www.forbes.com/sites/energyinnovation/2018/12/03/plunging-prices-mean-building-new-renewable-energy-is-cheaper-than-running-existing-coal/#44ffda531f31.

[185] Greentech Media. November 1, 2018. Report: "US on Track for Record Coal Retirements in 2018, With More on the Way." Available at: https://www.greentechmedia.com/articles/read/report-on-track-for-record-coal-retirements-with-more-on-the-way.

[186] For an exploration of the effects of natural gas operations on regional employment and income, see: Weber, Jeremy G. "The effects of a natural gas boom on employment and income in Colorado, Texas, and Wyoming." *Energy Economics* 34.5 (2012): 1580-1588.

[187] U.S. DOE Office of Policy. 2017. Transforming the Nation's Electricity System: The Second Installment of the QER. Chapter V. https://www.energy.gov/policy/initiatives/quadrennial-energy-review-qer/quadrennial-energy-review-second-installment.

[188] Forbes. 2019. "Renewable Energy Job Boom Creating Economic Opportunity As Coal Industry Slumps." https://www.forbes.com/sites/energyinnovation/2019/04/22/renewable-energy-job-boom-creating-economic-opportunity-as-coal-industry-slumps/#1ecb0a136654.

[189] Haggerty, J., M. Haggerty, K. Roemer, J. Rose. August 2018. Planning for the local impacts of coal facility closure: Emerging strategies in the U.S. West.

[190] Meter, Ken, Megan Phillips Goldenberg. 2015. *Critical Analysis of Economic Impact Methodologies*. Illinois Public Health Institute. Available at: https://www.crcworks.org/econimpacts.pdf.

[191] Muro, M., A. Tomer, R. Shivaram, J. Kane. April 2019. *Advancing inclusion through clean energy jobs*.

[192] Laborers' International Union of North America 2019.

[193] Muro, M., A. Tomer, R. Shivaram, J. Kane. April 2019. *Advancing inclusion through clean energy jobs.*

[194] Ettenson, L. March 18, 2019. *Clean Energy Jobs Still Lead, But Worker Diversity Needed*. Natural Resources Defense Council, Inc. Available at: https://www.nrdc.org/experts/lara-ettenson/clean-energy-jobs-still-lead-worker-diversity-needed.

[195] City of Austin, Texas, Press Release, "Community Grant Program Aims to Increase Access to Austin's Green Jobs", August 2019. Retrieved from: http://austintexas.gov/news/community-grant-program-aims-increase-fair-access-austins-green-jobs?mc_cid=2db2a5b784&mc_eid=b8ec1cc420

[196] CSI Multifamily Affordable Solar Housing (MASH) Program. Available at: https://www.cpuc.ca.gov/General.aspx?id=3752.

[197] GRID Alternatives. January 2019. Single-family Affordable Homes (SASH) Program: Semi-annual Program Status Report. Available at: https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442460500.

[198] https://aceee.org/sites/default/files/publications/researchreports/a1601.pdf (p. 11); Heeter, J., L. Bird, E. O'Shaughnessy, S. Koebrich. 2018. Design and Implementation of Community Solar Programs for Low- and Moderate-Income Customers. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-71652. https://www.nrel.gov/docs/fy19osti/71652.pdf, p. 5.

[199] The semi-annual report says: "SASH installation includes either a team of volunteers from the local community or graduates from job training programs. In addition, each sub-contracted installation requires at least one job trainee to participate in the project, as a paid worker learning valuable skills." (Grid Alternatives 2019. Single-family Affordable Solar Homes (SASH) Program: Semi-annual Program Status Report).

[200] Available at: https://leg.colorado.gov/bills/hb19-1314. See also Patti Poppe's, CEO of Consumer's Energy Michigan, speech on working on job transitions in October 2019, available at https://youtu.be/u2eM4arYvo4.

[201] Harris, R. August 2019. From an Extraction Economy to an Attraction Economy. Available at: https://www.wvtf.org/post/extraction-economy-attraction-economy#stream/0.

[202] Interview with Kevin Pranis, Minnesota & North Dakota Marketing Manager, Laborers' International Union of N. America.

