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Clean Air as a Bonus for Achieving Energy-Related State Goals

A review of policies and programs in 15 states

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Acronyms

ADMS	Advanced Distribution Management Systems
AMI	Advanced Metering Infrastructure
C&I	Commercial and industrial
CapEx	Capital expenditure
DAC	disadvantaged community
DER	distributed energy resource
DERMS	Distributed Energy Resource Management Systems
DOE	U.S. Department of Energy
DOT	Department of Transportation
DR	demand response
DSP	distribution system planning
EERS	energy efficiency resource standard
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EV	electric vehicle
FERC	Federal Energy Regulatory Commission
GRIP	Grid Resilience and Innovation Partnerships
GW	gigawatt
HB	House bill
HVAC	heating, ventilating and air-conditioning
IEEE	Institute of Electrical and Electronics Engineers
IIJA	Infrastructure Investment and Jobs Act
IRA	Inflation Reduction Act
IRP	integrated resource plan
IVVC	Integrated Volt-VAR Regulation
kW	kilowatt
MW	megawatt
NEVI	National Electric Vehicle Infrastructure
PSC	public service commission
PUC	public utility commission
PV	photovoltaic
REC	Renewable Energy Credit
RFP	request for proposal
ROE	return on equity
SB	State bill
TE	Transportation electrification
TVA	Tennessee Valley Authority

Executive Summary

Many U.S. states have adopted policies and programs that reduce air pollution as a bonus. For example, more than half the states have adopted energy efficiency resource standards, primarily designed to save utility customers money on their utility bills. But these standards also reduce air pollutants associated with producing and consuming energy.

Regardless of whether clean air is a driver for such state actions, they nonetheless serve to reduce a variety of pollutants, including particulates, nitrogen oxides, sulfur dioxide, and greenhouse gases like carbon dioxide.

To understand how a variety of state initiatives may provide this important ancillary benefit, Lawrence Berkeley National Laboratory (Berkeley Lab) conducted a study to explore policies and programs for six common energy-related areas for state action (Figure ES-1). The study encompasses 15 geographically diverse states that do not have mandatory climate goals—Arizona, Delaware, Florida, Georgia, Indiana, Iowa, Kentucky, Louisiana, Missouri, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, and Utah.

Figure ES-1. Six Common Energy-Related Areas for State Action

Researchers reviewed related statutes, regulatory proceedings, and executive orders for the target states and interviewed representatives of public utility commissions (PUCs) and state energy offices to explore connections between state actions in these six areas and reducing air pollution. This report describes our findings.

We also asked interviewees to provide their views on the importance of each of these areas for reducing carbon dioxide emissions in their state as a side benefit (Figures ES-2 and ES-3). Using local energy resources—for example, through renewable portfolio standards or incentives for in-state projects—and energy affordability were top selections by PUCs. Economic development was the leading driver cited by state energy offices.

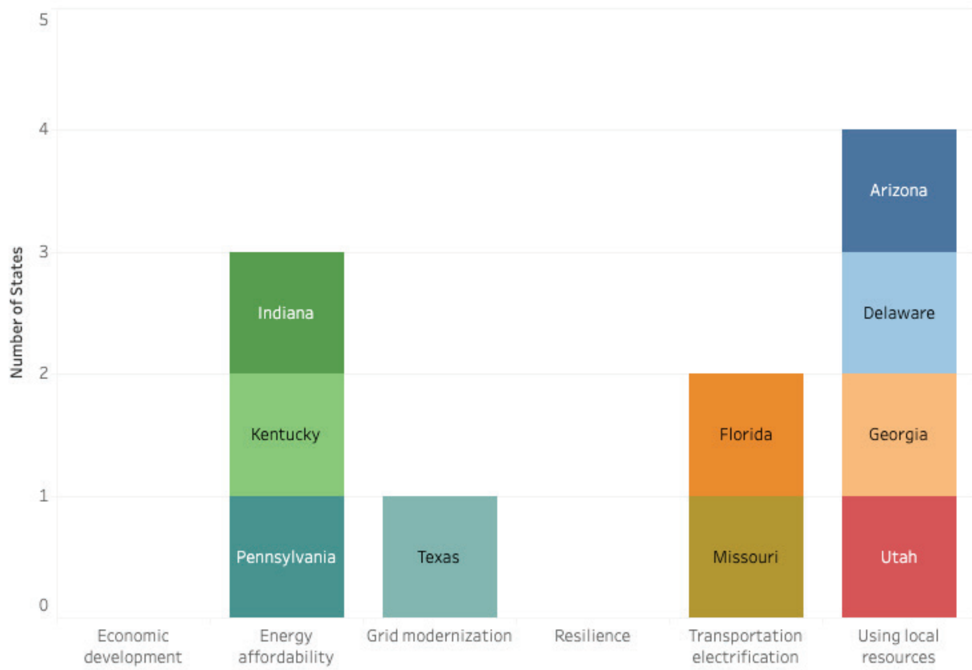

Figure ES-2. Primary Drivers for Carbon Reductions According to PUCs

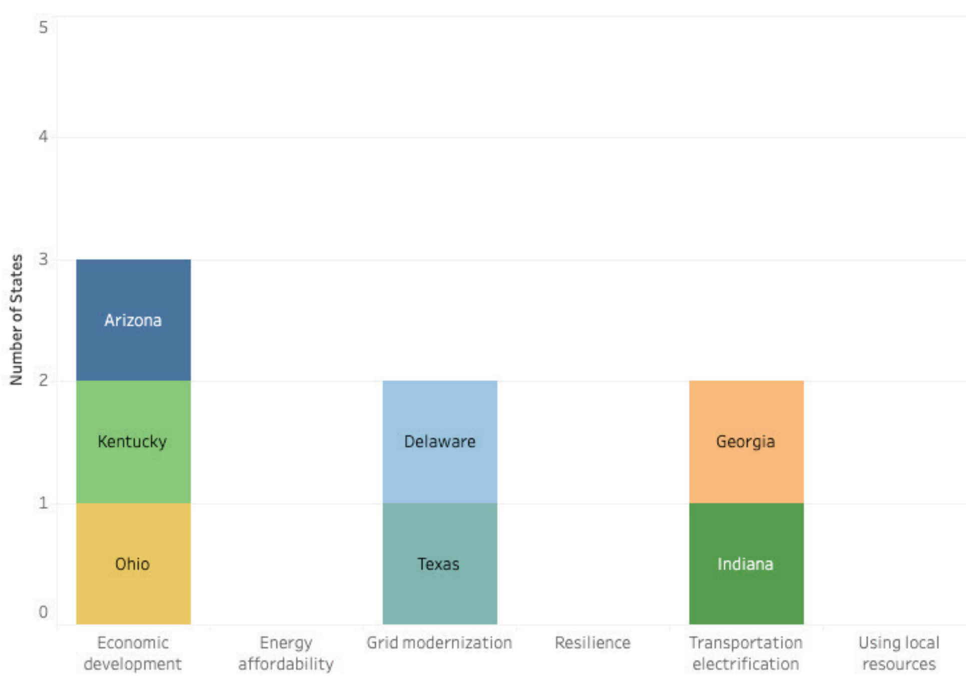

Figure ES-3. Primary Drivers for Carbon Reductions According to State Energy Offices[1]

[1] State energy office representatives in other states in our study did not select a driver, although some discussed focus areas for their work. For example, the Tennessee energy office focuses on transportation, energy security, resilience, and energy efficiency and load management.

Information presented in this report can serve as a guide for states that may wish to consider clean air benefits of initiatives designed to achieve other state goals, such as resilience, economic development, energy affordability, electrifying transportation, grid modernization, and using local resources. The report provides a wide variety of examples and resources that states can adapt to reduce carbon dioxide and other air pollutants while focusing on meeting their unique energy-related goals.

1. Introduction

Berkeley Lab conducts a wide range of studies to assist states in advancing their own energy goals, from grid modernization and resilience, to energy efficiency and renewable energy, to demand flexibility and energy affordability.[2] This report explores a variety of state actions in these and other areas that provide an important ancillary benefit—clean air.

1.1 Methods

Berkeley Lab collaborated with DOE's Office of Policy to select 15 geographically-diverse states that have not adopted mandatory climate goals, but have a wide range of policies, regulations, and programs that reduce greenhouse gas emissions and other air pollutants as a bonus (Figure 1-1).

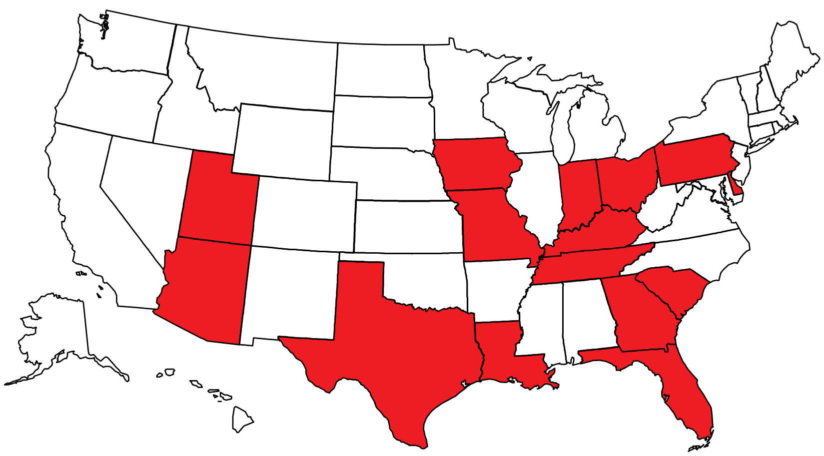

Figure 1-1. States Included in this Report

Berkeley Lab defined six themes for the study:

(1) *Transportation electrification* - Transportation electrification plans, electric vehicle (EV) incentives (e.g., tax credits), PUC actions in support of EV adoption goals (e.g., for charging infrastructure), time-varying rates for charging, and requirements for managed charging

(2) *Using local resources* - Planning requirements to leverage in-state renewable resources—both distributed and utility-scale—and policies that establish a preference for community resources

(3) *Economic development/clean energy manufacturing* - Jobs and retraining programs and requirements for in-state contractors, recruiting businesses that have clean energy commitments (e.g., enabling clean power onsite or delivered by utilities and third parties), supporting clean energy manufacturing and agriculture through tax policies for wind and solar development, and tourism

[2] See https://emp.lbl.gov/research-area.

(4) *Energy affordability* - Energy efficiency and demand-side management requirements (e.g., standards and programs for energy efficiency and demand response); measures to enable adoption of technologies for low- and middle-income households; and policies that enable these households to use these technologies to provide a range of grid services
(5) *Resilience* - State resilience plans; pilots, program incentives, and streamlined siting and permitting for microgrids and energy storage; considering the resilience value of storage for bulk power and distribution planning and demand-side management programs; battery storage procurement targets; incentives and penalties for resilience-related performance; resilience benefits of EVs; and approvals of relevant grid investments, such as rate case actions for targeted resilience investments
(6) *Grid modernization* - Planning requirements, approvals for capital investments in grid infrastructure, and guidance to better integrate distributed energy resources (DERs) and electrification into grid planning

Berkeley Lab engaged consulting firm E9 Insight to identify existing policies and regulations, and goals expressed by the legislature and executive branch, related to these six areas in the 15 target states. DOE's Office of Policy reviewed related executive orders (EOs) issued by Governors from 2017 to 2023.

Berkeley Lab researchers used this information as a baseline to conduct interviews with representatives of PUCs and state energy offices in these states.[3] Researchers reviewed draft interview questions with DOE, the National Association of State Energy Officials, and the National Association of Regulatory Utility Commissioners. In addition to going into more depth on identified state policies, regulations, and programs, researchers asked interviewees to advise about any additional state activities that Berkeley Lab should review related to the six study areas.

1.2 State Drivers

Researchers also asked state representatives which of the six areas were primary and secondary drivers of reductions in energy-related carbon dioxide emissions in their state (Tables 1-1 and 1-2).[4] PUCs primarily cited using local resources, energy affordability, and transportation electrification. Responses from state energy offices were more diverse, with economic development most commonly cited as a driver.

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[3] Interviews were completed in 2023. In some states, Berkeley Lab interviewed the Governor's energy policy advisor in addition to, or instead of, the state energy office.

[4] State energy office representatives in Iowa, Florida, Louisiana, Missouri, Pennsylvania, South Carolina, and Tennessee did not select a driver, although some discussed focus areas for their work. For example, the Tennessee state energy office focuses on transportation, energy security, resilience, and energy efficiency and load management.

Table 1-1. Drivers of Carbon Reduction in Target States According to Public Utility Commissions[5]

State	Primary Driver	Other Driver
Indiana	Energy affordability	
Kentucky	Energy affordability	Using local resources
Pennsylvania	Energy affordability	
Texas	Grid modernization	Using local resources
Florida	Transportation electrification	Using local resources
Missouri	Transportation electrification	Using local resources
Arizona	Using local resources	Transportation electrification
Delaware	Using local resources	
Georgia	Using local resources	Transportation electrification
Utah	Using local resources	Transportation electrification

Table 1-2. Primary Drivers of Carbon Reduction in Target States According to State Energy Offices

State	Primary Driver	Other Driver (1)	Other Driver (2)
Arizona	Economic development	Resilience	
Kentucky	Economic development		
Ohio	Economic development	Energy affordability	Resilience
Delaware	Grid modernization	Using local resources	Transportation electrification
Texas	Grid modernization	Resilience	
Georgia	Transportation electrification	Using local resources	
Indiana	Transportation electrification	Economic development	Grid modernization

State representatives interviewed also cited other drivers for reducing carbon emissions:

- *Maximize the value of funding through the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA)* (Pennsylvania, Tennessee, Utah)
- *Develop alternative electricity sources*
  - Geothermal energy at abandoned oil and gas wells (Pennsylvania)
  - Advanced nuclear (Tennessee) – EO 101 created the Tennessee Nuclear Energy Advisory Council to advance the state's nuclear energy leadership, and the state's 2023-24 budget included a $50 million Nuclear Fund
  - Hydrogen (Utah)
- *Outreach and education*—for example, technical assistance for local governments and universities to pursue federal funding (Tennessee)

[5] PUC representatives in Iowa, Ohio, and South Carolina did not select a driver. Researchers were unable to secure an interview with the Louisiana Public Service Commission and did not interview the Tennessee PUC because it does not regulate relevant electricity activities.

- *Target other carbon emission sources and solutions*
    - Focus on industrial sector emissions (Pennsylvania)
    - Reduce refinery emissions (Utah)
    - Expand telecommuting to improve air quality (Utah)
    - Enhance smart mobility (Tennessee)
- *Pursue other policy and regulatory objectives*
    - Energy transition planning (Pennsylvania, Utah)
    - Integrated resource planning (Indiana, Georgia)
    - Energy independence (Arizona)
    - Reduce transportation costs and increase public transportation (Utah)
    - Equitable access to energy infrastructure for rural areas (Utah)
    - Improve infrastructure to get energy resources to market (Utah)
    - Change rate structures to create a responsive grid (Pennsylvania)
    - Interconnection policy (Texas)

Several states mentioned climate action planning explicitly, although their goals are not binding:

- Pennsylvania Climate Act 70 (2008) requires a state climate plan every three years and a greenhouse gas inventory annually. A Climate Change Advisory Committee advises the Department on implementation of the Act. EO 2019-07 directed the Department of Environmental Protection to, "no later than September 15, 2020, develop and present to the Pennsylvania Environmental Quality Board a proposed rulemaking package to abate, control, or limit carbon dioxide emissions from fossil-fuel-fired electric power generators…."
- In Delaware, the Climate Action Plan (2021) includes "action areas" to minimize greenhouse gases and maximize resilience to climate change impacts, including expansion of clean energy, energy efficiency improvements, transition to zero-emission EVs, updating state regulations, and support for communities and stakeholders. The requirement also addresses challenges for low- and middle-income residents to access community solar and renewable energy incentives.
- Louisiana's Climate Action Plan (2022) is designed to meet a state goal of net-zero greenhouse gases by 2050, with interim targets.
- SB 192 (2023) in Kentucky allows an investor-owned electric utility to apply to the Public Service Commission (PSC) to use securitization to finance both extraordinary costs and costs associated with retirement of electric generation.
- Local governments in several states, including Arizona, Florida, Kentucky, Louisiana, Tennessee, and Utah, have adopted goals for clean energy and carbon reduction.

States that want to estimate reductions of greenhouse gases and other air pollutants from energy-related policies and programs can use tools from the U.S. Environmental Protection Agency (EPA): AVoided Emissions and geneRation Tool (AVERT) or EPA's Greenhouse Gas Equivalencies Calculator.[6] [7]

[6] In addition, EPA offers resources to incorporate energy efficiency and renewable energy in State Implementation Plans to comply with the federal Clean Air Act.

[7] Also see Specian, M. (2024). *Accounting for Change: Policies and Technical Approaches for Reducing Greenhouse Gas Emissions through Energy Efficiency Programs*. American Council for an Energy-Efficient Economy.

2. Transportation Electrification

Many states are advancing transportation electrification (TE) because it delivers multiple benefits. TE can reduce reliance by the state and its residents on fuels that are subject to market price volatility and supply chain disruptions, helping to stabilize transportation costs and improve energy security. Fueling vehicles with electricity can provide more price stability for customers and is often cheaper than gasoline, particularly because EVs are typically more fuel efficient than traditional internal combustion engine vehicles.[8] EVs improve local air quality by reducing tailpipe emissions, leading to positive health outcomes. In addition, TE is an emerging industry that can help spur economic growth for states. New manufacturing for cars and batteries, and innovation in the sector, can lead to job creation and economic growth.[9]

With increasing levels of wind and solar generating facilities, TE also reduces carbon dioxide emissions. States can take a wide variety of actions to advance TE across agencies and stakeholders, including in the following areas discussed in this chapter:

- Planning, education and outreach
- Grants, financing, and technical assistance
- EV rate design and infrastructure
- Technology and manufacturing
- Other programs and initiatives

2.1 Planning, Education, and Outreach[10]

Thoughtful planning is critical to strategically and effectively deploy funds and create a useful infrastructure network for electrified transportation. States have conducted studies that evaluate EV charging needs and preferable infrastructure siting for many years and are now increasing their focus because of federal funding that requires specific plans (discussed below).

Public knowledge and awareness of TE programs and options are critical. Automakers have steadily increased the number of EVs for sale in the last decade.[11] Given the relative newness of EV buying options, customers frequently have questions and concerns about EVs before investing. Public information efforts that help buyers understand the benefits of EVs and reduce their concerns related to charging availability and "range anxiety"[12] can help to increase the share of EVs on the road and effectively engage stakeholders in planning processes.

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[8] U.S. Department of Energy Alternative Fuels Data Center (n.d.).
[9] Clean Investment Monitor (n.d.).
[10] For resources and tools on EV infrastructure planning and implementation, see the U.S. Department of Transportation website.
[11] U.S. Department of Energy (2014).
[12] "Range anxiety" is the fear of a vehicle running out of charge.

Tennessee – *Building capacity to reach future EV drivers.* Drive Electric Tennessee brings together key stakeholders to promote EV adoption throughout the state. In 2018, the organization facilitated a process with utilities, state agencies, cities, transit agencies, industry, advocacy groups, and others to develop the Drive Electric Tennessee Roadmap. The document focuses on meeting a goal of at least 200,000 EVs in the state by 2028 and outlines challenges and activities to achieve that goal. The roadmap identified four opportunity areas: charging infrastructure availability, awareness, promoting innovation and supportive policies, and increasing EV offerings and availability.

Based on its findings, Drive Electric Tennessee hosts three working groups on infrastructure, awareness, and policies and programs. The "Awareness" working group meets quarterly to promote greater understanding of the benefits of EVs. Their activities include helping local Drive Electric chapters develop capacity to promote EVs in their communities (Figure 2-1), promoting strong "ride and drive" events to get citizens and fleet managers into EVs, improving the Drive Electric Tennessee's digital marketing and presence, promoting best practices for EV charging signage, and developing case studies on fleet conversions.[13]

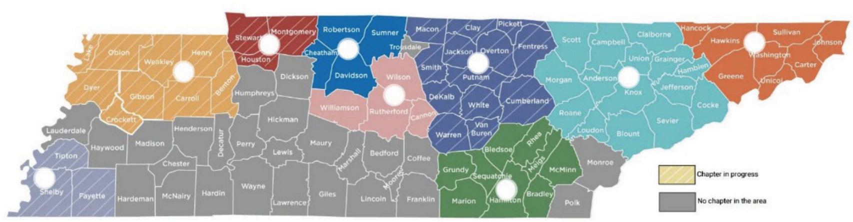

Figure 2-1. Drive Electric Tennessee's Local Chapter Development as of May 2024

Both the organization as a whole and the Awareness Working Group track their impacts. For example, the number of EVs in the state has increased from 5,000 in 2017 to almost 40,000 in 2024, and Drive Electric Tennessee reached over 71,000 individuals about EVs in person in 2023 (Figure 2-2).[14]

Total number of events	=	30
Total number of people directly reached	=	6,541
Total number of rides and drives	=	1,176
Total number of PEVs at events	=	512
Total in-person exposure	=	71,263

Figure 2-2. Drive Electric Tennessee's Awareness Working Group 2023 Impact Assessment

Texas – *Engaging the public to strategically deploy federal funding.* The federal National Electric Vehicle Infrastructure (NEVI) program funds state EV charging station development, maintenance, and data sharing along alternative fuel corridors. To receive funding, each state has to submit a NEVI plan to the U.S. Joint Office of Energy and Transportation and receive approval by the Federal Highway

[13] Drive Electric Tennessee (n.d.).
[14] Drive Electric Tennessee Homepage. https://www.driveelectrictn.org/.

Administration.[15] Following a planning process spurred by the IIJA, the Texas Department of Transportation's (DOT) 2024 Vehicle Infrastructure Plan was approved, and the state released its annual funds in conjunction with the plan.

The Texas DOT public involvement team supported development of the Vehicle Infrastructure Plan through its own Public Involvement Plan. The team created resources for public engagement intended to create a direct line of communication with the public that would allow input from residents to inform the overall deployment strategy. Engagement resources include an interactive map where the public can suggest EV charging station locations (Figure 2-3), social media posts and a program webpage, surveys, and a virtual meeting. Importantly, the final Vehicle Infrastructure Plan discusses how public input influenced its findings. For example, DOT added an area to study for EV infrastructure needs. The report lists public engagement statistics (Table 2-1).

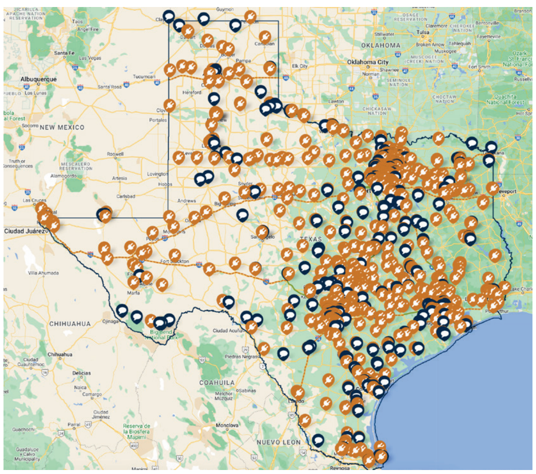

Figure 2-3. Snapshot of the Texas DOT's Interactive EV Charging Mapping Tool

Table 2-1. Texas DOT Vehicle Infrastructure Plan Public Involvement Results

Public Involvement Method	Count 2022	Count 2023
Unique Webpage Visitors (EV Landing Page)	4,751	1,829
Webpage Visits, Views	7,056 - 8,041	3,078 - 4,158
Facebook Views, Comments, Reactions, Shares	566 - 258 - 261 - 47	31,527 - 166 - 126 - 19
Twitter Views, Likes, Retweets, Comments	6,414 - 20 - 18 - 1	9,657 - 15 - 13 - 7
Completed Surveys	692	340
Emails to TxDOT_NEVI@txdot.gov	192	842
Map - Comments	115	82
Map - Charging Location Suggestions	381	326
Texas EV Plan downloads	698	498
Pre-Recorded Virtual Public Meeting – Views	593	269
Written plan reviews from interested parties	32	8

[15] U.S. Department of Transportation. 2024. Fiscal Year 2024 EV Infrastructure Deployment Plans. https://www.fhwa.dot.gov/environment/nevi/ev_deployment_plans/.

Pennsylvania – *Creating a one-stop-shop for customer EV education.* Electric utility First Energy proposed an [EV pilot program] to educate customers about EVs, provide incentives for charging, and ultimately drive EV adoption in the state. The awareness and education portion of the pilot includes:

- Expansion and maintenance of an online EV education platform (Figure 2-4) that allows customers to compare EV models, research incentives and rebates, and learn about charging options
- A grant assistance program that provides support in the form of grant writing, submission, and post-award reporting services for local governments, schools, transportation authorities, and nonprofit organizations seeking federal funding
- A fleet advisory program that provides feasibility studies, business case and cost-effectiveness analyses, risk mitigation, and procurement services to commercial and municipal fleet owners seeking to go electric
- A dealership toolkit program that funds informational kiosks at dealerships so buyers have access to information on EV purchasing, maintenance, charging, rebates and incentives, and utility rates at their fingertips[16]

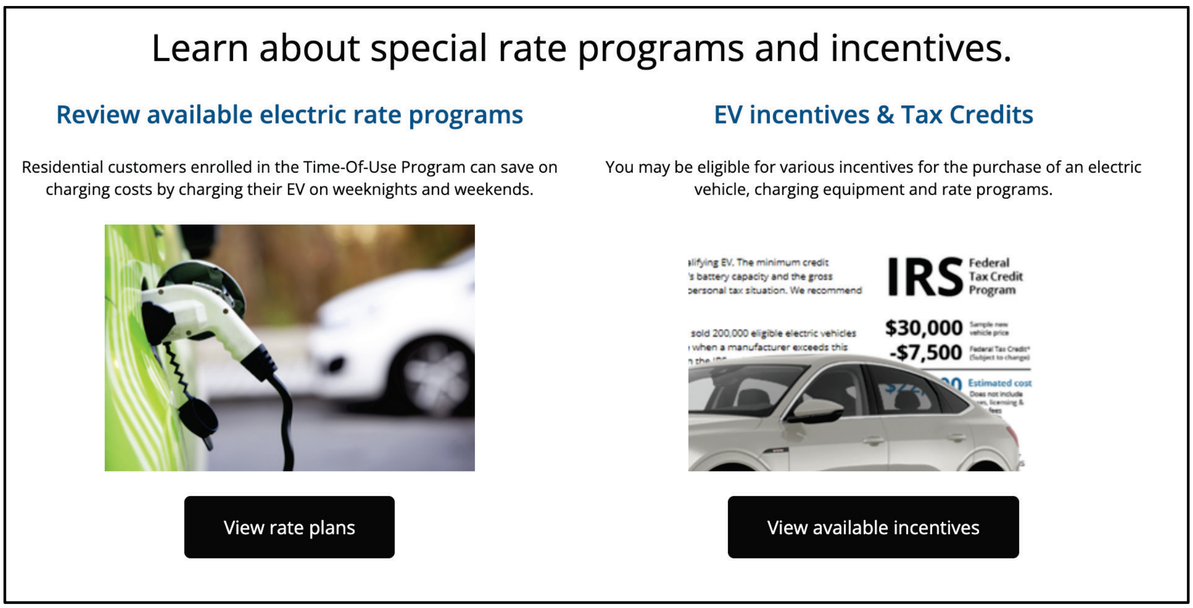

Figure 2-4. A Snapshot of FirstEnergy Pennsylvania's Met-Ed Operating Company's Online EV Education Platform

The utility cites customer benefits including increasing access to newer and cleaner transportation options, reducing tailpipe emissions, and expanding public charging infrastructure.[17] The company included the program in its 2024 application for approval of proposed rate increases.

[16] FirstEnergy Pennsylvania Electric Company. 2024, *2024 Base Rate Case Filing, Volume III of V.* Docket No. R-2024-3047068. https://www.puc.pa.gov/pcdocs/1822988.pdf#page=905#. Additional filings and information can be found in Docket no. R-2024-3047068, at https://www.puc.pa.gov/docket/R-2024-3047068.
[17] FirstEnergy Pennsylvania Electric Company, 2024, *2024 Base Rate Case Filing, Volume III of V.* Docket No. R-2024-3047068. https://www.puc.pa.gov/pcdocs/1822988.pdf#page=905#.

2.2 Grants, Financing, and Technical Assistance

State agencies may provide or authorize programs that help customers or entities finance EV or EV charging equipment purchases, installation, and maintenance. Grants and funding also can help innovative technologies and companies reach commercialization, contributing to economic growth and competitiveness in the state. Reducing the upfront cost or providing creative financing opportunities lowers barriers to TE deployment. State incentives can be braided with federal funds, such as the National Electric Vehicle Infrastructure Formula Program and the Charging and Fueling Infrastructure Discretionary Grant program.[18] States also can provide technical assistance in areas such as grant writing and program design to enable more diverse entities to take advantage of funding opportunities, which can increase innovation and opportunity in the state.

Tennessee – *Providing assistance for grant applicants*. The Tennessee Department of Environment and Conservation is using Volkswagen settlement funds to help school districts replace their buses with electric school buses. The Department offers no-cost assistance to applicants and held open office hours to help them take advantage of the program. The program awarded 35 recipients in 2024 that will result in 134 school bus replacements, 70% in localities with poor air quality and almost 30% in counties that are among the most economically distressed in the country.

Pennsylvania – *Funding alternative fuel and vehicle investments.* The Pennsylvania Department of Environment Protection offers multiple competitive grants to residents, businesses, schools, and nonprofits to support TE and other alternative fuels initiatives. One of the programs, called the Alternative Fuels Incentive Grant Program, is funded through a legislatively authorized tax on utility electric energy sales and has been in place for over 30 years. The program funds vehicle retrofits and purchase of alternative fuel vehicles, refueling infrastructure, and research, training, development and demonstration of alternative transportation fuels and vehicles.[19] Alternative fuels include electricity, hydrogen, advanced biofuels, and others. While most awards are for purchasing alternative fuel vehicles or installing fueling stations, the Department has awarded a few entities with funding for innovative technology projects, such as for advanced renewable natural gas demonstrations.[20]

The Driving PA Forward Grant, funded through Pennsylvania's Volkswagen settlement allocation, primarily aims to reduce nitrogen oxide emissions from mobile sources to improve air quality and reduce negative health impacts from pollution. The grant program has funded more than 1,100 projects total through a variety of activities (Figure 2-5).

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[18] See Bennett, R., 2024, *National Electric Vehicle Infrastructure Formula Program (NEVI) Brief for State Public Utility Commissions*. National Association of Utility Regulatory Commissioners.

[19] Pennsylvania Department of Environmental Protection (2024).

[20] For example, see the Lego V LLP Non-Pipeline Renewable Compressed Natural Gas Virtual Transportation Project in Pennsylvania Department of Environmental Protection (2022).

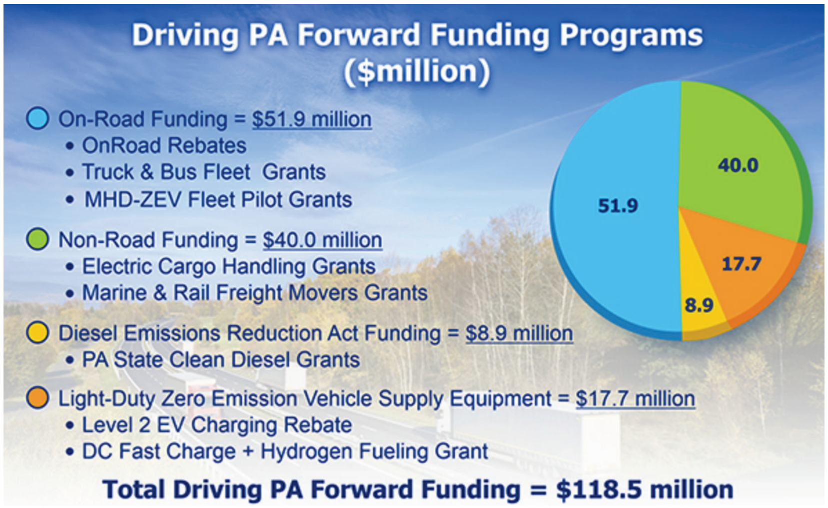

Figure 2-5. Driving PA Forward Grant Funding Allocation[21]

As one example, the program funded the diesel truck replacement project for the Rail Management Services company. By replacing five diesel semi-tractors with electric equipment to move containerized cargo, the project will reduce nitrogen oxide emissions by almost 74 tons over the life of the project and will avoid the use of approximately 50,000 gallons of diesel fuel annually. The project also reduces other pollutants like $PM_{2.5}$ and carbon monoxide and results in cost savings for the company.[22]

2.3 EV Rate Design and Infrastructure

While the purchase price of EVs typically is higher than for internal combustion engine vehicles, they are attractive to customers because they have lower maintenance costs, and electricity is often a cheaper fuel than gasoline.[23] In addition, some consumers want to reduce their carbon footprint for transportation.

Many utilities and states have identified EV adoption as a major driver of electricity load growth in the coming years. Utilities can propose, and regulators can approve, EV rate design aligned with the costs and benefits of EV charging. For example, rate design can encourage drivers to charge vehicles at times when clean energy is abundant, such as during the middle of the day when solar energy production is abundant, and at times when electricity demand is lower such as overnight. Many states are taking a close look at EV rate design to ensure that rates appropriately balance multiple objectives, including accurately reflecting cost drivers, promoting EV adoption, facilitating EV-grid integration and off-peak charging, and promoting customer understanding of the rates.[24]

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[21] MHD - medium- and heavy-duty; ZEV - zero emission vehicle.
[22] Pennsylvania Department of Environmental Protection Newsroom (2022).
[23] U.S. Department of Energy Alternative Fuels Data Center (n.d.).
[24] See Cappers, P., and A. Satchwell, 2022, EV Retail Rate Design 101; Cappers, P. et al., 2023, A Snapshot of EV-Specific Rate Designs Among U.S. Investor-Owned Electric Utilities.

States also can adopt legislation and regulatory guidance to facilitate EV adoption and charging infrastructure by utilities and third parties.

Arizona – *The wheels on the bus go electric.* SB 1246 (2022) allows school districts to contract with third parties to provide charging infrastructure and management services for electric school bus programs. In addition, the Arizona Corporation Commission directed the investor-owned electric utilities file to transportation electrification implementation plans every three years for review and approval.

Indiana – *Legislation to support EV rates and infrastructure.* HB 2022 (2020) authorized the regulatory commission to approve per-kWh pricing for retail EV charging. In addition, the bill authorized utilities to submit applications to the commission to set up public-use EV pilot programs. Utilities can install, own, or operate charging infrastructure or make-ready infrastructure to support public use EVs, and provide incentives or rebates to customers to encourage their investment in EVs and associated EV supply equipment.

Louisiana – *Promoting EV charging infrastructure and competition.* SB 460 (2022) directs the PSC to drive the expansion of EV charging infrastructure and establish a rate structure that encourages EV charging competition. The bill calls for transparent pricing, more stable electricity costs, expanded investment opportunities in charging infrastructure, innovation, and widespread implementation of publicly available fast charging, charging technology and equipment.

Pennsylvania – *Setting long-term policy for electric transportation.* The state is preparing for an "impending sea change" in the transportation sector and is considering how rates can support effective and equitable use of the distribution grid for all customers.[25] A coalition of stakeholders interested in EV promotion petitioned the PUC to adopt a policy statement on EV rate design. One hundred and six people participated in a working group on this issue, resulting in a report to the PUC with a number of recommendations based around themes identified by participants (Figure 2-6). The PUC issued a proposed policy statement on EV rate design in a proceeding to inform its content.

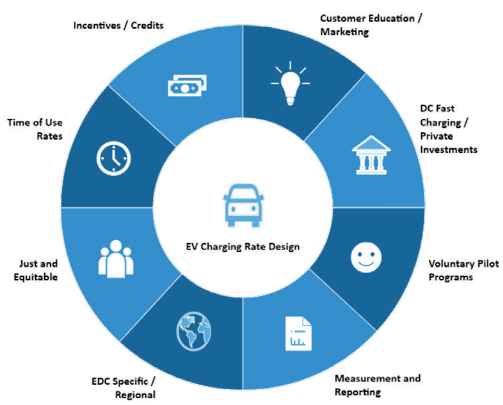

Figure 2-6. EV Charging Rate Design Issues Identified by Pennsylvania Rate Design Working Group

25 Pennsylvania Public Utilities Commission (2023).

2.4 Technology and Manufacturing

Vehicles and the automotive industry contribute to many states' economies. Even in states where auto manufacturing is more limited, vehicles and transportation are critical for moving goods and services around the state and connecting people to jobs and community services. The automotive industry is poised for technological innovation with growing sales of electric, connected (vehicles that can communicate with one another or with other infrastructure—see Figure 2-7), and autonomous vehicles and as vehicle technologies become more sophisticated. Some states are working to become leaders in this field, as the following examples illustrate.

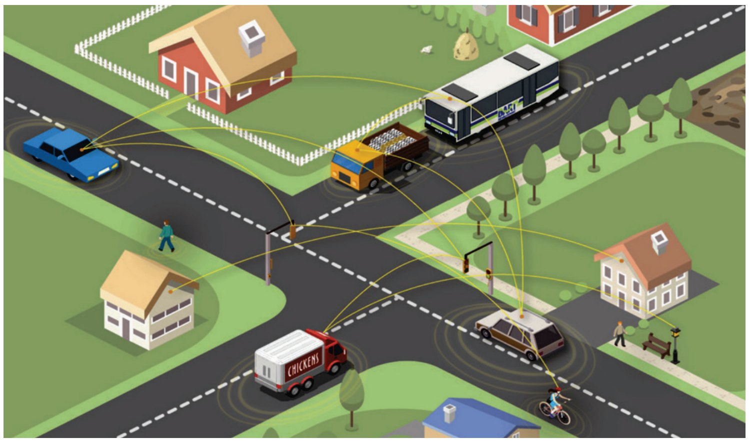

Figure 2-7. Delaware Department of Transportation's Representation of Connected Vehicles

Ohio – *Advancing innovation in the transportation sector.* In 2019, Governor Mike DeWine issued EO 2019-26D to promote smart mobility solutions in the state. The order recognizes the importance of the transportation sector and industry as part of the state's history and economy. It memorializes DriveOhio as a statewide center to promote Safety, Mobility, Access, Reliability, and Talent (SMART) pillars in the transportation sector. In particular, DriveOhio is tasked with building connections across stakeholders, recommending technology and financing solutions to meet state transportation objectives, supporting industry and innovation in the mobility sector, and ultimately improving transportation safety across the state.

DriveOhio programs are focused on advanced mobility, automated and connected vehicles, and EVs. Under the EV umbrella, DriveOhio offers resources to support entities in receiving funding for EV charging infrastructure, deploys EV charging to support equitable access and economic development, and supports planning studies, such as a study that identifies actions needed to help truck freight transition to an electric future (Figure 2-8).

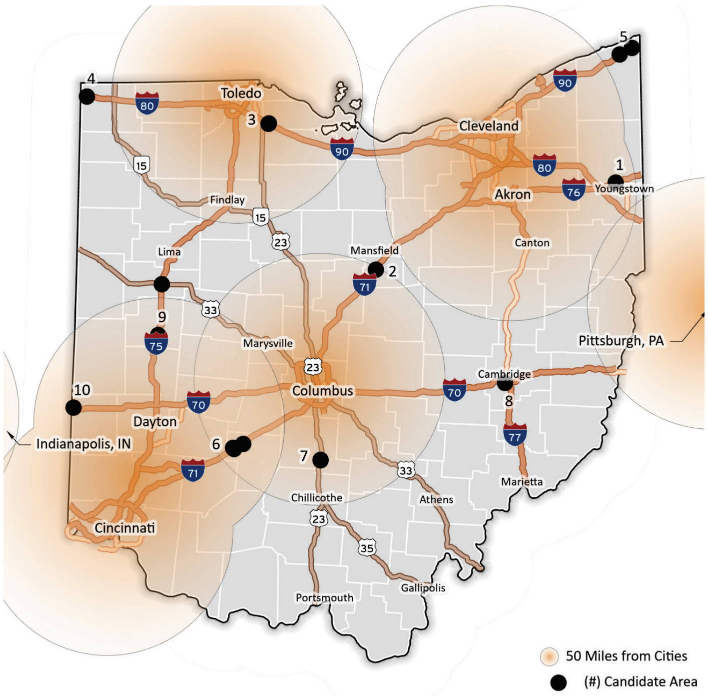

Figure 2-8 Candidate EV Truck Charging Sites Identified in DriveOhio's Freight Electrification Study

The state's focus on the transportation sector in service of economic growth, improved safety, and innovation is intended to reduce carbon emissions by shifting transportation fuel to electricity over time and improving transportation efficiency.