[203] For example, the EPA Region 10 office initiated an effort to work with tribal governments, especially those in Alaska, using coordinators. The utility that serves the tribe could also initiate such an effort. The coordinator should be physically located in the tribal nation, and preferably be a member of the tribe themselves.

[204] Sterling, J. *et. al.* 2013. "Treatment of Solar Generation in Electric Utility Resource Planning." National Renewable Energy Laboratory, Report number: NREL/TP-6A20-60047, December 2013. Retrieved from: https://www.researchgate.net/publication/264157351_Treatment_of_Solar_Generation_in_Electric_Utility_Resource_Planning.

[205] The Partnership for Southern Equity has Just Energy Circles designed to help advocates understand energy policy and siting decisions. See, https://sites.google.com/view/pse-just-energy-circle.

[206] California Code GOV Section 65040.12. Available at: https://codes.findlaw.com/ca/government-code/gov-sect-65040-12.html. See also, a web portal describing California's environmental justice requirements is available at: https://calepa.ca.gov/envjustice/; Washington State Environmental Policy Act (1971) available at: https://app.leg.wa.gov/rcw/default.aspx?cite=43.21C; Overview of WA SEPA available at: https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/Basic-overview.

[207] "Environmental Justice Comments on the Millennium Bulk Terminal Draft Environmental Impact Statement", submitted by Stand, Sierra Club and Oregon Physicians for Social Responsibility to the Washington Department of Ecology and the Cowlitz (WA) County EIS team. Available at: www.millenniumbulkeiswa.gov/Comments/MBTL-SEPA-DEIS-0003353-100940.pdf. Originally six coal export terminals were proposed for Washington and Oregon ports. The involvement of environmental justice and environmental advocates has resulted in zero of these terminals being permitted, with some cities passing a ban on such facilities. For history see: "Permitting Coal Export Terminals in the Pacific Northwest", the Sierra Club, Available at: https://content.sierraclub.org/creative-archive/sites/content.sierraclub.org.creative-archive/files/pdfs/100_121_CoalExport_PNW_Whitepaper_05_low_0.pdf.

[208] The citizen science movement is gaining momentum with advances in air monitoring technology. We highlight two efforts to educate student and parents here. One effort has just begun on air monitoring at 13 Denver elementary schools in the *Love My Air* program. See: https://www.denvergov.org/content/denvergov/en/environmental-health/about-us/news-room/newsroom_2019/love-my-air-2019-kickoff.html. Another involves teaching students in grades 6-8 about energy use and water quality with a civic engagement focus. This is documented by Condon (Loyola) and Wichowsky (Marquette) in "Developing Citizen Scientists – effects of an inquiry based scient curriculum on STEM And Civic Engagement" in the Elementary School Journal, Vol 119, Number 2, Oct 19, 2018, U of Chicago press.

[209] Personal knowledge of and over 35 years of air quality experience by James, C. RAP.

[210] See, Whited, Melissa, Tim Woolf, and Alice Napoleon. 2015. *Utility Performance Incentive Mechanisms: A Handbook for Regulators.* Synapse Energy Economics. https://www.synapse-energy.com/project/performance-incentives-utilities. See also, Littell, David, Camille Kadoch, Ranjit Bharvirkar, Max Dupuy, Brenda Hausauer, Carl Linvill, Janine Migden-Ostrander, Jan Rosenow, Wang Xuan, Owen Zinaman, and Jeffrey Logan. 2018. *Next-Generation Performance-Based Regulation*. https://www.raponline.org/knowledge-center/next-generation-performance-based-regulation-volume-2-primer-essential-elements-of-design-and-implementation/.

[211] For a comprehensive report on performance-based ratemaking, see: Aggarwal, S., E. Burgess. 2014. *New Regulatory Models*. Available at: https://energyinnovation.org/wp-content/uploads/2014/06/SPSC-CREPC_NewRegulatoryModels.pdf. For a more recent primer on outcome-based, program-based, and action-based performance incentive mechanisms, see: Woolf, T., J. Hall, M. Whited. 2018." *Earnings Adjustment Mechanisms to Support New York REV Goals:*

Outcome-Based, Program-Based, and Action-Based Options." Synapse Energy Economics. Available at: http://www.synapse-energy.com/sites/default/files/AEEI-EAM-Report-17-062.pdf.