Delaware – *Laying a foundation for the connected transportation system of the future.* Delaware's EO 14 (2017) states that "connected and autonomous vehicles … have the potential to radically transform how the world works, plays, and lives." Building on a culture of innovation, the state established an Advisory Council on Connected and Autonomous Vehicles to guide development of the technology. The Department of Transportation hosted meetings of the Advisory Council and issued a final report that includes recommendations in four key areas: economic development, technological security and privacy, transportation network infrastructure, and impacts on safety.

The Advisory Council identified roadway maintenance and supportive technology as major factors in supporting connected and autonomous vehicles, which rely on clear markings, functioning traffic signals, and strong telecommunications systems. Delaware has a state-owned telecommunications system that connects with its Integrated Transportation Management System, which is the backbone of the state's data collection and technological progress in the transportation sector. The Department of Transportation was awarded a federal grant to deploy artificial intelligence within this system.[26] Such data collection and machine learning can support public awareness of real-time traffic conditions, reduce accidents, lower energy consumption and air emissions, and improve travel times.[27]

[26] Delaware Department of Transportation (n.d.).
[27] State of Delaware (2018).

2.5 Other Programs and Initiatives

Some states are working to maximize the benefits of EVs and get ahead of the technology curve by developing strategies to support the EV industry and grid integration technologies and programs like demand response and vehicle-to-grid initiatives. Examples include:

Georgia. *Attracting new investments and supporting existing automotive industry through the transition to EVs.* In 2021, Governor Kemp announced a statewide initiative to strengthen the state's position as a national leader in the electric mobility industry. An Electric Mobility and Innovation Alliance identified 10 opportunities to help Georgia become a national leader in e-mobility and offered policy recommendations to further enhance the state's attractiveness to the industry and foster innovation in related fields such as drones, autonomous vehicles, connected vehicles, and battery technology.

Ohio. *EV rebates for demand response capability.* AES Ohio launched a $5.1M EV supply equipment rebate program designed to spur customer investment in Level 2 and DC fast-charging infrastructure. The PUC approved the rebate program as part of a Stipulation for the utility's Smart Grid Phase I Plan. To be eligible for the rebate, EV chargers must be capable of being actively curtailed during peak demand periods.

Utah. *EV charging that responds to grid needs.* The PSC approved Rocky Mountain Power's EV demand response pilot, launched on January 1, 2024. EV owners in the utility's service territory that enroll in the program receive financial incentives when they participate in utility-initiated demand response events. The events last 5–15 minutes and are designed to allow Rocky Mountain Power to respond to real-time grid conditions. Following data collection throughout the 3-year pilot period, the utility plans to file for approval of a permanent program.

3. Using Local Energy Resources

State policies can encourage the use of local energy resources that reduce air pollution, like solar, wind, and hydropower. Development of these resources can foster numerous benefits, including energy independence, economic development, job creation, resilience, and reduction in carbon emissions and other pollutants.

This chapter provides examples of how states can advance the development and use of local energy resources while reducing carbon emissions in the following areas:

- Renewable energy goals and standards
- Building energy codes
- Utility-owned or purchased renewable energy
- Programs and tariffs
- Funding for in-state projects
- Studies, demonstration projects, education, and outreach

3.1 Renewable Energy Goals and Standards

Many states foster the development of local resources by mandating that a certain percentage of the energy sold in the state is sourced from clean or renewable resources. Roughly half of the growth in renewable energy since 2000 can be attributed to state renewable energy requirements.[28] Table 3-1 shows the standards for renewable energy implemented by the states considered in this report, by percentage of retail electricity sales or capacity.

Table 3-1. State Renewable Energy Standards[29]

State	Standard
Arizona	15% by 2025
Delaware	40% by 2036
Indiana	10% by 2025 (voluntary)
Iowa	105 MW of generating capacity (legacy RPS)
Missouri	15% by 2021
Ohio	8.5% by 2026
Pennsylvania	18% by 2020–21
South Carolina	2% by 2021 (voluntary)
Texas	10,000 MW by 2025
Utah	20% by 2025 (voluntary)

[28] National Conference of State Legislatures. 2021. State Renewable Portfolio Standards and Goals.
[29] Berkeley Lab. 2024. Renewables Portfolio Standards Resources; DSIRE database.

In addition to state-level goals, cities have implemented their own renewable energy goals. For example, the mayor of Louisville, **Kentucky,** issued an executive order in 2022 announcing a recommitment to previous city goals of 100% renewable electricity for government operations by 2030, 100% clean energy for all government operations by 2035, and 100% clean energy community-wide energy by 2040.

In New Orleans, **Louisiana**, the city council regulates the local investor-owned utility, Entergy New Orleans, instead of the Louisiana PSC. In 2021, the council passed the Renewable and Clean Portfolio Standard, which requires the utility to achieve a portfolio of 100% clean energy by 2050. The policy emphasizes the use of local solar and energy efficiency as primary means to reach the energy goal, as well as the need for better transmission and distribution infrastructure for renewable energy sources. In addition, the state's Priority Climate Action Plan identifies several goals for renewable energy, including offshore wind and community solar.

3.2 Building Energy Codes

By considering local energy resources in building codes and permitting processes, local leaders can lower barriers to adoption. According to the National Renewable Energy Laboratory, the soft costs of solar—which includes everything except the physical hardware—can make up more than half of the costs of residential solar systems, so efforts to reduce these costs can make adoption more affordable and accessible.[30]

The following states have taken action to facilitate the adoption of local energy resources in building codes and permitting processes.

Arizona – *Automating the permitting process.* Arizona HB 2373 (2023) allows municipalities in the state to use a qualified automated permitting platform to verify code compliance for solar projects on residential properties.

Delaware – *Requiring space for solar.* House Bill 11 (2023) requires solar-ready zones for roofs of new commercial buildings with a foundation footprint of 50,000 square feet or larger. In addition, Delmarva Power requires all inverters that connect to its distribution system to be compliant with IEEE Standard 1547-2018 for advanced inverters, which facilitates the integration of DERs, including renewable

30 Ramasamy et al. (2023).

energy, on its distribution system. The standard ensures that new technologies can connect to the grid in a manner that supports grid stability.

Florida – *Expanding compliance pathways.* In 2017, the legislature enacted HB 1021 authorizing solar energy systems manufactured or sold in the state to be certified by professional engineers, providing another pathway for compliance with state standards.

Texas – *Publicly developing interconnection requirements*. Through the spring and summer of 2023, the Public Utility Commission of Texas (PUCT) facilitated public workshops and developed draft language to update DER interconnection requirements in the Electric Reliability Council of Texas (ERCOT) region.

3.3 Utility-Owned or Purchased Renewable Energy

Utility-provided renewable energy is a major avenue for development of local resources, typically as an outcome of utility integrated resource plan (IRP) processes. PUCs can influence the pace and scale of renewable resources that utilities build or acquire. The following states are among those advancing the development of local energy resources through these and related processes.

Florida – *Accelerating solar resources.* In 2017, the PSC approved Duke Energy Florida's 2017 revised settlement agreement. The agreement authorized the utility to invest over $1 billion to construct and acquire 700 megawatts (MW) of solar power facilities between 2017 and 2021, accelerating the company's previous 10-year solar installation plan. It also approved the utility's proposal to begin construction of a 74.9 MW solar power plant to be located in Hamilton County, Florida, in 2018.

The PSC approved utility-scale solar projects for other utilities as well. For example, the agency authorized Tampa Electric to develop 140 MW of solar and Florida Power & Light to build twenty solar facilities totaling 1,460 MW.

In 2022, the PSC approved updated rate adjustments for Florida Power & Light and Duke Energy Florida based on the impact of production tax credits established by the federal IRA. The tax credits resulted in reductions in revenue requirements that totaled more than $100 million dollars in 2022 and 2023.

Georgia – *Increasing procurement of renewable energy.* When the PSC approved Georgia Power's 2019 IRP, PSC Chairman McDonald made a motion to increase the company's solar energy procurement to 2,210 MW, the largest increase in renewable energy in the state's history. The five-member Commission voted unanimously in favor of the motion. The procurement includes both utility-scale and distributed generation solar systems.

Approval of the Georgia Power 2022 IRP continued the agency's support of solar, adding a total of 2.3 gigawatts (GW) of renewable resources to be installed between 2026 and 2029, the largest solar capacity addition ever approved in an IRP cycle in Georgia. The Commission also approved increased levels of energy storage. In addition to the 265 MW McGrau Ford battery energy storage system, the

Commission voted 4 to 1 to require a competitive request for proposals (RFP) for an additional 500 MW of energy storage, which will be operated by Georgia Power.

Louisiana – *Planning for renewable resources*. The PSC approved Entergy Louisiana's updated 2023 IRP, which includes the addition of 9.3 GW of renewable capacity and 450 MW of battery energy storage over the 20-year planning horizon. The following year, the PSC approved Cleco's IRP, which included buildouts of 740 MW of utility-owned solar and 150 MW of battery storage.

Missouri – *Mandating investment in local energy resources.* The state legislature passed SB 564 in 2018, including authorization of $8.4 billion in grid infrastructure spending over 10 years and requiring investments in utility-scale solar and other technologies. The legislation required regulated utilities to invest in utility-scale solar in the state or in adjacent states, requiring between $3.5 million and $14 million in investments by 2023, varying by utility size.

South Carolina – *Replacing coal with solar.* Duke Energy Progress and Duke Energy Carolinas filed a combined "Carolinas Resource Plan" in 2023 for North and South Carolina. The IRP requested approval of a portfolio that includes the retirement and replacement of coal plants and the addition of 6,000 MW of solar by 2031, as well as near term activities associated with onshore wind and batteries.

3.4 Programs and Tariffs

Programs and tariffs can support the development of local energy resources by providing structured compensation mechanisms for customers who install systems on site or community solar programs.

Arizona – *Community solar and storage.* The state Corporation Commission filed an amendment for the 2022 Renewable Energy Standard Implementation Plan for Arizona Public Service to create a community solar program. As a result, the utility created a community solar pilot program that enabled approximately 20,000 low- to moderate-income customers to participate. In 2023, the Commission issued a policy statement on community solar plus storage, reserving half of the projects for low- to moderate-income customers and the remaining half for nonprofit organizations, schools, municipalities, and small commercial customers.

The state also has voluntary green power tariffs for large customers (≥10 MW), such as Arizona Public Service's Alternative Generation Program.

Delaware – *Community solar for low- to moderate-income.* The state's Community Solar Law requires a portion of all community solar projects to serve low- and middle-income households. The law also eliminates other barriers to these projects, such as limitations on ownership, management, and contract models.

Florida – *Providing compensation for owner-installed and community programs.* HB 7135 (2008) established the state's net metering program, compensating distributed generation systems such as solar, geothermal, wind, biomass, ocean, hydrogen, waste heat, and hydroelectric power up to 2 MW. Subsequently, utilities in the state have established a variety of programs for customers.

- In 2020, the PSC approved Florida Power & Light's petition for approval of its $1.79 billion SolarTogether program, a voluntary community solar program to allow customers to subscribe to a portion of solar capacity built through the program and receive a credit for a portion of the system savings produced by that capacity. Customers have the option to subscribe to kilowatts of solar capacity from solar facilities built for the program (1,490 MW total). Participating customers' monthly bills include the cost of their subscribed capacity, as well as credits that reflect the system savings generated by their subscribed capacity. Florida Power & Light allocated 10% of the residential capacity, or 37.5 MW, to low-income customers. The program allocates 55% of benefits to participants and 45% to the general body of customers. The utility estimated that Phase 1 of the program will save $249 million.
- In 2021, the PSC approved Duke Energy Florida's application for a new voluntary Clean Energy Connection program and tariff. The voluntary community solar program allows customers to pay a subscription fee in exchange for receiving bill credits related to generation produced by the program's solar facilities. The utility is building 750 MW of solar generation, comprised of 74.9 MW projects with in-service dates between 2023 and 2025. The utility estimated the present value revenue requirement of the projects at $533 million, with an objective to displace higher-cost fossil-fuel generation. Low-income customers receive fixed credits to offset their participation costs.
- Also in 2021, the PSC approved a 1,788 MW expansion of the SolarTogether subscriber program. The settlement also included a smart panel pilot, solar power facilities pilot program (Commercial and Industrial [C&I] solar siting program), pilot asset optimization program, green hydrogen project, and "the world's largest" 409 MW solar-power battery storage system at Manatee Energy Storage Center.
- In 2023, the PSC approved Duke Energy Florida's petition to establish its Clean Energy Impact Program, which provides customers an option to buy Renewable Energy Credits (RECs) from Duke-owned renewable energy facilities. The utility's petition noted that the renewable attributes of 13 of its current solar facilities were not currently being utilized or sold, and that such an option would create value for future renewable generation.

Georgia – *Renewable energy options for large customers.* In 2017, the PSC approved Georgia Power's application for a C&I Renewable Energy Development Initiative program. The program provides additional renewable options for C&I customers, enabling customers to purchase a subscription for a portion of the production of a portfolio of up to 200 MW of additional renewable facilities procured through the utility-scale RFP process.

Iowa – *Net metering and community options for solar and wind.* Senate File (SF) 583 (2020) codified net metering rules until 2027, or until the aggregate nameplate capacity of distributed generation in the state reaches 5% of aggregate peak demand of all electric utilities in the state. Net metering was first integrated into Iowa Code § 476.41 in 1984. In 2017, utilities initiated "net billing"[31] pilot programs. Before 2027, utilities can file (and have filed) "inflow-outflow tariffs"[32] provided that the compensation rate for outflow credits is 1:1, or identical to the net metering rate. When one of the two benchmarks of SF 583 is reached, the Iowa Utilities Board will be required to implement rules referred to in the bill and develop new methodologies for DER compensation.

In 2018, the Iowa Utilities Board approved Interstate Power and Light Company's proposed Beyond Solar program and tariff, which offers customers a subscription to support electricity generated by in-state solar and wind facilities owned by the utility. The program provides residential, commercial, and industrial customers a community renewable energy option. Customers can make fixed contributions and select one of three support levels, measured in 1-kW block increments, or support solar energy at participation levels of 25%, 50%, or 100%. Beyond Solar pricing consists of a monthly charge based on the cost of the renewable energy sources and administrative costs, plus a monthly credit for the avoided cost of energy plus a capacity credit for the renewable energy sources.

Louisiana – *Voluntary tariff for solar energy.* In 2021, Entergy Louisiana filed a petition for approval of its Solar Portfolio, the Geaux Green Option (Rider GGO), Cost Recovery and Related Relief. Rider GGO is a voluntary rate schedule that allows customers to subscribe to a portion of the Solar Portfolio (and potentially to other future resources) and receive value from renewable energy and associated RECs.

Missouri – *A full menu of tariffs and incentives.* In 2022, Missouri Governor Parson signed SB 745 addressing solar compensation and taxation, utility accounting, and power plant retirement. The legislation established a sales tax exemption for solar energy equipment so long as the purchased systems and supplies are sold or leased to an end user, or used to produce, collect, and transmit electricity for resale or retail.

In 2007, the Missouri General Assembly enacted the Net Metering and Easy Connection Act, amending the state's rules (386.890 R.S. Mo. and 4 CSR 240-20.065) to establish a net metering compensation structure for distributed energy. The rule applies to renewable generation resources including wind energy, solar-thermal energy, hydroelectric energy, photovoltaics (PV), and hydrogen fuel cells up to 100 kW, and prevents utilities from charging an interconnection fee. Net metering is eligible until net metered resources comprise 5% of the utility's peak load.

SB 564 (2018) requires Missouri utilities to allocate between \$7 million and \$28 million in solar rebates by 2023 depending on utility size, for residential systems ≥25 kW and nonresidential systems ≥150 kW.

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31 "Unlike net energy metering, banking of kilowatt-hours within a billing cycle to offset future consumption is not typically allowed with net billing. Additionally, credits are not granted in kilowatt-hour terms, but rather all net energy exports are metered and credited at a predetermined sell rate—often reflecting the utility's avoided cost rate...." National Renewable Energy Laboratory, n.d.

32 Under inflow-outflow tariffs, the distributed generation customer pays all applicable charges, including approved riders, for electricity the utility delivers to the customer. The customer receives a credit in dollars for energy exported to the utility during the billing period. The customer may use the dollar credits to offset any applicable volumetric charges billed on a kilowatt-hour basis in future billing periods. Iowa Utilities Board, n.d.

In 2023, the PSC approved Ameren Missouri's request to create a subscription-based Renewable Solutions program. The program allows commercial, industrial, and governmental customers to subscribe to varying levels of renewable energy. The PUC also required Evergy to initiate a stakeholder engagement process related to its proposed Rate Modernization Plan. The company's plan includes a low-income and general solar subscription pilot and rider, a residential battery energy storage pilot, and a green pricing (REC-based) program.

South Carolina – *Utility and community programs.* The state's Distributed Energy Resource Program Act (Act 236, 2014) permitted utilities to apply for Commission approval to participate in a DER program. Pursuant to this Act, Duke Energy's Shared Solar Program offers access to the benefits of solar through a community solar program. Participants can choose the level of their subscription, limited to each participant's historical demand (and capped at 500 kW for nonresidential participants). In exchange for the monthly subscription fee, the participant receives a monthly energy bill credit equal to that participant's pro rata share of actual generation output produced by the shared solar facility.

The state's Energy Freedom Act (Act 62, 2019) created a variety of renewable energy programs including net metering, community solar, and voluntary renewable energy programs administered by the utilities.

In 2021, the PSC approved a time-varying net metering tariff intended to align Duke customers' bills more closely with the costs and savings realized by the utility. Customers with rooftop solar continue to receive 1-to-1 credits for surplus electricity, but the rates they pay—and receive—vary by time of day. When solar power is abundant, customers will receive a smaller credit but also pay less for any electricity they use. Credits are higher during periods of peak demand.

Tennessee – *Facilitating residential solar and storage procurement.* The Tennessee Valley Authority's (TVA) Green Connect program aims to streamline residential customers' procurement, installation, and interconnection of solar or solar plus battery resources. While the program does not offer financial incentives for procurement or installation itself, it connects customers to verified installers, provides educational resources, and offers a TVA-facilitated interconnection application.

Texas – *Providing a voluntary renewable energy option.* Entergy's 2022-24 rate case included a proposal for a new Green Future Option (GFO) to allow customers to access utility-scale renewable resources and take advantage of economies of scale of such projects to satisfy their sustainability objectives. In exchange for a fixed monthly payment corresponding to a certain portion of the capacity of a resource, customers receive energy credits based on market conditions and the ability to claim any associated RECs that Entergy will retire on their behalf. The tariff was developed in response to interest from customers, including larger customers seeking more renewable options to help meet corporate sustainability goals.

Utah – *Enabling community-wide renewable energy.* Utah's Community Renewable Program (HB 411, 2019) allows communities served by electric corporations with more than 200,000 retail customers in the state to jointly choose a 100% renewables program in lieu of service from the utility. Of the 23 eligible communities, 18 communities signed up with the Community Renewable Energy Agency. Individual customers in those communities can opt out of the program by a specified date.

Tariffs (Schedule 32, Schedule 34) enable Rocky Mountain Power to supply electric service from renewable energy facilities owned or contractually tied to large customers.

3.5 Funding for In-State Projects

Financial incentives can encourage development of in-state renewable energy projects, both utility-scale and distributed. Common mechanisms include tax credits, grants, loans, loan guarantees, and rebates for rooftop solar.

Iowa – *Tax credits for solar across sectors.* In 2012, the Department of Revenue established tax credits for installation of personal and corporate solar energy systems. Credits total $5 million annually, including a $1 million carveout for residential customers. Individual credits are calculated as 50% of applicable federal investment tax credits, not exceeding $20,000 for commercial and $5,000 for residential projects.[33]

Pennsylvania – *Financing for clean energy.* The Pennsylvania Energy Development Authority finances clean, advanced energy projects through grants, loans, and loan guarantees. Eligible projects include solar, wind, low-impact hydropower, geothermal, biomass, landfill gas, fuel cells, integrated gasification combined cycle, waste coal, coal-mine methane, and demand management measures. In addition, the state's Economic Development Financing Authority offers tax-exempt and taxable bond financing.

Tennessee – *A variety of financing programs.* As discussed in the Energy Affordability chapter (Chapter 5), the state offers several programs to help finance renewable energy projects through loans and grants.

[33] The tax credits are no longer available.

3.6 Studies, Demonstration Projects, Education, and Outreach

Following are other mechanisms that states have used to develop local energy resources.

Delaware – *Exploring offshore wind development.* Governor Carney's EO 13 (2017) established an Offshore Wind Working Group to study how the state can participate in developing offshore wind, leverage related economic opportunities, and make recommendations for engaging in development of offshore wind.

Indiana – *Informing local decision-makers.* The Office of Energy Development's Good Questions program provides information to local decision-makers on the impacts and benefits of utility-scale wind and solar.

Missouri – *Facilitating beneficial pilot projects.* SB 564 allows the PSC to approve investments in a small scale or pilot project if it is designed to advance knowledge of innovative technologies or technologies that create benefits and savings.

Pennsylvania – *Exploring geothermal resources.* HR 185 (2023) directs the Joint State Government Commission to conduct a study on the feasibility of using geothermal energy technologies that use abandoned mining locations and operations in the state and issue a report on its findings and recommendations to the House of Representatives.

Texas – *Advancing building design.* The Energy Conservation Office's Innovative Energy Demonstration Program promotes use of renewable energy and sustainable building design.

4. Economic Development

States prioritize economic development to improve the quality of life for residents through increased private investment, innovation, and job growth.[34] Policies that promote economic development can be designed to reduce air emissions. For example, jobs and retraining programs can shift activity from carbon-intensive sectors to clean energy industries and manufacturing, requirements for hiring in-state contractors can attract businesses that prioritize clean energy deployment (e.g., by deploying solar onsite or buying renewable energy from the utility or a third party), and tax policies can promote specific types of technologies or businesses. The state's economic landscape, policy priorities, and natural resources drive its unique economic development priorities. Aligning economic development with state energy planning can help guide policies and programs to achieve multiple objectives.[35]

This chapter offers insights into how states can reduce carbon emissions while conducting the following economic development activities:

- Planning
- Grants and development assistance
- Workforce development
- Considering economic development in utility regulation
- Other industry support

4.1 Planning

States create overarching or issue-specific economic development plans to guide implementation strategies to promote growth and improve the quality of life for residents. Planning processes and resulting plans are an important foundation to bring together diverse stakeholders and establish common understanding of the current economic landscape, economic development goals, capacity building gaps and needs, and stakeholder roles to achieve state objectives. Collaboration through stakeholder engagement also can improve implementation efficiency.

Plans may include assessment of baseline conditions, a strategic direction, and an action plan informed by an analysis of the state's strengths, weaknesses, and opportunities. Plans also may include a framework for evaluating the implementing organization's performance toward identified metrics.[36]

Kentucky – *Setting a statewide vision for energy and economic development.* In 2021, Kentucky Governor Andy Beshear released KYE3: Designs for a Resilient Economy with the state's Energy and Environment Cabinet. Described as "an energy strategy wrapped in economic development," it addresses energy, environment, and economic development as "inextricably linked"[37] (Figure 4-1).

[34] See "Economic Development" at https://www.eda.gov/about/economic-development-glossary.
[35] For example, see National Association of State Energy Officials (2022), *Trends and Highlights from Recent Comprehensive State Energy Plans*.
[36] See U.S. Economic Development Agency, (2023) *Comprehensive Economic Development Strategy*.
[37] Kentucky Energy and Environment Cabinet (2021a).

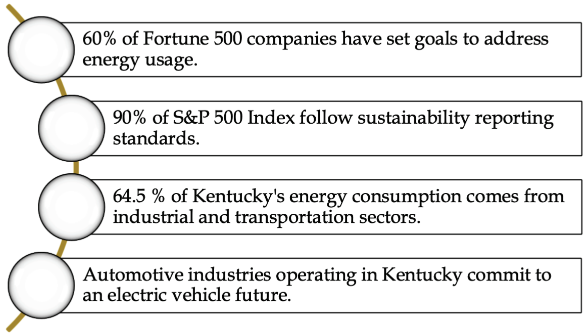

Figure 4-1. Foundational Economic Development Linkages to Energy in Kentucky[38]

Following the KYE3 report, a Nuclear Energy Development Working Group identified low energy prices as a primary competitive advantage for the state, where manufacturing, vehicle and battery production, and healthcare and metals industries are expanding.[39] Businesses require reliable energy sources and are increasingly demanding carbon-free power to meet corporate sustainability goals. The state identified a number of key energy strategies for economic development (Table 4-1). The plan emphasizes the importance of communities and their ability to leverage federal funds for resilience. The strategy does not create specific targets or performance metrics, instead emphasizing flexibility and ability of communities to adapt activities to their needs and preferences. To date, plan implementation has focused on hydrogen and advanced nuclear development.[40]

[38] Kentucky Energy and Environment Cabinet (2021b), 9.
[39] Kentucky Office of Energy Policy (2023).
[40] See Team Kentucky. 2022. E3 Activities, News, and Events. https://eec.ky.gov/Energy/Pages/E3-Activities,-News,-and-Events.aspx.

Table 4-1. Example Energy Strategies for Economic Development in Kentucky

Strategy Area	Example Activities
Manufacturing	• Meet new energy supply chain needs for existing manufacturers • Attract opportunities for transitioning from coal to advance carbon products • Recruit research and development and innovative industrial facilities • Develop carbon capture utilization and sequestration activities • Increase big data processing capabilities
Fuels	• Create alternative fuel transportation corridors • Grow renewable gas and sustainable aviation fuels • Establish the state as a hydrogen hub for production, transportation, exports, and industrial uses
Infrastructure	• Create an electric distribution system that is self-healing, self-sufficient, and auto-sensing • Plan for electric transmission to support clean energy growth • Encourage resilient, grid-connected buildings • Grow infrastructure for capturing, transporting, and utilizing methane • Support a diversified, secure, sustainable, and resilient energy supply
Sustainable Workforce	• Conduct a workforce assessment • Develop pre-K through post-graduate pathways for a sustainable workforce • Provide rapid apprenticeships and certifications
Lead by Example	• Improve state government sustainability practices • Expand resilient funding opportunities • Increase fuel-diverse low- and zero-emission fleets • Improve access to data and transparency • Assess utility regulation modernization

Iowa – *Creating concrete strategies for improving strategic energy development.* The Iowa Economic Development Authority and the Department of Transportation issued a statewide Energy Plan in 2016. As Chair of the planning effort, Lieutenant Governor Kim Reynolds introduced the plan by recognizing the strategic importance of energy to the state's economy and economic development. Four major objectives of the plan relate to economic development and jobs, each associated with specific strategies (Table 4-2).

Table 4-2. Iowa Energy Plan: Economic Development and Energy Career Objectives and Strategies Assessment

		Environmental and Public Health Impacts				Economic Impacts				Energy System Impacts			
Objective	**Strategy**	**Air**	**Land**	**Water**	**Health**	**Jobs**	**Business Attraction**	**Energy and Technology Exports**	**Research and Development**	**Reduced Costs**	**Reliability**	**Affordability**	**Diversification**
Facilitate the development of diverse financing options for widespread adoption of energy efficiency and renewable energy practices and technologies.	1.1 Use Iowa's Qualified Energy Conservation Bond Allocation	--	--	--	--	∧	●	--	--	--	--	--	--
	1.2 Iowa Lease-Purchase Agreements	--	--	--	--	●	--	--	--	●	●	∧	●
	1.3 Solar Tax Credit Independence	∧	●	∧	∧	●	∧	--	--	●	●	●	●
	1.4 On-Bill Financing	∧	--	∧	∧	●	●	--	--	∧	●	●	●
	1.5 Energy Investment Partnerships/ Green Banks	∧	--	∧	--	--	∧	--	∧	--	--	--	--
Foster innovation and increase the commercialization and expansion of energy-related businesses and technologies.	2.1 Energy Storage Advancement	--	--	--	--	∧	∧	●	∧	∧	∧	∧	●
	2.2 Iowa Innovation Acceleration Fund Modifications	--	--	--	--	∧	∧	--	∧	--	--	--	--
	2.3 Increase Technical Assistance Funding for SBIR/STTR Outreach	--	--	--	--	∧	∧	--	∧	--	--	--	--
	2.4 Technology Platform Based Economic Development	--	--	--	--	∧	●	--	∧	--	--	--	--
	2.5 Business Accelerators and Small Business Support Centers	--	--	--	--	∧	∧	--	∧	--	--	--	--
Strengthen energy education and awareness throughout Iowa.	3.1 Energy Information Clearinghouse	--	--	--	--	∧	●	--	∧	--	--	--	--
Increase the local talent pool for energy-related careers while promoting employment and training opportunities in the energy sector.	4.1 Accelerate and Elevate Energy Sector Partnership Efforts	--	--	--	--	∧	●	●	●	--	--	--	--
	4.2 Build Robust Career Pathways to High-Demand Occupational Needs	∧	--	--	--	∧	●	●	●	--	--	--	--

∧ Positive direct impact
∨ Negative direct impact
-- Neutral impact
● Unknown impact

The plan includes detailed analysis on the state's existing energy workforce, research and development core competencies, and opportunities for economic development. For example, the report assessed the state's energy production and distribution value chain, historic research funding awards, and demand trends for energy-related occupations and skills.

4.2 Grants and Development Assistance

States that are focused on economic development may provide explicit support for new businesses and industries, communities, and innovation across policy priorities, including those that result in carbon reductions. This can take many forms, such as funding for early-stage companies, grant opportunities for community resilience projects, technical assistance for organizations applying for federal funding, and creating or supporting incubators to help innovative organizations mature.

Texas – *Funding early-stage companies to foster innovation.* A Texas State Energy Conservation Office program supports two Clean Energy Incubators, at the University of Texas at Austin and the Texas A&M Engineering Experiment Station. The primary purpose of the state's program is to create jobs by helping companies grow and develop.[41] The University of Texas incubator focuses on sustainability and is an "engine to growth and a stimulator to meaningful and proven economic development."[42] The incubator focuses on five key areas that can all lead to carbon reductions (Figure 4-2).

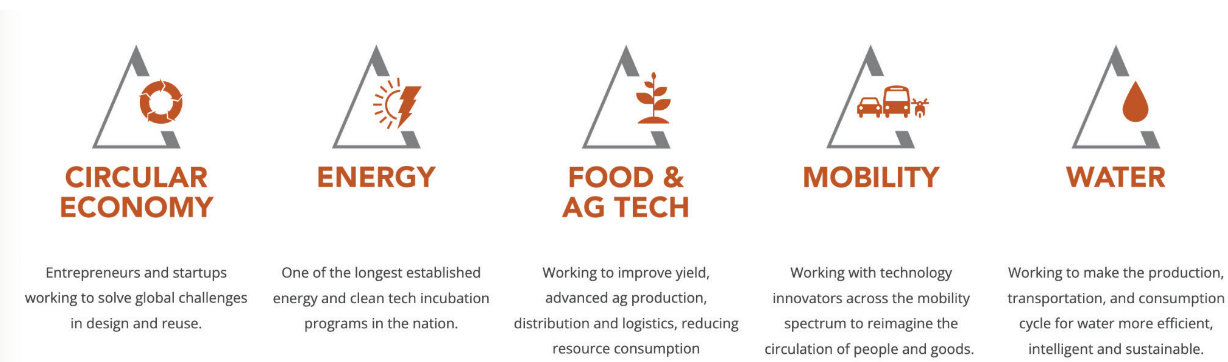

Figure 4-2. Impact Areas for the University of Texas at Austin Technology Incubator

The Incubator has supported over 300 companies, covering issues from improving local supply chain availability for grocery stores to deploying smart shower heads for the hospitality industry, resulting in over $3 billion in economic impact for the Central Texas region.[43] Representatives from the Texas State Energy Office noted that these incubators support state economic development, particularly by helping businesses stay in Texas.[44]

41 State Energy Conservation Office. *Clean Energy Incubators.* https://comptroller.texas.gov/programs/seco/programs/clean-energy.php.
42 Austin Technology Incubator. *About Us.* https://ati.utexas.edu/about/.
43 Austin Technology Incubator. *About Us.* https://ati.utexas.edu/about/.
44 See https://docs.google.com/document/d/1MjY24O0A3iemixvofwEi56OmgZI0D-db/edit?usp=sharing&ouid=100104787232874798477&rtpof=true&sd=true.

Utah – *Offering and marketing grants for critical sectors.* Utah's Office of Energy Development recognizes that the state's energy industry and rich natural resources are important to its economic development goals of job creation, strengthening the state economy, and ensuring higher standards of development.[45] In 2017, the energy industry directly and indirectly represented almost 6% of the state's gross domestic product and 4% of employment. The state supports Utah-based research and development. For example, the state has supported research into large-scale energy storage projects, renewable natural gas, advanced geothermal, and clean hydrogen. One such project, the Frontier Observatory for Research in Geothermal Energy (FORGE), also offers its own funding opportunities in partnership with DOE to spur pathways to commercial geothermal energy development.[46] The Office of Energy Development also supports grant and development assistance by maintaining a webpage of available funding opportunities at the residential, state, federal, and international levels.[47]

4.3 Workforce Development

Job creation is a pillar of economic development. Good jobs improve the quality of life for residents through stable salaries and benefits, increase employers' competitiveness, and can facilitate employee recruitment and retention. The transition to clean energy and increased local manufacturing across the U.S. creates an opportunity to retrain workers for better quality jobs and to train a new workforce for emerging sectors and opportunities. For example, growth in clean energy jobs recently outpaced job growth for the economy overall. In particular, growth is occurring in the EV battery, offshore wind, and grid modernization sectors.[48]

Missouri – *Developing a talent pipeline for the state's workforce.* Missouri created the Apprentice Missouri program by executive order with a goal of having 20,000 apprenticeship participants by 2025. The state has surpassed that goal and has since increased its goal to 55,000 participants by 2025. Apprenticeships provide paid work experiences to increase the skilled workforce across the state and across industries, including those that impact carbon emissions, such as heating and cooling, electricity, agriculture, and wastewater operations.

Utah – *Training the next generation for emerging industries.* Operation Gigawatt, part of Utah's energy plan, aims to double the state's energy-generating capacity in 10 years. Economic development objectives include "Utilize targeted policies, regulatory streamlining, and infrastructure development to attract investment, create jobs, and improve Utah's global energy market position" and "Partner with educational institutions and industry to create talent pipelines for targeted energy sectors." For example, the state's Talent Ready program covers a variety of career pathways and guarantees job interviews with participating employers for students who finish the program. Some of the pathways support clean energy industries including electrician training, construction management, and diesel technician training.

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[45] Utah Office of Energy Development (2022).
[46] See Utah Forge. Research and Development Funding Opportunities. https://utahforge.com/solicitations/.
[47] See Utah Office of Energy Development. Funding and Financial Opportunities. https://energy.utah.gov/homepage/funding/.
[48] U.S. Department of Energy (2023).

4.4 Considering Economic Development in Utility Regulation

Utilities and utility regulators play key roles in state economies. Utilities control or influence the capacity of electricity resources, supply energy for transportation, and create jobs both internally and through contract work for electricians, journey workers, and construction workers. Regulatory consideration of the economic impacts of utility projects may be limited to assessment of cost-effectiveness of resource choices and analyses of rate impacts. State legislatures may enable or require quantification of other impacts of utility investments such as job creation or set preferences for hiring local contractors or maintaining in-state generating facilities.

South Carolina – *Favoring programs and investments that support in-state economic growth.* H4062 (2022) addresses the role of renewable energy and electricity in economic development. The law states that the availability of affordable and clean energy is an important factor for businesses deciding to operate or expand in the state. The law allows utilities to propose economic development rates to the South Carolina Department of Commerce, prospective manufacturing businesses, and commercial and industrial customers that agree to add 100 new employees and make at least $400,000 in new capital investments. For qualifying C&I companies, the utility can offer a rate that is lower than the retail rate and that supports sustainability initiatives, such as real-time pricing and clean energy riders. The economic development rates, however, cannot increase rates for other customers and cannot be less than the utility's marginal cost of electricity. The law allows utilities to fast-track interconnection of renewable energy systems that will support the new facilities and requires that the PSC consider in its decision-making quantifiable economic development impacts from prospective C&I entities.

Prior to this law, Dominion Energy South Carolina implemented an Economic Development Rider for C&I customers with new load over 500 kW, add at least 25 new full-time permanent employees, and invest over $500,000 in new capital. The rider applies a percentage discount to the underlying rate schedule based on the facility's load factor — up to 30% — declining to zero percent over five years.

Arizona – *Supporting communities on the frontline of the energy transition.* In 2020, the Arizona Corporation Commission investigated the economic impacts of the energy sector and directed its staff to open a docket to assess the impacts of fossil-fuel plant closures on communities that live near and operate the plants. Staff led working groups on funding, repurposing facilities, and ratepayer impacts that discussed a variety of issues, including: [49]

- The availability of federal funding through the IIJA and the Federal Interagency Working Group on coal community transition issues
- The availability of state assistance to attract new employers to impacted communities and for workforce development
- The appropriate level of ratepayer funding for community assistance and other forms of nonmonetary relief from regulated utilities
- Utilities' plans for facility replacement and decommissioning

[49] Abinah (2022). See Docket No. E-00000A-21-0010, https://edocket.azcc.gov/search/docket-search.

- Whether facilities can be transitioned to uses that create similar types of jobs of a similar quality
- Who bears the responsibility of stranded costs from early plant retirements and whether community transition costs should be recovered from ratepayers.

Resulting recommendations have informed proposals across Arizona's utilities, which the Commission has considered in multiple forums.[50]

Tennessee – *Making the state attractive to businesses.* Kingsport Power Company offers an Economic Development Rider that provides a 40% reduction to the billing demand over five years for qualifying customers. The rider is designed to attract new load to the service territory and to encourage economic growth. To qualify, companies must newly connect or add load of 500 kW or more, and either create at least 10 full time jobs or invest $2.5 million in new capital expenditures. In addition, the company must show that they would not add this load without the rider's discount. In its application for approval of the rider, the utility offered that the rate would attract new load and benefit customers by spreading fixed costs over a greater base. Many utilities offer such rates to promote business opportunities in their states. Pairing such riders with voluntary renewable energy tariffs, such as Kingsport Power Company's optional Renewable Energy Choice Rider, could help meet multiple state objectives—economic development and using local energy resources—if the resources supporting the tariff are in-state.

4.5 Other Industry Support

States can support specific industries aligned with economic development priorities or reduce barriers for businesses to operate in the state through policies and programs, including those that address environmental sustainability. For example, states can improve permitting and siting processes and provide tax exemptions and other incentives to attract new industries and reduce their operating costs.

Pennsylvania – *Lowering barriers to efficiency and project completion.* In 2023, Governor Josh Shapiro signed EO 2023-07 to improve statewide efficiency for permitting, licensing, and certifications. The order supports the Administration's priorities for economic development and professional opportunities by removing barriers for businesses that want to operate in the state. In part, the EO required agencies to register information on their permitting processes and timelines with the state. In response, the state's Office of Transformation and Opportunity drafted recommendations for each agency to improve their functions.

Such process improvements may support growth of renewable energy projects because permitting is often a barrier to their deployment.[51] The Office of Transformation and Opportunity identified that the Department of Environmental Protection, which issues over 40,000 permits a year, had an acute need for modernized permitting processes. In July 2024, the agency developed the Streamlining Permits for Economic Expansion and Development (SPEED) program to ensure faster review of certain permits. The

[50] For example, related efforts are discussed in Abinah (2022).
[51] See, for example, Bird and McLaughlin (2023).

increased focus on permitting improvements has reduced the agency's backlog of permits by more than 45% and resulted in 95.2% of 2023 applications processed more quickly and efficiently (Figure 4-3).[52]

Figure 4-3. Permit Applications Received and Processed in 2023 by Pennsylvania Department of Environmental Protection

Missouri – *Reducing costs for priority sectors and technologies.* Many states have some form of tax break or incentive to support renewable energy industry development and technological deployment. SB 745 (2022) exempts companies from state sales tax when purchasing solar energy systems and established the "Task Force on Fair, Nondiscriminatory Local Taxation Concerning Solar Energy Systems." The group's final report includes findings and recommendations related to conducting fair solar property tax assessments across the state, how tax revenues should be held, how to classify solar property for tax purposes, and how the industry should pay into solar taxes.

[52] Pennsylvania Department of Environmental Protection. 2024. *Permit Modernization.* https://www.dep.pa.gov/Business/Pages/default.aspx.

5. Energy Affordability

State policies and regulations that reduce energy waste for residents and businesses through energy efficiency programs reduce power bills. Impacts may be greatest for low-income households, typically living in poorly weatherized homes with inefficient appliances, and small businesses, often an underserved market sector. Energy efficiency also reduces air pollution, including carbon emissions. In addition to higher energy consumption, buildings with limited weatherization and inefficient heating and cooling systems place higher loads on the grid during peak demand periods, when utilities often rely on the most inefficient and carbon-intensive power plants.