[212] See, https://www.electriccooporganizing.org/toolkit.

[213] These alternatives include energy efficiency, renewable energy, and new technology like electrification (e.g., converting from fossil fuel heating to heat pumps that offer heating and cooling with improved efficiency using electricity that will improve over time as the grid becomes cleaner).

[214] The Institute for Market Transformation is one NGO that is focused on building efficiency and making data accessible and available for tenants and building owners through codes, data systems, and data analysis. Their efforts to explore landlord/tenant relationships can be explored here https://www.imt.org/making-buildings-more-efficient/owners-and-tenants/landlord-tenant-energy-partnership/.

[215] https://www.rggi.org/rggi-inc/board-of-directors.

[216] RGGI website, https://www.rggi.org/program-overview-and-design/design-archive/mou-model-rule.

[217] Yale University. 2020. https://www.yaleclimateconnections.org/2020/01/power-plant-emissions-down-47-percent-under-the-regional-greenhouse-gas-initiative/.

[218] Hibbard, PJ., S.F. Tierney, P.G. Darling, S. Cullinan. 2018. *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States*. The Analysis Group. Available at: https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf.

[219] Abt Associates. 2017. Analysis of the Public Health Effects of the Regional Greenhouse Gas Initiative, 2009-2014.

[220] Analysis Group, 2018. Available at https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf

[221] A recent study shows a variety of terms and definitions in use by RGGI states to denote disadvantaged communities and consumers, including: low income, working poor, asset-limited, income restrained, socially vulnerable with regard to climate change impacts, environmental justice communities, minority, socially disadvantaged or disadvantaged communities, under-represented or under-resourced, residents with a high health disparity or health inequities (Herb, J. and M. Kaplan. 2019. *Field Notes: Equity & State Climate Policy*. Prepared for the RGGI Project Series: The Environmental Analysis & Communications Group, Rutgers University Bloustein School of Planning and Public Policy, and the Rutgers Climate Institute, p. 39. Available at: https://drive.google.com/file/d/1mB-12SYJHQV4VjFe4OItZFfvQPdLB-cz/view.

[222] Regional Greenhouse Gas Initiative, Inc. 2019. *The Investment of RGGI Proceeds in 2017*.

[223] States use a variety of environmental justice definitions, building from the U.S. EPA's Environmental Justice-Related Terms As Defined Across the PSC Agencies (https://www.epa.gov/sites/production/files/2015-02/documents/team-ej-lexicon.pdf). (MA, NJ, NY, and MD).

[224] https://www.rggiprojectseries.org/performance

[225] Herb, J. and M. Kaplan, 2019.

[226] Herb, J. and M. Kaplan, 2019, p. 34.

[227] Id, p. 2.

[228] Id, p. 27.

[229] https://greenbank.ny.gov/, https://greenbanknetwork.org/rhode-island-infrastructure-bank/.

[230] https://www.rggi.org/program-overview-and-design/stakeholder-comments.

[231] Abt Associates. 2017. *Analysis of the Public Health Effects of the Regional Greenhouse Gas Initiative, 2009-2014*.

[232] Acadia Center. 2017. *Strengthening RGGI to Improve Public Health*. Available at https://acadiacenter.org/wp-content/uploads/2017/05/Acadia-Center-Strengthening_RGGI_to_Improve_Health_2017_05_09.pdf

[233] Transportation and Climate Initiative of the Northeast and Mid-Atlantic States. https://www.transportationandclimate.org/.

[234] https://www.georgetownclimate.org/files/Final_TCI-statement_20181218_formatted.pdf.

[235] https://www.transportationandclimate.org/sites/default/files/TCI-Framework_10-01-2019.pdf.