This chapter provides examples of how states can implement policies in five areas to make energy more affordable, while reducing carbon emissions as a bonus:

- Energy efficiency resource standards
- Other utility energy efficiency requirements
- Grants and financing for energy efficiency
- Improvements to manufactured housing
- Low-income households and other underserved populations

5.1 Energy Efficiency Resource Standards

An energy efficiency resource standard (EERS) sets specific energy efficiency targets for utilities (electric, gas, or both) and sometimes state-led programs. The standard is established through legislation or regulation. An EERS requires utilities or third-party program administrators to procure a designated amount of energy efficiency, typically over a specified period. The standards vary by state, from less than 1% to 2.5% of retail electricity sales annually.[53] About half of U.S. states have such a standard in place.

Some states have voluntary energy efficiency targets or include energy efficiency as an eligible resource in renewable portfolio standards, clean energy standards, or alternative energy standards. Other states call for all cost-effective energy efficiency resources, as determined by benefit-cost tests, IRPs, or other means.

Arizona – *Integrating standards with resource planning and demand flexibility*. The Arizona Corporation Commission required two utilities to integrate the results of energy efficiency savings into their IRPs. The Commission issued a decision in 2022 requiring Arizona Public Service and Tucson Electric Power to achieve 1.3% annual savings through energy efficiency over a three-year period and report the savings in their next IRPs. In addition, both utilities are required to develop demand-side resources providing capacity savings of at least 35% of their 2020 peak demand by 2030 using demand response, energy storage, and smart thermostats.

[53] Frick et al., (2025).

Missouri – *Aligning utility and customer interests*. The Missouri Energy Efficiency Investment Act allows utilities to recover energy efficiency costs and provides an earnings opportunity for energy savings. Enacted in 2009, the Act facilitated the acquisition of demand-side resources by putting energy efficiency on a level playing field with utility capital investments. Specifically, the legislation provides for timely cost recovery for utility investments in energy efficiency, ensures that utility financial incentives are aligned with helping customers use energy more efficiently, and allows earnings opportunities associated with cost-effective, measurable, and verifiable energy savings. The legislation set a goal of 1.9% energy savings by 2020. Missouri utilities submit plans for energy efficiency and demand response programs about every three years.

Pennsylvania – *Ramping up targets and customer savings*. Pennsylvania uses an energy efficiency potential study to inform its goals. The state established statewide EERS goals in 2008 through Act 129, which directs the PUC to adopt an energy efficiency and conservation program. Utilities with more than 100,000 customers must develop plans to reduce energy demand and consumption in their service territories. Initial requirements reduced energy consumption by 1% per year relative to a baseline period and reduced peak demand by 4.5%. The PUC adopted new targets for Phase IV of the program in a 2020 order. Based on energy efficiency potential studies, the Commission set targets of 3.1% over a five-year period. The order also maintained a requirement that at least 5.8% of program funding go to low-income customers.

Texas – *Focusing on peak demand reductions*. Texas was one of the first states to include a peak demand reduction requirement as part of its EERS. SB 1125 (2011) amended the standard, requiring utilities to achieve a peak demand savings of 0.4%, subject to cost caps. The bill also added a focus on reducing demand in the winter.

5.2 Utility Energy Efficiency Requirements

States may enact requirements for utilities to develop their own energy efficiency plans and targets and specify how utilities should develop those plans. Following are examples of such policies.

Florida – *Identifying sector level efficiency goals*. In 2023, the PSC adopted changes to Rule 25-17.0021 for establishing goals for electric utilities every five years. The goals are broken down by sector—residential and commercial/industrial—and include both energy and demand targets. The goals are based on assessments of the technical potential of available measures and an estimate of the total cost-effective savings reasonably achievable over a 10-year period. The rule also specifies a list of market segments and end-use categories that must be considered, including demand-side renewable energy systems.

Missouri – *Modeling efficiency and demand response in IRP*. The state's resource planning rule (20 CSR 4240-220.80(4)) requires that the PSC identify contemporary resource planning issues for utilities to incorporate into each IRP. The PSC issued an updated list of issues in October 2022. The updated list includes studying and modeling customer-side demand response programs and technologies, including residential smart thermostat programs, residential battery storage systems, EV charging programs, and commercial and industrial demand response programs.

Georgia – *Increasing efficiency goals over time*. The PSC's order approving Georgia Power's 2022 IRP increased the utility's energy efficiency goals by 15%, on top of an equivalent increase required in the order for the utility's 2019 IRP. The 2022 order required future IRPs to model energy efficiency and other demand-side resources in a manner that competes against supply-side resources for determining the least-cost resource portfolio.

Iowa – *Utility and state goals to advance efficiency*. Utilities must submit four-year energy efficiency plans and goals based on Senate File 2386 (2008) and corresponding Iowa Code (§ 476.6.16). In the plans for the period 2014–2018, Interstate Power & Light and MidAmerican set goals of 1.1% and 1.19%, respectively. The Iowa Energy Plan, co-published by the Iowa Economic Development Authority and Department of Transportation, identifies a range of priorities and action items, including increasing energy efficiency and decreasing operating costs of the state's existing and new buildings in all sectors. The plan also includes recommendations to support energy efficiency efforts in underserved areas.

South Carolina – *Protecting customers and evaluating efficiency scenarios in IRPs*. The South Carolina Freedom Act directs the PSC to protect customers from rising costs and provide customers with opportunities to reduce or manage their energy usage. The Act also requires utility IRPs to evaluate low, medium, and high cases for the adoption of energy efficiency and demand response programs.

5.3 Grants and Financing

Energy efficiency measures often require substantial initial investments from customers. Following are examples of state programs that provide grants and financing to consumers to alleviate this barrier, accelerating the adoption of energy efficiency and other measures and associated emissions reductions.

Missouri – *Low-interest loans to communities*. The Missouri Division of Energy offers low-interest loans (2.5% in 2025) to school districts, public colleges and universities, hospitals, and local governments for energy-saving investments and energy efficiency projects to reduce energy use and cost. Eligible technologies include high-efficiency lighting, combined heat and power systems, renewable energy systems, waste heat recovery systems, high efficiency heat pumps, and other heating, ventilating and air-conditioning (HVAC) systems. In 2023, the program supported over $2.5 million in loans to school districts in the state.

Tennessee – *Loans and financing for commercial buildings, private and public entities, counties and state facilities*. Tennessee has several programs that provide grants and financing for energy efficiency.

- The state's Commercial Property Assessed Clean Energy and Resilience Act, signed into law in 2021, established the C-PACER Program to enable financing of investments in a variety of energy efficiency and clean energy projects, including energy storage, microgrids, energy efficiency, and renewable energy. PACE loans are tied to the property instead of the individual, so the repayment obligation transfers with property ownership. This alleviates potential barriers to investing in commercial properties if owners may not stay in the property long enough to recoup their investment.

- Tennessee's Energy Efficiency Loan Program, administered by the Department of Environment & Conservation, provides low interest loans to private and public entities for a variety of energy efficiency and renewable energy improvements. The program offers five-year loans between $20,000 and $5 million with a fixed interest rate of 2%, as well as 10-year loans with an interest rate of 5%.
- The Clean Energy Tennessee Grant program provided $13.6 million across 133 grants for county-level energy efficiency improvements and deployment of clean energy between 2012 and 2019. Grants included funding for improvements in lighting, HVAC, and insulation.

5.4 Manufactured Housing

Manufactured homes typically are not as energy-efficient as site-built single-family and multifamily homes, presenting a large opportunity for energy savings and carbon reductions. In addition, residents of manufactured homes are often low income. Programs to encourage efficient new and retrofitted manufactured housing can reduce energy bills and carbon emissions while reducing energy burdens for low-income households.

South Carolina – *Manufactured home tax credits*. SB 1141 (2008) provided tax incentives for energy-efficient manufactured homes from July 1, 2009, to July 1, 2024. In addition to an exemption from a portion of sales tax, the program provided a $750 credit for qualifying energy-efficient manufactured homes that were purchased and used within the state.

5.5 Low-Income Households and Other Underserved Populations

Low-income households often live in homes that are poorly weatherized and have inefficient heating systems and other energy-consuming equipment. They pay far more for energy, as a percent of household income, than households on average,[54] and are often underserved by energy efficiency programs. Rural communities also are generally underserved. These populations present some of the greatest opportunities for energy savings and DERs and, as a result, carbon reductions.

Delaware – *Community solar for all*. The state's Community Solar Law requires a portion of all community solar projects to serve low- and middle-income households. The law also eliminates barriers to community solar projects, such as limitations on ownership, management, and contract models.

Iowa – *Supporting efficiency in underserved areas*. The **Iowa** Energy Plan, produced by the state Economic Development Authority and Department of Transportation, includes recommendations to

[54] See Bell-Pascht, A., *Combined Energy Burdens: Estimating Total Home and Transportation Energy Burdens*, ACEEE, 2002.

support energy efficiency efforts in underserved areas. For example, the state's City Energy Management Program pilot project, established with a grant from DOE, provided one-on-one assistance to municipalities through a shared energy manager. The pilot enabled 19 Iowa cities to set energy reduction goals, develop action plans, and identify and implement energy efficiency projects. The plan suggests that this program could be replicated and expanded to support local governments and deliver energy programs to residents and businesses in rural Iowa.

Louisiana – *Applying equity goals in line with funding opportunities*. The IIJA provides funding for significant investments in grid infrastructure, cybersecurity, EV infrastructure, energy efficiency, and the clean energy supply chain. Louisiana EO JBE 22-19 (2022) established a requirement for state agencies to comply with equity requirements for IIJA spending. The order focused on the use of small, minority-owned, women-owned, and veteran-owned businesses for procurement and contracting opportunities. The order also included engagement with local and tribal governments in order to increase access to IIJA funding opportunities.

6. Resilience

Resilience means "preparing for, adapting to, withstanding, and recovering rapidly from major disruptions."[55] State policies, regulations, and programs that increase grid resilience lead to a wide range of investments that mitigate vulnerabilities to extreme weather and other hazards. For example, 14 states—including Texas, Florida, and Utah—have adopted resilience planning requirements for regulated utilities.[56] Grid resilience investments that facilitate integrated volt-VAR control (IVVC); deployment, integration, and utilization of DERs and microgrids; and time-varying rates that reduce loads during peak demand periods can reduce carbon emissions.

This chapter provides examples of how states can implement policies in the following areas to improve resilience while reducing carbon emissions as a bonus:

- Grants and financing
- Studies
- Planning and procurement
- Emergency and disaster planning

6.1 Grants and Financing

Funds and loans for grid resilience investments reduce the cost of projects that mitigate the impacts of disruptive events. Funds may be used to upgrade grid infrastructure, implement new technologies, and adopt practices that ensure the grid can withstand and recover from disruptions such as natural disasters, cyberattacks, and other emergencies. Resilience grants and financing mechanisms commonly include microgrids.[57] The carbon benefits depend on the type of resources used to power them. If the microgrid runs on renewable energy resources and energy storage, the carbon benefits could be substantial.

Ohio – *Supporting renewable energy and grid resilience projects*. Renewable Energy and Grid Resiliency grants ($2 million from IIJA) are available for public entities, nonprofit organizations, businesses, and manufacturers for onsite projects that generate electricity from nondepletable sources of energy or support grid resiliency, or both. With eligible resources that include solar, wind, geothermal, microgrids, combined heat and power, battery storage and bioenergy, these projects improve grid resilience while reducing carbon.

Georgia – *Creating resilient critical facilities with solar + storage*. Georgia's Solar Resiliency Technical Assistance Program offers grants to cities, counties, K-12 schools, and state agencies that can be used

55 Presidential Policy Directive. (2013). *Critical Infrastructure Security and Resilience*.
56 Schellenberg and Schwartz (2024).
57 Defined by DOE as "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.'' Ton, D.T., and M. Smith, "The U.S. Department of Energy's Microgrid Initiative," *The Electricity Journal*, Vol. 25, issue 8, October 2012.

for feasibility studies and installation costs of solar PV and backup batteries to create resilient critical facilities (Figure 6-1). The Georgia Environmental Finance Authority awarded grants to nine communities, reimbursing up to 85% of the cost of backup battery and solar PV (up to a maximum of $200,000), with systems that range from 33–100 kW.

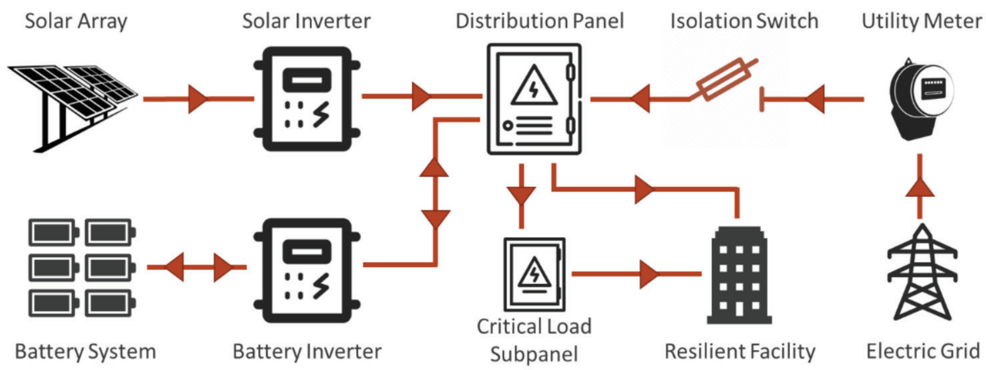

Figure 6-1. AC Coupled Solar PV Plus Energy Storage Diagram

Source: Georgia Environmental Finance Authority (2022)

Pennsylvania – *Expanding financing for resilience projects*. SB 635 (2022) expands Commercial Property Assessed Clean Energy (C-PACE) financing for resilience projects, including energy storage, microgrids and backup power generation, for agriculture, C&I, and multifamily housing. (The C-PACE program also finances improvements for energy efficiency, indoor air quality, water conservation, and renewable energy.) In defining a resilience improvement, the bill specially refers to withstanding natural disasters with resilience measures related to flood mitigation, wind resistance, energy storage, and microgrids.

Tennessee – *C-PACER program enables financing for resilience, clean energy investments*. The Commercial Property Assessed Clean Energy and Resilience Act, signed into law in Tennessee in 2021, established a Commercial Property Assessed Clean Energy and Resilience (C-PACER) program enabling entities to repay financing for qualifying facility improvement and construction projects. Qualifying projects include energy storage, microgrids, and other resilience projects; energy efficiency or consumption reduction projects; and clean renewable energy projects, including behind-the-meter generation or demand-side management technologies.

6.1.1 Grid Resilience State and Tribal Formula Grant Awards

The federal Grid Resilience State and Tribal Formula Grants program is designed to strengthen and modernize the power grid against wildfires, extreme weather, and other natural disasters. The program distributes funding to states over five years based on a formula that includes population size, land area, and probability and severity of disruptive events. The states then award these funds to a diverse set of projects, with priority given to efforts that generate the greatest community benefit, which may include carbon reduction. DOE awarded FY 22-23 grants for all 15 states discussed in this report. This represents only the first tranche of funding.

Ohio – *Improving resilience by upgrading aging infrastructure and grid technologies*. Ohio received $14.2 million in Formula Grant funding to improve grid reliability by reducing the frequency and duration of outages in disadvantaged communities, while enhancing resilience to address all hazards. The PUC held a competitive selection process and ultimately selected 13 projects awarded to six organizations in the state (Figure 6-2). These projects focus on improving resilience by upgrading aging infrastructure, including undergrounding lines. Improved grid infrastructure may have capacity to integrate more renewable energy, including DERs. The self-healing grid technology for Duke Energy's project also typically increases DER integration capabilities, given that monitoring and control solutions improve grid flexibility throughout the year—not just during disruptive events.

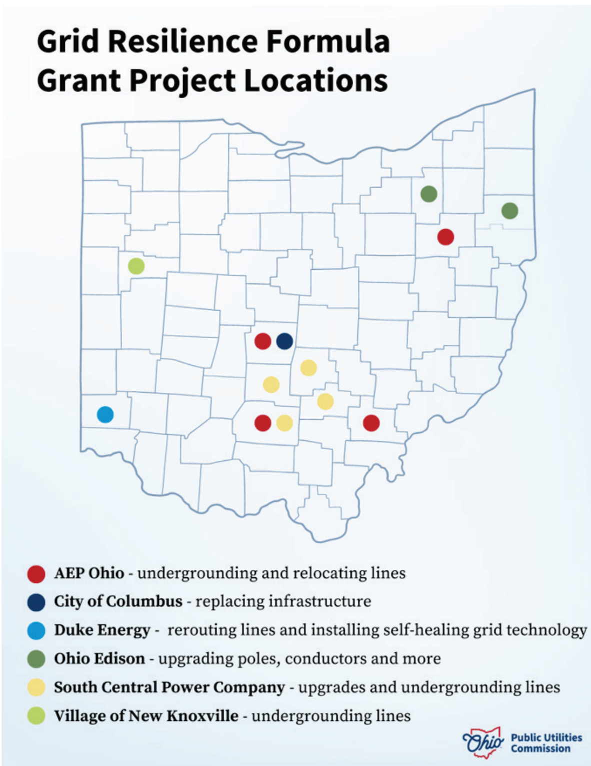

Figure 6-2. Ohio Grid Resilience Formula Grant Awards (Proposed to DOE for Final Approval)

Source: Public Utilities Commission of Ohio (2024)

South Carolina – *Leveraging monitoring and control technologies to enhance situational awareness for extreme weather events*. South Carolina received $10.4 million in Formula Grant funding, with a focus on increasing monitoring and control capabilities to provide visualization and enhance situational awareness leading up to, during, and after extreme weather events. Santee Cooper—South Carolina's state-owned electric utility—held a competitive selection process and ultimately selected 18 projects awarded to eight electric cooperatives and four other utilities within the state. Most of the projects feature monitoring and control technologies, referred to as distribution automation, self-healing grid, and fault location, isolation, and service restoration. While these projects focus on optimizing grid operations during disruptive events, the monitoring and control technologies also can facilitate more DER integration throughout the year.

Texas – *Minimizing disruption during extreme weather events*. Texas received $60.6 million in Formula Grant funding to identify gaps in grid resilience and minimize disruption to normal grid operations during extreme weather events. The Texas Division of Emergency Management indicated the following preferred resilience measures:

- Weatherization technologies and equipment
- Fire-resistant technologies and fire prevention systems
- Monitoring and control technologies
- Vegetation and fuel load management
- Adaptive protection technologies
- Advanced modeling technologies

Monitoring and control, adaptive protection, and advanced modeling technologies could reduce carbon by enabling DER integration.

Other states – Each of the other 12 states in this report were awarded a specific funding amount and indicated their primary goal for the state Formula Grant program as follows:

1. Arizona – $13.3 million for improving the reliability and resilience of the electric grid to reduce the frequency and duration of power interruptions, especially in areas that are being disproportionately affected by disruptions
2. Delaware – $2.9 million for reducing the likelihood, frequency, and consequences of disruptions in disadvantaged communities
3. Florida – $30.4 million for enhancing and maintaining the reliability and resilience of the electric grid
4. Georgia – $17.3 million for maintaining and enhancing the reliability and resilience of the electric grid, with the goal of minimizing the frequency and duration of power outages
5. Indiana – $9.2 million for improving the resilience of the electric grid against natural disasters and ensuring the availability of power during disasters to critical community services, such as public safety, communications, medical, and transportation systems
6. Iowa – $11.8 million for increasing grid resiliency by undertaking preventive actions to strengthen the grid against severe weather and improving asset management through evaluation and monitoring
7. Kentucky – $11.1 million for improving the safety and reliability of the electric grid serving critical facilities or under-resourced communities and vulnerable populations, which are at heightened risk from all hazard types
8. Louisiana – $16.0 million for modernizing the power infrastructure system to withstand stresses and shocks from extreme weather events and large-scale disruptions and moving toward a secure, resilient, and affordable grid
9. Missouri – $13.9 million for producing measurable improvements in resilience and reliability, with a focus on small- to medium-sized communities, disadvantaged communities, and critical infrastructure

10. Pennsylvania – $16.2 million for protecting urban and rural communities from the consequences of disruptive events affecting electrical grid infrastructure
11. Tennessee – $15.2 million for improving grid resilience by maintaining and enhancing the reliability of the electric grid and minimizing the frequency and duration of power outages resulting from natural hazards
12. Utah – $11.7 million for reducing the overall negative impacts of disruptive events on Utah's residential and commercial power end users.

Some of the Formula Grant projects to be awarded in these states may reduce carbon, particularly for capacity enhancements, replacement of aging infrastructure, and technologies that facilitate DER integration by optimizing grid operations with enhanced monitoring and control.

Federally Funded GRIP Projects

In October 2023, DOE announced $3.5 billion in Grid Resilience and Innovation Partnerships (GRIP) Program investments for 58 projects across 44 states to strengthen electric grid resilience and reliability. While most of the applicants are utilities, states also were eligible to participate, as a complement to the Grid Resilience State and Tribal Formula Grants. Georgia and Louisiana, for example, received significant GRIP grants, with a federal cost share of nearly $250 million for each state.

Georgia – *Improving resilience and clean energy deployment.* The Georgia Environmental Finance Authority leads the project, which aims to improve resilience and clean energy development through a comprehensive smart grid infrastructure upgrade program that includes investments in battery storage, local microgrids, and grid reliability while implementing new transmission lines to link communities. With a focus on remote and hard-to-reach communities, these investments will increase access to clean, renewable, and sustainable energy sources for residents in rural Georgia.
Louisiana – *Accelerating clean energy and resilience.* The Louisiana Department of Natural Resources will deploy GRIP funds to accelerate more abundant, affordable, and reliable clean energy for greater power resilience to extreme weather. Hubs for Energy Resilient Operations will advance decarbonization and community-based energy and resilience planning. With a network of Community Resilience Hubs powered by DERs, this project could reduce carbon with microgrids that have low-carbon energy sources.

DOE announced additional GRIP grants in 2024, totaling $7.6 billion for 105 projects in all 50 states and the District of Columbia.

6.2 Studies

Grid resilience studies involve analyses aimed at assessing and enhancing the robustness of electrical grids against various threats and disruptions. These studies evaluate the grid's ability to prevent, withstand, adapt to, and recover from adverse conditions such as natural disasters, supply shortages, and other emergencies. To the extent that studies highlight the value of clean energy resources in mitigating the impacts of these adverse conditions, carbon benefits could arise from implementing study recommendations.

Kentucky – *Role of microgrids in mitigating natural disaster risk*. The [Regional Microgrids for Resilience Study] analyzed outage risks for natural disasters and how microgrids, including those with solar PV and battery storage, could provide enhanced resilience. The study identified possible microgrid locations (Figure 6-3) based on a preliminary prioritization that began with identifying critical infrastructure facilities. Priorities were refined taking into consideration selection criteria including critical infrastructure facility type, geographical proximity, natural hazard risk, power outage history, population density, and underserved areas. Follow-up includes funding for two universities to build microgrids, a more in-depth study on water and wastewater treatment facilities, and working with development districts to understand energy needs of critical facilities and hazard mitigation measures.

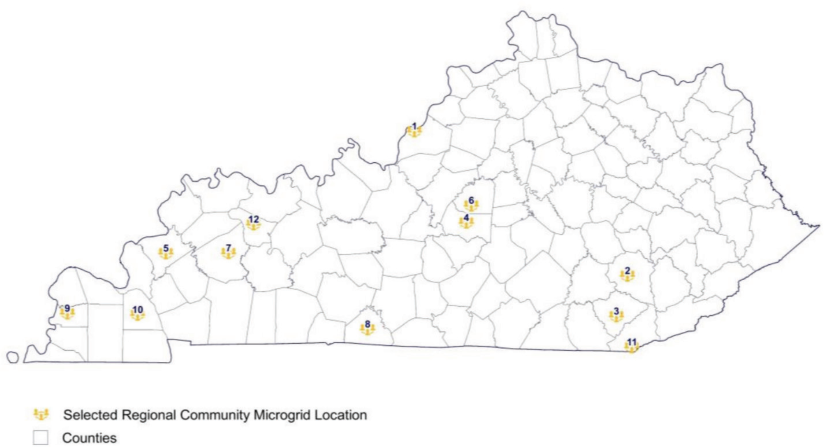

Figure 6-3. Selected Regional Community Microgrid Locations

Source: Smart Electric Power Alliance (2021)

Texas – *Blueprint for mitigating wholesale market reliability issues*. In 2022, the PUC issued an order outlining a two-phase blueprint for addressing reliability issues in the state's wholesale market design. The Phase I blueprint directs improvements for the wholesale market's Operating Reserve Demand Curve, implementing better price signals, adopting performance standards, potentially developing customer aggregation programs to improve demand response assets, reforming Texas' Emergency Response Service, and developing a host of other ancillary products. These types of measures could deliver significant carbon benefits by reducing the need for peaking generators.

Arizona – *Performance incentives for improving resilience*. In June 2022, Commissioner Marquez Peterson issued a request to staff to file recommendations regarding how the Commission should be compensating electric utilities for how well they perform based on additional performance metrics. Potential metrics included those related to:

- Balancing, decongesting, and flattening load on the grid
- Preventing, responding to, and quickly restoring service following unplanned outages

The ability to flatten load on the grid could deliver significant carbon benefits by reducing the need for peaking generators.

Iowa – *Using demand response to address winter peaks*. In 2023, the Iowa Utilities Board issued an order requesting information regarding utilities' winter 2023–2024 preparedness plans. The impact of long-duration extreme weather events, such as 2021's Winter Storm Uri, has underscored the need to consider extreme scenarios for resource planning. Some of the questions the Board asked utilities to answer pertain to the role of demand response programs in addressing seasonal grid peaks, potentially reducing the need for peaking generators. The companies must provide information on the extent to which they plan to rely on emergency and/or economic demand response programs to avoid the need for load shed events. They Board also directed the utilities to provide any plans to expand demand response programs in the future.

Pennsylvania – *Investigating energy storage as a distribution asset*. The PUC issued a policy statement in 2023 that set forth proposed guidelines for use of energy storage as electric distribution assets to enhance reliability and resiliency. In an April 2024 order, the final policy statement recognizes that electric distribution companies may use energy storage systems to solve distribution system issues and provide grid resilience.

Missouri – *Highlighting energy storage technologies in special contemporary issues*. In October 2022, the Missouri PSC issued an updated list of special contemporary resource planning issues for utilities to discuss in IRPs, including those pertaining to resilience:

- Studying and modeling customer-side demand reduction technologies, including residential battery storage rebates and free installation of utility-owned battery storage, and associated demand flexibility programs
- Studying and modeling the ability of storage to meet current and future demand, including review of various technologies, pricing, integrating storage into existing utility-scale solar sites, and offering free storage installation to C&I customers willing to participate in demand reduction programs

6.3 Planning and Procurement

Grid resilience planning and procurement involve strategic processes and activities necessary to ensure that electrical grids are robust, adaptable, and capable of withstanding and recovering from disruptions. Planning includes the development of comprehensive strategies and policies, while procurement involves acquiring the necessary resources, technologies, and services to implement these plans.

States and utilities are increasingly facing planning and procurement challenges related to retirement of fossil-fueled resources. If these resources retire and the utility uses renewable resources to replace them, then the carbon benefits could be substantial. Further, resilience measures that reduce peak demand and curtail excessive use during grid emergencies could deliver significant carbon benefits by reducing the need for procuring peaking generators.

Texas – *Legislation requires Texas utilities to file resilience plans*. House Bill 2555 (2023) directs the PUC to adopt transmission and distribution resilience plan requirements. Under the statute and the PUC's adopted rule, regulated utilities can submit resilience plans on a voluntary basis, but if they do so they must follow the PUC's requirements to apply for accelerated cost recovery for resilience investments. Eligible resilience measures that also may reduce carbon include infrastructure upgrades and information technology.[58] As of July 2024, two large utilities—Oncor and CenterPoint—submitted plans under the resilience plan requirements. Oncor's proposed resilience plan includes measures that may reduce carbon (Table 6-1), particularly infrastructure upgrades and the flexible and self-healing distribution system, both of which may improve integration of renewable resources, including DERs.

Table 6-1. Oncor Proposed Resilience Plan and Framework

Resiliency Measure	Description	CapEx	O&M	SRP Project Prioritization Framework
Overhead System Resiliency & Modernization	Modernize & harden legacy overhead system including poles, crossarms, equipment & lighting protection	$1,134 M	$97 M	1. Wildfire Mitigation Zones
Underground System Resiliency & Modernization	Modernize & harden legacy underground system with cable injection/replacement, equipment upgrade & automation	$573 M	$27 M	2. Underperforming Feeders
Flexible and Self-Healing Distribution System	Enable and optimize distribution automation through new ties, capacity & intelligent switches	$480 M	$31 M	3. Customer Benefit
VM+	Expand VM along laterals & leverage remote sensing capabilities	$9 M	$276 M	4. Vegetation Management
Wildfire Mitigation	Enhance risk modeling & awareness, mitigate wildfire risk through fire-safe devices, defensible space & hardening	$145 M	$37 M	5. Physical & Cyber Security
Oncor Secure	Physical security, video & event correlation systems & asset protection	$71 M	$9 M	Embedded across these are foundational technology to ensure secure and reliable implementation.
Enhanced Digital Grid	Enhance cybersecurity risk mitigation and enhance/secure digital backbone infrastructure	$480 M	$45 M	

Attachment A

Source: Oncor Electric (2024). CapEx - capital expenditures; O&M - operation and maintenance; VM+ - enhanced vegetation management

Missouri – *Establishing regionally focused energy initiatives*. The Missouri State Energy Planning process identifies and addresses topics critical to the state's energy needs. The core values of the process include assuring energy resilience, using affordable rates and renewable energy options to enhance business retention in the state, developing in-state energy resources, and ensuring affordability and equity. The planning process establishes regionally focused initiatives, such as supporting the resilience

58 While the focus of many resilience plans is the physical grid, utilities may consider measures that improve resilience under bulk system emergency alerts and fuel supply shortages, such as information technology investments to optimize load shedding, improve energy efficiency (PNNL et al. 2023), and control microgrids and DERs (PNNL 2022).

of military installations and facilities, and improving disaster preparedness and resilience, including assuring energy availability through backup generation and energy or fuel storage.

Georgia – *Using renewable energy to mitigate reliability and resilience impacts of coal plant retirements*. The PSC approved Georgia Power's IRP action plan to improve reliability and resilience in north Georgia, including issuing an RFP for renewable energy. The action plan mitigates the significant gap between generation and load forecasted in this region, which will increase with future coal retirements. If renewable energy resources replace retired coal plants, the carbon benefits could be substantial.

Ohio – *Utility smart grid plan targets investments in resilience*. In 2021, the PUC approved a settlement filed in a proceeding on Dayton Power & Light's proposal for $267 million in smart grid investments. Across its territory, the utility will invest $77.6 million in advanced metering infrastructure (AMI), while $109 million will fund self-healing grid technologies, including distribution automation, substation automation, and advanced distribution management. The order specifies that resilience projects may include any or all of the following: (1) renewable energy, including DERs that are not dependent on the delivery of fuel, (2) energy storage, (3) advanced control systems, and (4) reducing energy consumption, including through lighting and water upgrades, HVAC, and boiler-system improvements. All of these resilience measures can reduce carbon by reducing energy consumption, lowering carbon intensity, or facilitating integration of renewable energy resources, including DERs.

Utah – *Legislation requires utilities to file wildland fire protection plans*. House Bill 66 (2020) requires electric utilities to submit wildland fire protection plans to the PSC for review. Under the statute and the PSC's adopted rule, qualified utilities are required to submit wildland fire protection plans every three years. Wildfire mitigation measures can reduce carbon emissions,[59] and facility upgrades that reduce wildfire risk could allow for more renewable energy integration, including DERs.

6.4 Emergency and Disaster Planning

Emergency and disaster planning for electric grid resilience involves preparing strategies, protocols, and resources to respond effectively to events that can disrupt the electrical grid. This planning aims to minimize the impact of such events, ensure rapid recovery, and maintain the continuity of electricity supply. Recovery, rebuilding, and redevelopment efforts may lead to improved energy efficiency and new and better infrastructure that can accommodate more renewable energy, including DERs.

State Energy Security Plans, required by IIJA to receive State Energy Program funding, serve as the foundation of state resilience planning (NASEO and Berkeley Lab 2023), typically focused on emergency and disaster planning for all energy resources. While these plans are generally not publicly available due

[59] A University of California-Merced study found that carbon dioxide emissions from forest fires have surged by 60% globally since 2001, and almost tripled in some of the most climate-sensitive northern boreal forests. Oct. 17, 2024. https://news.ucmerced.edu/news/2024/global-co2-emissions-forest-fires-increase-60.

to sensitive information on critical infrastructure and emergency management, some states have made redacted versions of the plans publicly available.

Kentucky – *Understanding cross-sector interdependencies to mitigate the impacts of energy disruptions*. The Kentucky Energy Security Plan serves as a resource primarily for state energy emergency personnel. The plan focuses on coordination, monitoring, assessment, and response for energy disruptions, with an emphasis on understanding cross-sector interdependencies (Figure 6-4) to help mitigate the potential consequences of large-scale failures of energy systems. The plan details actions that may be taken to alleviate or lessen the impact of disruptive events, including conservation measures and load curtailment, which could deliver carbon benefits by reducing the need for peaking generators.

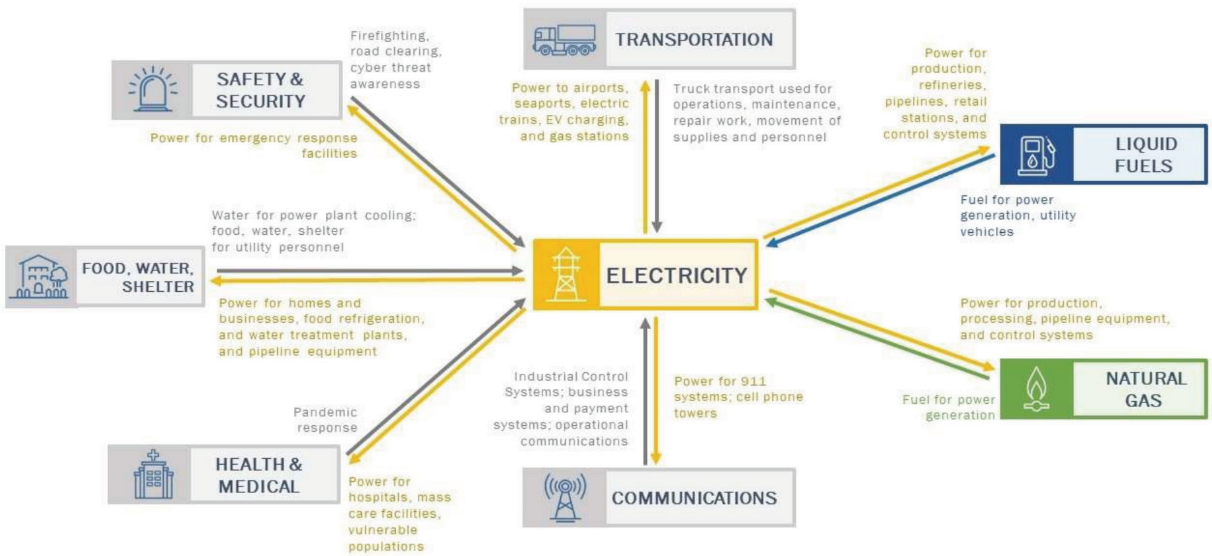

Figure 6-4. Energy Lifeline Interdependencies

Source: Kentucky Energy Security Plan (2023)

Delaware – *Responding to energy supply disruptions by reducing demand*. The Delaware State Energy Security Plan describes how the state will respond if an energy shortage of a substantial nature occurs or appears imminent. The plan discusses three basic strategies to minimize disruption of energy supply or the perception of an emergency:

1. Voluntary and mandatory demand reduction measures
2. Substitution of alternative resources when possible
3. State government programs to curtail excessive use

Such measures that reduce peak demand and curtail excessive use of the electricity system during grid emergencies could deliver significant carbon benefits by reducing the need for peaking generators.

Iowa – *Coordinating long-term rebuilding and reconstruction*. Executive Order 4 (2019) established the Flood Recovery Advisory Board to serve as the central point of coordination of state activities for the recovery and rebuilding efforts following severe and widespread flooding in the state, which caused $1.6 billion in damages. The Board is tasked with long-term rebuilding and reconstruction efforts. This type of cross-sector coordination of rebuilding and reconstruction could lead to improved grid infrastructure that can integrate more renewable energy, including DERs.

Delaware – *Facilitating home repairs with resilience fund*. Executive Order 44 (2020) establishes the Delaware Resilience Fund program to address property damage from two tropical storms. Funding is primarily for home repairs and clearing roadways. Program funds directed to community organizations is for home repairs not covered by the homeowner’s insurance, directed at applicants that fall within appropriate income guidelines. Home repairs could increase energy efficiency, particularly for low-to-moderate income households without sufficient resources (including insurance coverage) to make comprehensive repairs that meet the latest codes and standards.

Louisiana – *Coordinating recovery and redevelopment*. Executive Order JBE 16-65 (2016) establishes the Restore Louisiana Task Force to oversee post-flood recovery and redevelopment, including housing and infrastructure. This type of centralized coordination of rebuilding and reconstruction could lead to improved grid infrastructure that can integrate more renewable energy, including DERs. Home repairs could increase energy efficiency.

7. Grid Modernization

Investments in grid modernization can lead to reduced carbon emissions by design or as a side benefit. For example, utilities can increase hosting capacity for solar PV and EV charging, adopt systems to expedite DER interconnection processes, invest in technologies to improve integration and utilization of DERs, and install AMI to enable time-varying rates that reduce demand on the least-efficient generating facilities. This chapter discusses examples in four areas:

- Studies
- Utility regulatory requirements
- Utility infrastructure investments
- IIJA smart grid grants

7.1 Studies

Studies related to distribution system planning (DSP) and grid modernization focus on technical topics such as engineering details, computational modeling, and standards, as well as institutional matters such as rules, regulations, and decision-making processes. Studies that evaluate ways to improve interconnection and utilization of distributed solar, batteries, microgrids, and other DERs on the distribution system can lead to policies, regulations, and programs that increase DER employment and reduce electricity system emissions.

Ohio – *Interconnection rules for DERs.* The PUC issued an order in 2021 adopting amendments to the Ohio Administrative Code regarding DER interconnection rules and created a stakeholder group to further develop the rules. The group filed a progress report in January 2024 and requested that the Commission open a new proceeding to address Federal Energy Regulatory Commission (FERC) Order 2222, pertaining to participation of DERs in regional electricity markets.

South Carolina – *Evaluating nontraditional solutions.* Following settlement of its 2022 Rate Case and release of its Climate Risk and Resilience Study, the PSC directed Duke Energy Progress to develop and implement at least one potential target initiative as part of its Grid Improvement Plan to evaluate the effectiveness of nontraditional distribution solutions such as microgrids and battery storage systems.

Tennessee – *Analytical support for grid integration*. In October 2023, Tennessee Tech University received a grant from the Appalachian Regional Commission, funded by the IRA, to develop a multistate Smart Grid Deployment Consortium to apply advanced grid modeling to help electric utilities integrate smart grid technologies and DERs.

Texas – *Segmenting circuits.* In September 2023, the PUC issued a memo and final order requiring its utilities to conduct and file transmission and distribution system circuit segmentation studies by September 2024. The studies include engineering analyses of feeder segmentation or sectionalization to manage and rotate outages more evenly across all customers and across circuits more effectively while prioritizing critical facilities; feasibility of using automated reclosers (Figure 7-1) and other technology to further sectionalize critical circuits to enable more granular and flexible outage management; and identifying feeders with critical facilities that, if equipped with segmentation and backup power (including microgrids and solar plus storage), can enhance the utility's flexibility for outage management. The studies also estimate capital costs and identify regulatory, statutory, and operational barriers to implementing potential measures.

Figure 7-1. "TripSaver" automated recloser

Source: CHELCO

7.2 Utility Regulatory Requirements

Of the 15 states discussed in this report, three require regulated utilities to file some type of plan related to electric distribution system planning. Plans that address the interconnection, integration, and utilization of DERs such as distributed PV, storage, and demand flexibility, emissions reductions can facilitate reduced air pollutant emissions in the electricity sector.

- **Delaware** requires an annual distribution Safety, Infrastructure, and Reliability Plan and long-range plans submitted every five years.
- **Indiana** utilities file plans with the regulatory commission for timely recovery of costs for new or replacement transmission, distribution, and utility storage projects for safety, reliability, system modernization, or economic development. Plans cover a 5–7 year period and are updated annually.
- **Pennsylvania** utilities must file Long Term Infrastructure Improvement Plans for review by the PUC. Approved expenditures to repair, improve, or replace eligible distribution property can be recovered through a Distribution System Improvement Charge.

Utility regulatory requirements may address other planning and technical issues related to distribution system planning and grid modernization, such as the following.