[236] Virginia's adopted RGGI rule includes a requirement that the state "evaluate impacts of the program…including economic, energy, and environmental impacts on vulnerable and environmental justice and underserved communities" as well as a plan that ensures "increased participation of environmental justice communities in the (program) review" (Herb, J. and M. Kaplan. 2019, p.36)

[237] The current PIPP electric rules are located at: http://codes.ohio.gov/oac/122%3A5-3. The current PIPP gas rules are located at http://codes.ohio.gov/oac/4901:1-18-12v1. Both sets of rules are going through a proceeding (as of November 2019), with revisions expected to be finalized by early 2020.

[238] The current PIPP electric rules are located at: http://codes.ohio.gov/oac/122%3A5-3. The current PIPP gas rules are located at http://codes.ohio.gov/oac/4901:1-18-12v1. Both sets of rules are going through a proceeding (as of November 2019), with revisions expected to be finalized by early 2020.

[239] Background notes based on personal conversation on 15 November 2019 between Christopher James (RAP) and James Williams (Ohio Consumer Council).

[240] James interview of PIPP staff.

[241] The exact definition of "third party" will be included in the regulatory revisions. But a "third party" could be a CAA, a church, or another family member who could pay the utility bill on behalf of the PIPP customer.

[242] Cost-effectiveness tests present an opportunity area in Ohio (and in many states) in terms of the types of tests that states use and their analytical procedures. Excluding societal benefits and looking at costs and benefits by each measure, rather than bundling them to reflect how programs actually operate, often makes individual measures "fail" cost-effectiveness tests, especially for measures applied to rental properties. For non low-income customers, EE cost-effectiveness tests apply, and measures with benefit-cost ratios less than 1.0 are not deployed.

[243] Energy Choice Ohio web site comparing rate plans of companies providing natural gas services to residential customers. Available at: http://www.energychoice.ohio.gov/ApplesToApplesComparision.aspx?Category=NaturalGas&TerritoryId=1&RateCode=1.

[244] Brockway, N., J. Kallay, E. Malone. 2014. *Low-Income Assistance Strategy Review: Options for the design and implementation of ratepayer-funded assistance programs for low- income electricity customers*. Prepared by Synapse Energy Economics for the Ontario Energy Board. https://www.synapse-energy.com/sites/default/files/Low-Income-Assistance-Strategy-Review-14-111.pdf

[245] Ibid.

[246] U.S. Department of Health and Human Services, State PBF/USF History, Legislation, Implementation: Colorado, 2016. https://liheapch.acf.hhs.gov/dereg/states/cosummary.htm.

[247] Consolidated Edison, "Help Paying Your Bill," https://www.coned.com/en/accounts-billing/payment-plans-assistance/help-paying-your-bill.

[248] The Total Resource Cost (TRC) test is applied; EE measures must achieve a TRC ratio of 0.91 or higher to be eligible for installation on low-income customers. While this ratio does allow consideration of measures that are not cost-effective (i.e., measures with a ratio of 1.0 or higher would provide more economic benefits than their cost to install), it would exclude some measures that would help to reduce low-income customer's energy bills. American Council for an Energy-Efficient Economy (ACEEE), "Guidelines for Low-Income Energy Efficiency Programs." https://database.aceee.org/state/guidelines-low-income-programs.

[249] It is likely that the straight-forward payment terms will be adjusted to make them more attractive and beneficial to customers.

[250] Rocky Mountain Institute. 2015. *A Small Iowa Town Embraces Energy Independence*. Available at https://rmi.org/blog_2015_06_16_a_small_iowa_town_embraces_energy_independence/.

[251] United States Census Bureau. 2019. *American Community Survey 5-Year Estimates*. Available at https://www.census.gov/data/developers/data-sets/acs-5year.html. (Reported data are for 2017.)

[252] Rocky Mountain Institute. 2015. *A Small Iowa Town Embraces Energy Independence*. Available at https://rmi.org/blog_2015_06_16_a_small_iowa_town_embraces_energy_independence/.

[253] The City of Bloomfield Iowa. 2019. *Residential Energy Use Map*. Available at https://www.cityofbloomfield.org.

[254] The City of Bloomfield Iowa. 2019. *Utility Rates*. Available at https://www.cityofbloomfield.org.