Missouri – *Planning for voltage optimization.* Included in the PSC's order updating issues that utilities must address in IRPs are analysis and planning activities related to actions necessary for systemwide voltage optimization of distribution systems, which can reduce energy consumption and lower peak demand.

Texas – *Fact-finding for DSP and DER interconnection.* In 2022, the PUC issued a request for comments on questions regarding distribution planning, cost, and data accessibility. Key questions included how to promote DER participation and improved grid resilience, which entities should be involved in planning processes, and what new equipment, processes, and standards need to be considered. Subsequently, two new dockets—54224 (cost-recovery for service to DERs) and 54233 (technical requirements and interconnection process for DERs)—were opened to establish and look further into rulemaking processes for DERs.

Guidance on DER aggregation. A PUC memo established a framework and schedule for implementation of an aggregated DERs pilot, to be developed by a task force including ERCOT and PUC officials, transmission and distribution service providers, retail electric providers, aggregators, and other experts. The memo offered the task force specific goals, including producing a proposal for a specific aggregated DERs pilot program, in accordance with the recommendations of a Docket No. 51603 memo; producing an accompanying aggregated DERs program governing document; developing business procedures for contracting, data sharing, and grid services qualification; and establishing a forum for program participants to develop milestones and discuss program progress, challenges, and lessons.

Utah – *Stakeholder engagement on grid modernization*. In 2021, the PSC established a collaborative stakeholder process related to grid modernization and rate design. Rocky Mountain Power filed a compliance report in response with information on its AMI project scope and schedule, grid modernization, and advanced rate design plans and schedule.

7.3 Utility Infrastructure Investments

Utility distribution infrastructure investments include standard equipment such as poles, wires, and transformers, as well as computer software and hardware. Advanced Distribution Management Systems (ADMS) are enterprise software platforms that enable utility engineers, field crews, and operations personnel to monitor, control, and optimize distribution grids. Fault location, isolation, and service restoration refers to grid sensors and software that integrate with ADMS to quickly identify problems on the grid and automatically restore power when possible. It is combined with devices such as reclosers, which shut off power when a transient problem occurs and then restore it. Distributed Energy Resource Management Systems (DERMS) are software platforms that monitor and control DERs and optimize dispatch based on grid needs (Figure 7-2). AMI facilitates time-varying rates as well as improved DER integration and utilization. All of these technologies enhance reliability and resilience of distribution systems in the face of increasing penetration of DERs and EVs, supporting reductions in carbon emissions and other air pollutants.

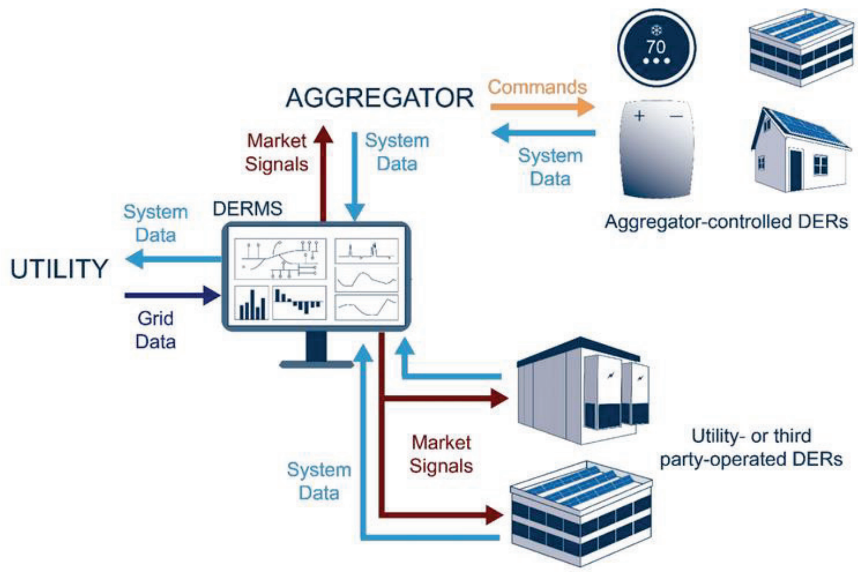

Figure 7.2 Distributed Energy Management System (DERMS)

Source: Driscoll. 2018 (used in Hegedus. 2023)

Arizona – *Modeling and IT for DERs.* In its 2022 rate case filing, Arizona Public Service reported that it was developing feeder-level DER modeling to support grid modernization and requesting to invest $297.5 million in capital spending for IT, including a $15.3 million investment to upgrade its ADMS.

Delaware – *Technology upgrades.* Delmarva's proposed 2024–2026 Infrastructure, Safety, and Reliability plan includes investments in AMI, distribution automation, and a comprehensive feeder improvement program.

Georgia – *Real-time awareness of DER operations.* A PSC stipulation and order in Georgia Power's 2022 rate case authorized the utility to prepare the electric system for higher levels of DERs. The stipulation includes system modifications to enable modeling and visibility of DERs; integrating modifications with real-time operations platforms such as emergency management, distribution management, and supervisory control and data acquisition systems; and establishing DER remote configuration capabilities. The utility will report back to the Commission in its 2025 IRP on the development of these systems and the need for any further system modifications for DER integration.

Iowa – *DER integration for retail and wholesale markets.* Interstate Power & Light's 2023 rate case application includes investments related to the proliferation of DERs and EVs on its system and FERC Order 2222 implementation, such as ADMS to improve monitoring, optimization, and security of DER operations and related investments in a fiber-optic communications network. The utility also proposed battery storage pilot projects to support grid operations.

Kentucky – *Advanced metering and evaluation of new customer options.* In 2021, Louisville Gas & Electric proposed AMI deployment to replace some 419,000 electric meters and insert an AMI module in approximately 337,000 of its gas meters. The PSC approved a stipulation for a certificate of public convenience and necessity for the project. The stipulation includes engaging in a stakeholder process and evaluating peak-time rebates and an on-bill financing program for demand-side management. Customers can use a My Meter online dashboard to track and manage energy use (Figure 7-3).

Figure 7-3. Louisville Gas & Electric My Meter Dashboard

Source: LG&E

Louisiana – *Approval of grid modernization upgrades previewed in the utility's IRP.* Entergy's 2024 rate case application includes investments in a distribution automation program such as self-healing networks and automated reclosers. In March 2024, the PSC issued an order approving the utility's planned DSP investment strategies as documented in its updated 2023 IRP. The IRP addressed redesigning grid infrastructure to incorporate new technologies, including to enable multidirectional power flows for DERs, and to update related communications networks.

Enabling customers to share usage data with third-party service providers. In 2023, the Commission approved a joint settlement agreement for Phase II of Southwestern Electric Power Company's Advanced Metering System deployment program, replacing an additional 244,000 meters and deploying supporting technologies. Customers can access and share their data with any partner they choose, including to help manage their energy use.

Missouri – *Investing in state-of-the-art technologies.* In 2022, Ameren filed tariffs reflecting its five-year Smart Energy Plan, stemming from SB 564 (2018), which eased the regulatory approval process for utility infrastructure investments. Investments "to create a more resilient, reliable and sustainable energy grid" include over 2,350 smart switches to rapidly detect outages and reroute power; upgrading at least 500 power line miles and using stronger composite poles; upgrading at least 800 miles of aged and deteriorating underground cable with new cable; constructing 175 new or upgraded substations to address aging infrastructure; and installing 1.2 million smart meters.

Ohio – *Grid modernization technologies, DER and EV pilots, and new customer tools.* Ohio Edison's Grid Mod Phase II investments include projects to support integrated DERs. In 2022, the company filed for approval of this phase, to be implemented over four years. DER pilots include battery storage at a public EV charging station, residential and commercial EV charging, and commercial vehicle-to-grid. Among the technologies to be deployed are AMI, distribution automation, IVVC, and ADMS enhancements, including expanded integration of advanced applications for distribution automation, IVVC, and AMI, as well as the addition of a DERMS module. Grid Mod II also includes a smart thermostat rebate program and a Customer Energy Management program that home energy reports with customized information about customers' hourly electricity usage and suggestions for how to reduce usage leveraging AMI data.

South Carolina – *DERs as non-wires alternatives.* In 2023, the PSC approved a comprehensive settlement agreement in the Duke Energy Progress 2022 rate case, including commitments to inform future Grid Improvement Plans. Duke's Integrated Systems & Operation Planning stakeholder process will include sharing data concerning distribution Non-Traditional Solutions (NTS), as well as opportunities for stakeholders to provide inputs and recommendations on Duke's NTS planning framework and analyses and to review and provide feedback on the results. The planning framework looks across capacity and energy resource investments for generation, transmission, distribution, and customer programs (e.g., energy efficiency, demand response, and EV programs).

Texas – *Investing in advanced meters and DER interconnection.* In 2022, the PUC approved El Paso Electric's plan to install AMI across its service territory through 2025. The plan also includes investments in communications networks, supporting systems, a web-based customer interface, and customer education. Also that year, the PUC approved Southwestern Electric Power Company's revised Advanced Metering System plan, authorizing the deployment of advanced meters to customers in its Texas region. In March 2024, CenterPoint Houston filed a rate case application with the PUC, including investments to modernize the grid. Among the proposed capital investments are clean energy enablement/generation interconnections ($220.6 million).

7.4 IIJA Smart Grid Grants

The IIJA Smart Grid Grants are designed to increase the flexibility, efficiency, and reliability of the electric power system, with particular focus on:[60]

- Increasing transmission system capacity
- Preventing faults that may lead to wildfires or other disturbances
- Integrating renewable energy at both transmission and distribution levels
- Facilitating integration of EVs, buildings, and other grid-edge devices

The grants are used to demonstrate pathways to wider market adoption of smart grid technologies. Grant funds total $3 billion ($600 million per year for fiscal years 2022–-2026). Eligible entities include institutions of higher education, both for-profit and non-profit entities, state and local governmental entities, and tribal nations. The program builds on smart grid grants provided under the Recovery Act of 2009. Following are example projects funded in states included in this report.

[60] See DOE, "Smart Grid Grants," n.d.

Delaware – Pecan Street's Seasonal Solar Congestion Management project aims to accelerate the state's clean energy transition by meeting customer demand for rooftop solar. Anticipated outcomes include:

- Bypassing the need for distribution system upgrades by using low-cost, commercially available energy monitoring and communications technology to leverage the communications capacity of existing smart inverters
- Facilitating new solar arrays on 1,500 homes, including 150 in disadvantaged communities
- Reducing reliance on coal generation and increase summer peak reliability
- Increasing workforce development opportunities

Indiana, Kentucky, Louisiana, Ohio, Tennessee, and Texas. American Electric Power Service Corporation will implement ADMS software with an operational DERMS module to increase grid visibility and distribution management capabilities. Anticipated outcomes include facilitating the transition to cleaner DERs through enhanced asset management

Missouri – Empire Electric District Company's Distribution Automation project will enable a comprehensive sectionalization of the electrical system for greater reliability and flexibility, especially during severe weather events. Anticipated outcomes include:

- Installing and integrating 261 new and 49 existing vacuum reclosers arranged in 43 clusters, while upgrading telecommunications, poles, and stations for automatic system restoration and improved resilience outcomes
- Improving reliability by 33% with a modernized automation distribution system with reinforced resilience features at key DA nodes
- Supporting grid flexibility, including system capacity for electrification and renewables
- Deploying well-understood, commercially-demonstrated distribution components to replace outdated manual equipment and safeguard energy access for local communities

Pennsylvania – PPL Electric Utilities' Grid of the Future project will deploy a suite of technology investments to create an automated grid that predicts failures, reduces outages, increases resilience, improves customer affordability, and maximizes grid flexibility. Anticipated outcomes include:

- Integrating DERs, adopting a two-way power flow model, and enabling real-time grid control
- Advancing Pennsylvania state electrification goals by building a more reliable grid
- Reducing outage durations and preventing faults due to system disruptions during extreme weather events
- Increasing the use of advanced automation technologies for greater energy reliability during disruptive events
- Deploying advanced data analytics with artificial intelligence and machine learning to monitor outages, forecast changes in demand, and enhance real-time grid operations

Texas – Algonquin Power Fund America plans to deploy SmartValve, an advanced power flow control technology that quickly solves grid issues by unlocking additional transfer capacity on existing transmission lines. Anticipated outcomes include:

- Increasing transmission capacity by approximately 300 MW by rerouting power flows, maximizing renewable output, and improving interconnection ability
- Enhancing system visibility to enable grid operators to quickly rebalance the electrical system
- Making better use of existing infrastructure, unlocking increased transmission capacity while maintaining stability in the region, reducing clean energy curtailments, supporting additional clean energy generation development, and increasing the system's ability to respond to adverse contingency events

Utah – PacifiCorp's Resiliency Enhancement for Fire Mitigation and Operational Risk Management (REFORM) project will enhance control center capabilities by implementing a system of interoperable technologies that significantly enhance situational awareness to reduce or mitigate wildfires and improve grid flexibility, reliability, and resilience. Anticipated outcomes include:

- Introducing distribution fault anticipation devices, advanced relays with wildfire protection features, and communicating fault circuit indicators
- Reducing average power outages by five minutes, in part through improved electrical system visibility for grid operators
- Significantly enhancing advanced forecasting capabilities for wildfire risk management using high-performance computing to run weather models
- Preventing faults that may lead to wildfire or other system disturbances
- Enabling less-than-48-hour notification for public safety power shutoffs during wildfire events

8. Other Drivers

Each state has unique policy objectives, resources, and stakeholders that guide its activities. Some drivers have inherent ties to reducing air pollution, while others may reduce it as a side benefit. This chapter highlights additional drivers that state representatives cited in interviews with Berkeley Lab:

- Alternative electricity sources
- Other sources of carbon emissions
- Other policy and regulatory objectives

8.1 Alternative Energy Sources

States may explore alternative electricity sources to establish leadership in a certain industry, reduce energy imports, foster economic growth, improve electricity reliability and affordability, and reduce pollution. For example, states may choose to complement a growing fleet of variable renewable energy resources with other forms of clean electricity that are consistently available. Or states may position themselves as a major player in industries that are expected to grow in the future, such as nuclear energy or hydrogen.

DOE identified advanced nuclear energy as a key resource to deliver reliable power and meet climate goals. Advanced nuclear energy is expected to provide flexible baseload power, meaning that it can deliver energy at all times but ramp up and down to meet fluctuations in demand. Future reactors will likely be smaller, which could reduce construction costs that have been a barrier to deployment.[61] Hydrogen also is expected to play a major role in reducing air pollutants in the electricity sector. But more research and development are needed to commercialize clean hydrogen for highest-impact use cases. DOE's [U.S. National Clean Hydrogen Strategy and Roadmap](#) outlines strategies and guiding principles for hydrogen development (Figure 8-1).

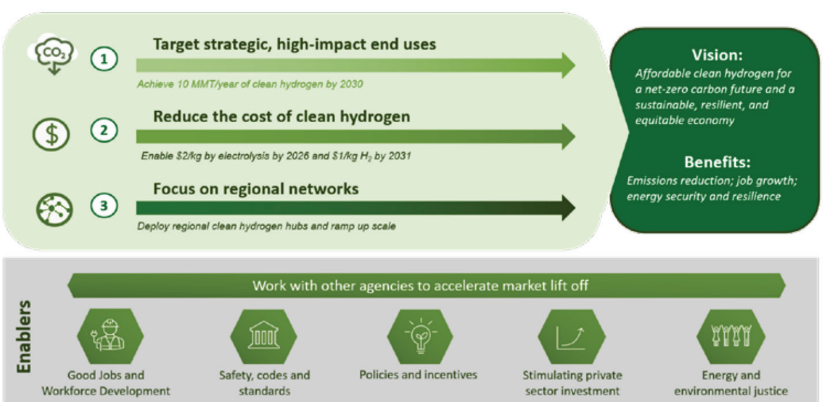

Figure 8-1. Hydrogen Strategies and Enablers

Source: U.S. National Clean Hydrogen Strategy and Roadmap

[61] U.S. Department of Energy Loan Programs Office, *Advanced Nuclear Energy Projects*, August 19, 2024. https://www.energy.gov/lpo/advanced-nuclear-energy-projects.

Geothermal has significant potential to provide clean, reliable, and flexible electricity across the United States. The federal Enhanced Geothermal Shot prioritizes support of enhanced geothermal energy deployment across the country (Figure 8-2). Following are examples of these types of state drivers.

Figure 8-2. DOE's Enhanced Geothermal Shot

Tennessee – *Carrying a nuclear energy legacy forward.* Tennessee is looking to capitalize on nuclear's position in the future electricity grid and build on the state's history with the technology. The state has hosted major nuclear research projects through the Manhattan Project and Oak Ridge National Laboratory and maintains a significant nuclear energy industry (Figure 8-3). In 2022, 45% of Tennessee's electricity came from nuclear energy. In addition, the state hosts the Watts Bar 2 plant, the first new nuclear reactor to reach service in the U.S. in the twenty-first century.[62]

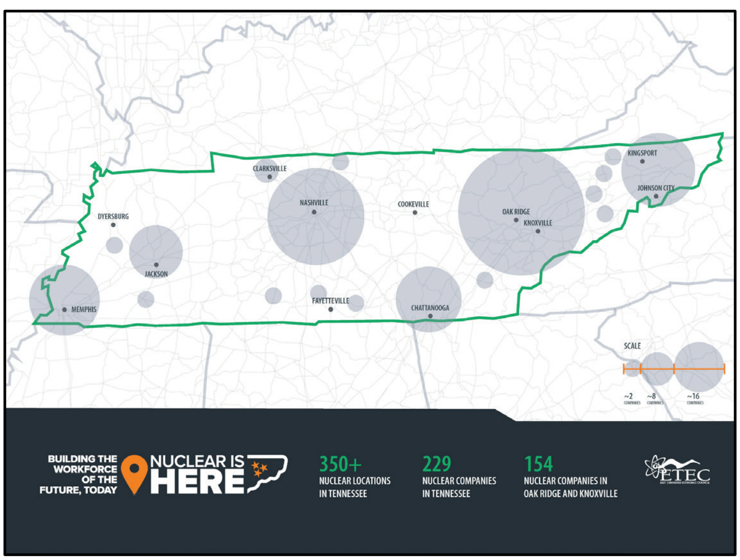

Figure 8-3. Tennessee's Nuclear Energy Industry

[62] U.S. Energy Information Administration. 2024. Tennessee State Energy Profile. https://www.eia.gov/state/print.php?sid=TN#:~:text=Tennessee%20Quick%20Facts&text=Tennessee's%20two%20nuclear%20power%20plants,of%20U.S.%20total%20refining%20capacity.

In 2023, Governor Lee took multiple actions to further nuclear innovation in the state, citing a desire to lead the country in nuclear advancement by attracting new companies and manufacturing capabilities. The Governor secured a $50 million Nuclear Fund in partnership with the state's General Assembly and launched the Advanced Nuclear Energy Advisory Council through Executive Order. The Task Force includes members from academia and research, utilities, government, the nuclear industry, and members at large. The state awarded funding in 2024 to Type One Energy, a company working to demonstrate stellarator fusion prototypes.[63] Other awards went to Roane State Community College and University of Tennessee, Knoxville, to develop nuclear energy curriculum. These awards are expected to contribute to a qualified workforce by training workers in advanced nuclear energy technologies.

TVA, a federal power marketing administration that provides electricity in the Southeast, is committed to nuclear energy. TVA identified aspirational goals to "develop and deploy a small modular reactor through federal partnership," and "become the nation's top-performing fleet by 2025." TVA received the first site permits in the country for small modular reactors, has exemplary safety ratings at all seven nuclear units, and won an award for innovative nuclear energy safety in fiscal year 2023.

Utah – *Hydrogen for the future.* Utah recognizes the importance of hydrogen produced from zero-emission fuels to provide flexible electricity as needed, as well as its use for industrial applications and transportation. The state supports and hosts several advanced hydrogen projects. For example, the IPP Renewed project in Delta is converting a coal-fired power plant slated for retirement into an 840 MW combined-cycle natural gas plant that will use 30% hydrogen fuel immediately when it enters service and transition to 100% hydrogen fuel over time. The project will employ 800 workers during construction and preserve jobs previously held by workers at the coal plant. Intermountain Power Agency, a political subdivision of the state, owns the project. The Advanced Clean Energy Storage Delta project will support the IPP Renewed Project with over 300 GWh of clean energy storage in the area's natural salt domes (Figure 8-4).