[255] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[256] Ibid.

[257] Ibid.

[258] Ibid.

[259] Ibid.

[260] Rocky Mountain Institute. 2015. *A Small Iowa Town Embraces Energy Independence*. Available at https://rmi.org/blog_2015_06_16_a_small_iowa_town_embraces_energy_independence/.

[261] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[262] Rocky Mountain Institute. 2015. *A Small Iowa Town Embraces Energy Independence*. Available at https://rmi.org/blog_2015_06_16_a_small_iowa_town_embraces_energy_independence/.

[263] Wind, T., B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[264] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[265] Ibid.

[266] Ibid.

[267] Rocky Mountain Institute. 2015. *A Small Iowa Town Embraces Energy Independence*. Available at https://rmi.org/blog_2015_06_16_a_small_iowa_town_embraces_energy_independence/.

[268] Ibid.

[269] The City of Bloomfield Iowa. 2019. "*Residential Energy Use Map*." Available at https://www.cityofbloomfield.org.

[270] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[271] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[272] The City of Bloomfield Iowa. 2019. "*Solar Array Production*." Available at https://www.cityofbloomfield.org; The City of Bloomfield Iowa. 2019. "*A Journey to Energy Independence*." Available at https://bloomfield.solar.

[273] Aaberg, A., M. Donahue, J. Farrell. 2019. *Voices of 100%: "Small Iowa Town Pushes for Energy Independence*." Institute for Local Self-Reliance. Available at https://ilsr.org/bloomfield-iowa-voices-of-100-podcast/.

[274] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[275] The City of Bloomfield Iowa. 2019. *Residential Energy Use Map*. Available at https://www.cityofbloomfield.org.

[276] Aaberg, A., M. Donahue, J. Farrell. 2019. "*Voices of 100%: Small Iowa Town Pushes for Energy Independence*." Institute for Local Self-Reliance. Available at https://ilsr.org/bloomfield-iowa-voices-of-100-podcast/.

[277] Ibid.

[278] The U.S. Corporation for National and Community Service. *City of Bloomfield FY 2015 Operation AmeriCorps.* Accessed December 26, 2019. Available at https://www.nationalservice.gov/about/open-government-initiative/transparency/data-sources/15ac171605.

[279] Ibid.

[280] Aaberg, A., M. Donahue, J. Farrell. 2019. *Voices of 100%: Small Iowa Town Pushes for Energy Independence*. Institute for Local Self-Reliance. Available at https://ilsr.org/bloomfield-iowa-voices-of-100-podcast/.

[281] Ibid.

[282] American Council for an Energy Efficient Economy. "On-Bill Energy Efficiency." Accessed December 31, 2019. https://aceee.org/sector/state-policy/toolkit/on-bill-financing.

[283] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[284] Wind, T., J. Logan, B. Haug. 2014. *Energy Independent Community*. The Iowa Association of Municipal Utilities for the City of Bloomfield, IA.

[285] Ibid.

[286] Ibid.

[287] Xcel also delivers natural gas to customers in Minnesota and four other states.

[288] Drake, T., D. Scott. 2019. *Performance Metrics for Xcel Energy's Electric Utility Operations*. Great Plains Institute. Available at: https://e21initiative.org/wp-content/uploads/2019/04/GPI_17-401_StakeholderMeeting1Summary_20190405.pdf.

[289] Minnesota Office of the Revisor of Statutes. 2019. *2019 Minnesota Statutes: 216B.16 Rate Change; Procedure; Hearing.* Available at: https://www.revisor.mn.gov/statutes/cite/216B.16.

[290] Minnesota Public Utilities Commission. 2017. *Findings of Fact, Conclusions, and Order.* Available at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={ECF405E1-C848-4D03-BBE3-91BA3DD17B96}&documentTitle=20176-132748-01. Docket No. E-002/CI-17-401, *In the Matter of a Commission Investigation to Identify and Develop Performance Metrics and, Potentially, Incentives for Xcel Energy's Electric Utility Operations*.

[291] Minnesota Public Utilities Commission. 2019. *Order establishing performance metrics.* Available at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={0082456D-0000-CA1F-9241-23A4FFF7C2FB}&documentTitle=20199-155917-01.

[292] Drake, T., D. Scott. 2019. "Performance Metrics for Xcel Energy's Electric Utility Operations: 2019 Stakeholder Engagement Process, Meeting 1 Summary Report." Great Plains Institute. Available at: https://e21initiative.org/wp-content/uploads/2019/04/GPI_17-401_StakeholderMeeting1Summary_20190405.pdf.

[293] Havey, K. 2019. "*Re: Xcel Energy Performance Metrics*." The City of Minneapolis, Division of Sustainability. Available at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7bC06F286B-0000-CD18-BB73-57FE74B6A344%7d&documentTitle=20196-153372-01.

[294] U.S. Energy Information Administration. 2018. "One in three U.S. households faces a challenge in meeting energy needs." *Today in Energy*. September 19. Available at: https://www.eia.gov/todayinenergy/detail.php?id=37072.

[295] Minnesota Public Utilities Commission. 2019. *Order establishing performance metrics.* Available at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={0082456D-0000-CA1F-9241-23A4FFF7C2FB}&documentTitle=20199-155917-01.

[296] Ibid.

[297] Ibid.

[298] Xcel Energy. 2019. *Proposed Metric Methodology and Process Schedule on Performance Metrics and Incentives.* Available at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={A025276E-0000-C611-824F-D1573C3FE154}&documentTitle=201910-157094-01.

[299] Scott, D. 2018. *Summary of e21 Roundtable Meetings convened by the Great Plains Institute.* Great Plains Institute. Available at: https://e21initiative.org/wp-content/uploads/2018/03/e21PBCRoundtable_MNPUC_February2018_V7-FINAL-ALL-DOCUMENTS.pdf.

[300] Call with Stacy Miller, Program Coordinator in the Division of Sustainability for the City of Minneapolis.

[301] Farnsworth, D., Shipley, J., Sliger, J., and Lazar, J. 2019. *Beneficial electrification of transportation*. Montpelier, VT: Regulatory Assistance Project. Retrieved from https://www.raponline.org/knowledge-center/beneficial-electrification-of-transportation/.

[302] Pressgrove, J. 2019. "Investing in Digital Equity: The Case for Broadband Expansion." *Governing*, October 25. Retrieved from https://www.governing.com/news/headlines/GT-Investing-in-Digital-Equity-The-Case-for-Broadband-Expansion.html.

[303] Kit Carson Electric Cooperative. n.d. "About Kit Carson Internet." Retrieved from https://kitcarson.com/internet/about-kit-carson-internet.

[304] Institute for Market Transformation. n.d. "Putting Data to Work Toolkit." Available at https://www.imt.org/how-we-drive-demand/building-policies-and-programs/putting-data-to-work/.

[305] "A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode." Berkeley Lab. (2019). "About Microgrids." Available at: building-microgrid.lbl.gov: https://building-microgrid.lbl.gov/about-microgrids.

[306] Green Mountain Power's Resilient Home pilot: https://greenmountainpower.com/product/powerwall/, accessed Feb. 28, 2020.

[307] Using ARRA funding in 2007 and later, MassDEP demonstrated the viability of reducing municipal energy costs for water supply and treatment in a number of towns. This work has since been expanded in other states, e.g., New Hampshire and beyond. Available at https://www.mass.gov/info-details/massachusetts-drinking-water-wastewater-facilities-energy-management-pilot, accessed Feb. 28, 2020.

[308] U.S. EPA ENERGY STAR. "Energy Efficient Products: Clothes Washers." https://www.energystar.gov/products/appliances/clothes_washers, accessed Feb. 28, 2020.

[309] The rate structure used by Fort Collins, Colorado is a good example. Fort Collins uses a rate structure that provides one rate for any usage up to 700 kwh per month with a low customer fixed charge less than $7 and an on peak charge for limited hours that is four times the off-peak rate that varies with summer and winter.

[310] Partnership for Southern Equity. "Just Energy Circle." https://sites.google.com/view/pse-just-energy-circle, accessed Feb. 28, 2020.