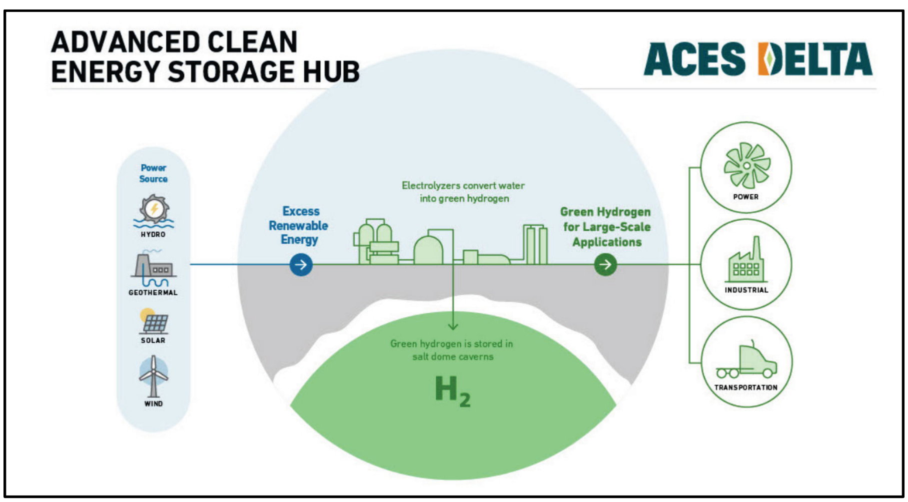

Figure 8-4. Advanced Clean Energy Storage Delta Conceptual Project Illustration

[63] For information on Type One Energy's technology, see https://typeoneenergy.com/our-technology/.

DOE's Loan Programs Office awarded the project more than $500 million in financing (Figure 8-5). Utah's hydrogen projects take advantage of the state's unique geology and geography and will help spur a regional market for hydrogen for electricity, transportation, and industrial uses.

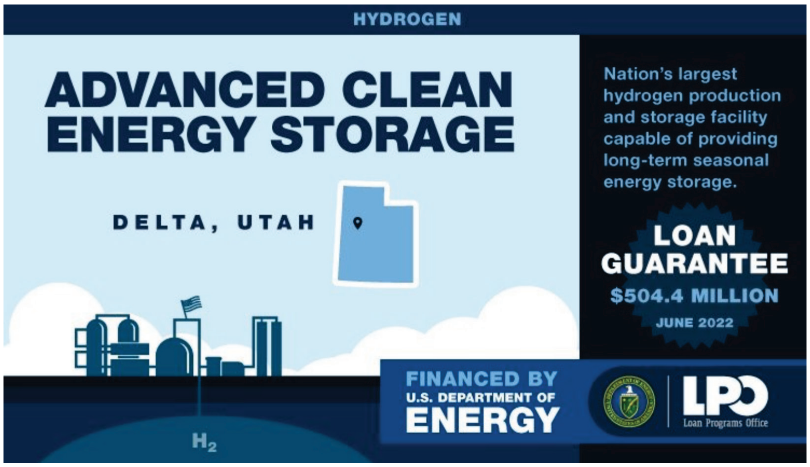

Figure 8-5. Illustration of Utah's Advanced Clean Energy Storage Loan

Pennsylvania – *Repurposing infrastructure to serve new purposes.* Pennsylvania has a long history of oil and gas development and is home to hundreds of thousands of abandoned oil and gas wells, a major source of methane emissions—a powerful greenhouse gas. The state offers financial support for entities that plug these wells to reduce potential public impacts and has supplemented state funding to plug orphaned wells with IIJA funding. Governor Shapiro identified this as a priority in his energy plan (Figure 8-6).

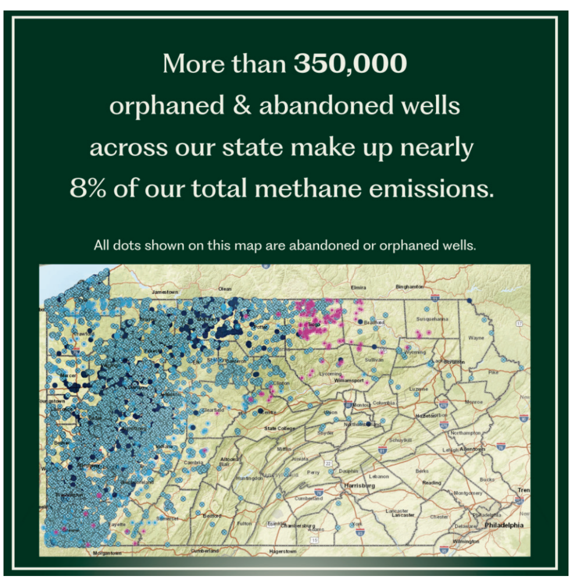

Figure 8-6. Pennsylvania's Orphaned and Abandoned Wells
Source: Governor's Energy Plan

The state also is exploring conversion of oil and gas wells to produce clean geothermal heat through ground-source heat pumps. Given the state's long history of drilling, workers' expertise could be redeployed for exploration of geothermal opportunities, particularly for heating applications. The Commonwealth offers grants to support geothermal system development.

8.2 Other Sources of Carbon Emissions

States may see opportunities to reduce emissions beyond electricity and heating. This chapter provides examples of states reducing emissions with initiatives targeted at other sectors.

Utah – *Reducing emissions from refineries and commuting.* Utah is prioritizing better air quality and emissions reductions in these two key areas.

Five oil refineries in Utah are subject to U.S. Environmental Protection Agency (EPA) fuel standards to reduce emissions from vehicles by producing cleaner (Tier 3) fuels. As small producers, EPA gave all of these refineries more time to meet the standards. However, Utah created a tax credit to help refineries meet the requirements and transition to cleaner fuel development on an expedited timeline. The High Cost Infrastructure Tax Credit offsets 30% of construction costs for Tier 3 fuel projects if they meet investment thresholds and other program requirements.[64] Figure 8-7 illustrates multiple benefits of these fuels.

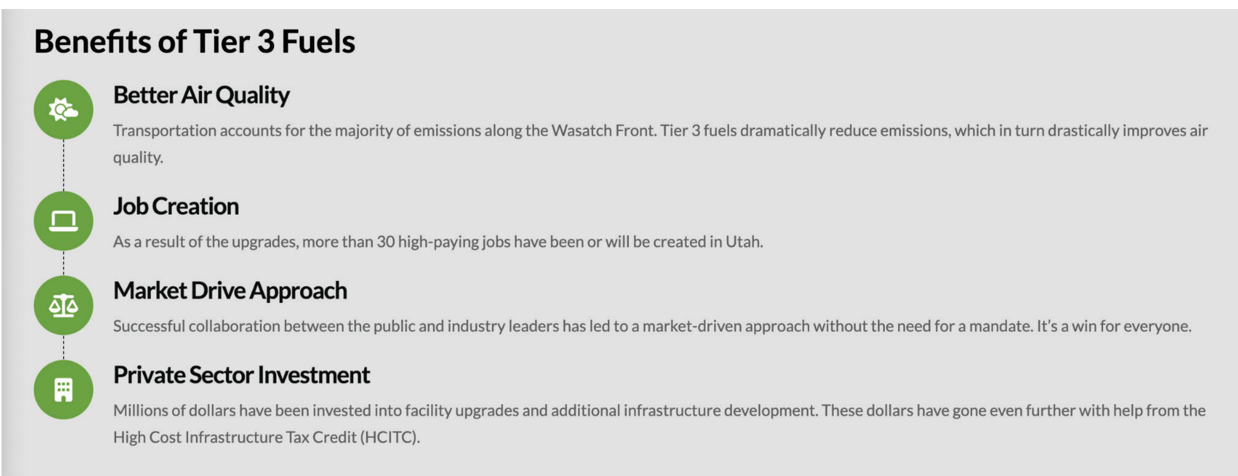

Figure 8-7. Benefits of Tier 3 Fuels

Source: Utah Office of Energy Development

As another means of improving air quality, Utah formalized a telecommuting program for state workers following a successful pilot by the Governor's Office of Management and Budget[65] in 2018

[64] Utah Office of Energy Development, *What are Tier 3 Fuels?*, https://energy.utah.gov/homepage/technology/tier-3-fuels/.

[65] Now the Office of Planning and Budget.

(Figure 8-8). The program, "A New Workplace: Modernizing Where, How, and When Utah Works," aims to recognize shifts in the modern workplace and prioritize performance over presence.

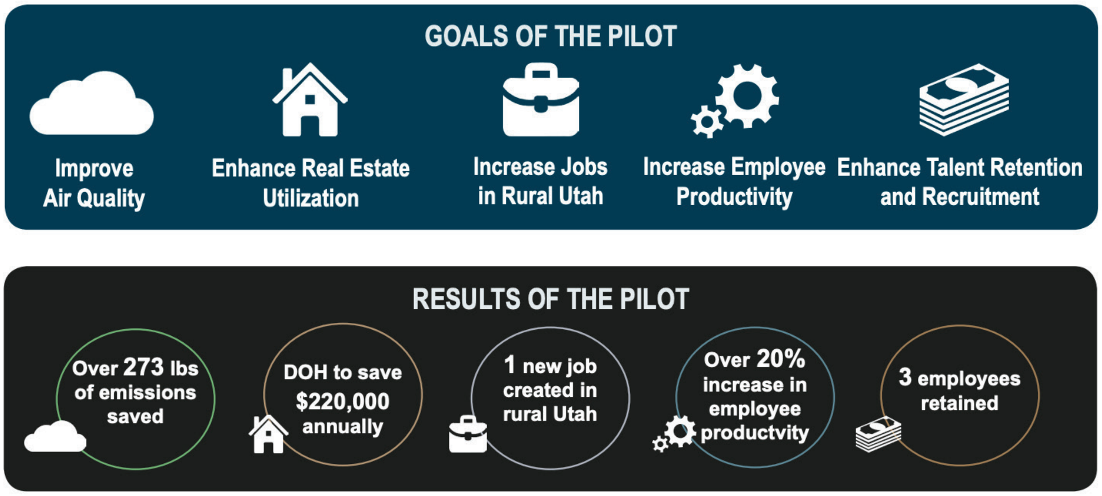

Figure 8-8. Utah's 2018 Telework Pilot Program Goals and Results

Following the pilot, teleworking expanded significantly in Utah due to the COVID-19 pandemic, resulting in the following impacts in 2020:

- ~2,600 lbs./month of avoided emissions for long-term remote workers and ~5,500 lbs./month during the COVID-19 pandemic
- 207 rural jobs created
- 135 employees retained or recruited
- Over 94,000 square feet of office space exited, resulting in improved building efficiency

The program also resulted in a remote work policy requiring agencies to direct employees with appropriate positions to telecommute on days with bad air quality. The policy aims to reduce negative impacts for sensitive populations, improve air quality overall, help workers save money on gas, and reduce the number of sick days.

Pennsylvania – *Engaging industry partners for federal funding and emissions reductions.* Industry is the largest emitter of greenhouse gases in Pennsylvania. The Governor's office communicates directly with industry partners to encourage them to take advantage of available federal tax credits and incentives that could help reduce their emissions.

EPA awarded almost $400 million to Pennsylvania under the IRA to fund a grant program called Reducing Industrial Sector Emissions in Pennsylvania (RISE PA). The grant program targets a 5% reduction in the state's industrial greenhouse gas emissions by providing grants to projects that cut emissions, including investment in low- or zero-carbon process heat systems like electric heat pumps or combined heat and power systems, carbon capture utilization and storage equipment, energy efficiency and waste reduction programs, and electrification projects. The program benefits state residents by taking advantage of available federal funding in a manner that will reduce statewide emissions, create jobs, and support the economy.

8.3 Other Policy and Regulatory Objectives

State legislatures, regulatory commissions, and other state agencies establish policies, regulations, and programs that can support multiple objectives, including emissions reductions.

Texas – *Anticipating renewable energy growth*. While Texas is the top crude oil- and natural gas-producing state in the nation,[66] it also is a leader in renewable energy generation. In 2023, Texas produced the most wind energy of any state, amounting to nearly 30% of the country's wind power. The state was second only to California in solar energy production. In total, Texas produced about 16% of the country's renewable energy in 2023. It has abundant solar and wind resources, as well as available land for power plant development, and has seen significant growth in renewable energy production over the last decade (Figure 8-9).[67] These resources provide carbon-free electricity for the state.

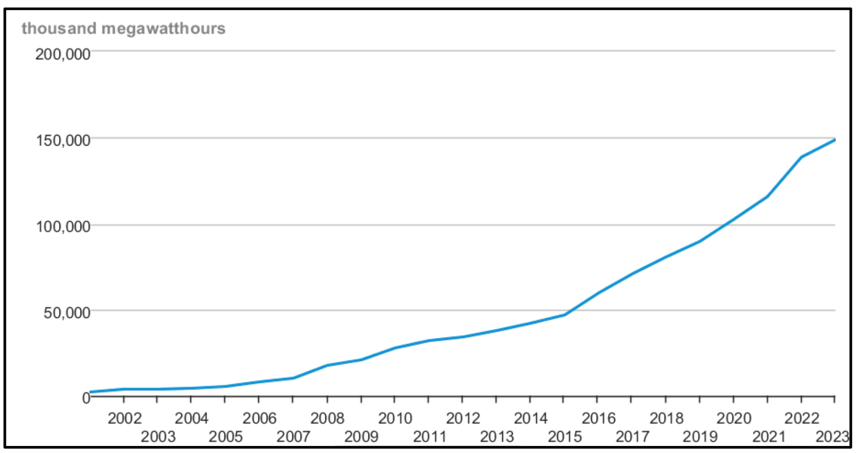

Figure 8-9. Texas Net Generation from Renewable Resources Other than Hydroelectric[68]

The state's generation interconnection policies and practices support renewable energy growth. In both 2021 and 2022, ERCOT interconnected the most capacity of any regional transmission organization (RTO) or Independent System Operator (ISO) in the country (Figure 8-10).

[66] U.S. Energy Information Administration (EIA), 2024, *Texas State Energy Profile,* https://www.eia.gov/state/print.php?sid=TX.
[67] U.S. Energy Information Administration (EIA), 2024, *Texas: State Profile and Energy Estimates*, https://www.eia.gov/state/analysis.php?sid=TX.
[68] U.S. Energy Information Administration (EIA), 2024, *Electricity Data Browser*, https://www.eia.gov/electricity/data/browser/.

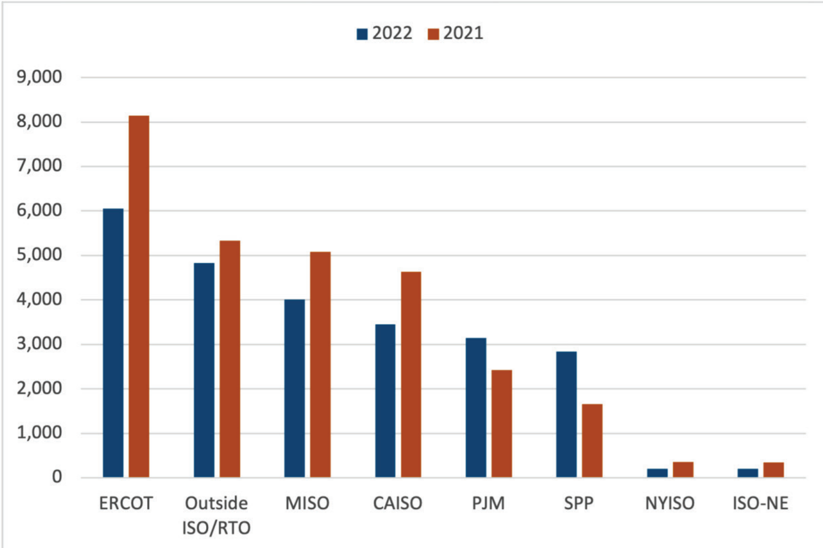

Figure 8-10. Interconnected Capacity by RTO/ISO and Regions Not Covered by an RTO or ISO[69]

Importantly, interconnection policies in Texas are understandable and predictable. The process that ERCOT uses for interconnection, called "Connect and Manage," is different than in most other regions. It does not require interconnection customers to pay for network upgrades to accommodate their resources, a common barrier to interconnection because customers can face high and uncertain network upgrade costs. Instead, ERCOT's approach manages network upgrades through proactive transmission planning outside of the interconnection process. Connect and Manage allows generators to interconnect to the system and addresses network constraints using resource curtailment. This approach reduces the scale and cost of required interconnection studies, significantly reducing interconnection times. According to one study, these types of practices reduced interconnection times by five years.[70]

Many stakeholders are focused on interconnection reform to help meet growing electricity demand and connect clean resources to the grid. In 2023, FERC issued a decision on interconnection reform, with Commissioner Clements' concurrence pointing to ERCOT's process for further exploration.[71] Interconnection reform also is important in light of coal plant retirements in many states.[72]

Kentucky – *Creating viable financing for asset retirement.* In 2023, Kentucky joined at least 23 other states addressing a growing issue associated with fossil-fuel plant retirement and utility stranded assets. When power plants retire before they are fully depreciated, customers may have to bear costs in electricity rates for infrastructure that is no longer used and useful. Securitization is a financing option that aims to help the utility secure lower cost financing by creating a tradeable and secure asset

[69] Norris (2023). Acronyms include: Midcontinent ISO (MISO), California ISO (CAISO), Southwest Power Pool (SPP), New York ISO (NYISO), and ISO New England (ISO-NE).
[70] Norris (2023).
[71] Norris (2023).
[72] Kline (2024).

backed by customer rate payments. This lowers the overall cost to customers compared to cost recovery without the use of securitization.[73]

Kentucky's electricity generation is dominated by coal-fired power plants (Figure 8-11). Utilities are preparing to convert and retire coal units. Duke Energy Kentucky's plans indicate that conversion of its East Bend coal plant to include natural gas cofiring capabilities will support compliance with the EPA's Clean Air Act updates, potentially reduce customer costs, and improve fuel diversity. Louisville Gas and Electric and Kentucky Utilities plan to retire 600 MW of coal-fired capacity and invest in replacements, including more than 1,000 MW of solar energy and battery storage, additional contracts for third-party solar energy, and 14 new energy efficiency programs.

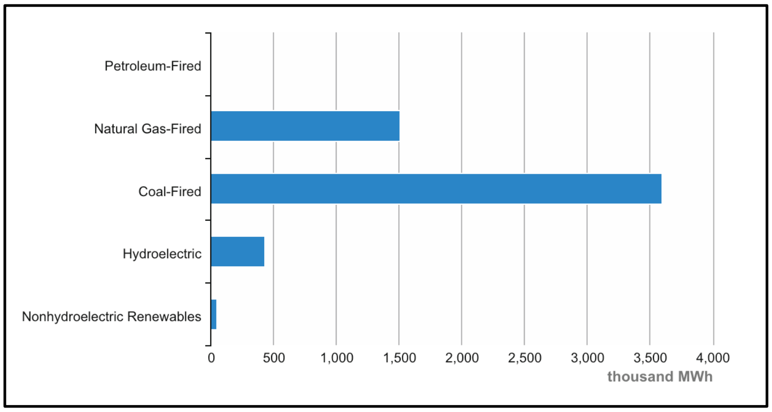

Figure 8-11. Kentucky's 2022 Net Electricity Generation Mix

These retirements follow enactment of SB 192 (2023), which allows investor-owned utilities to apply for securitization of costs associated with extraordinary investments and power plant retirement. For a single asset, the total cost must be over $200 million. Applications can group together multiple assets if the total value is over $275 million. The law specifies that applications should demonstrate benefits for customers compared to other financing options. Securitization of coal plants has provided such benefits in other states (Table 8-1), while also driving carbon emissions reductions.

Table 8-1. Examples of Benefits from Securitization for Coal Plant Retirements

Plant	State	Bond term	Retirement year	Amount securitized	Estimated savings to customers
D.E. Karn Units 1 & 2 (544 MW)	MI	8 years	2023	$677.7 M	≈ $126 M
Trenton Channel (536 MW) & St. Clair generation (1,547 MW) plants[4]	MI	≤ 15 years	2022	$601.6 M	≈ $51.5 M
AB Brown Units 1 & 2 (530 MW)	IN	18 years	2023	$350.125 M	≈ $60 M
Asbury Unit 1 (200 MW)	MO	15 years	2020	$82.9 M	≈ $25 M

[73] Kline (2024).

9. State IIJA and IRA Activities

Two historic laws invest in key areas to improve the country's economy, competitiveness, and climate readiness. The 2021 Bipartisan Infrastructure Law, also called the Infrastructure Investment and Jobs Act (IIJA), provides billions in funding to states, localities, Tribes, and others for transportation, climate, energy, environment, broadband, and additional projects (Figure 9-1). The 2022 Inflation Reduction Act (IRA) created a suite of funded programs to promote innovation, reduce consumer costs, and spur a clean energy economy.

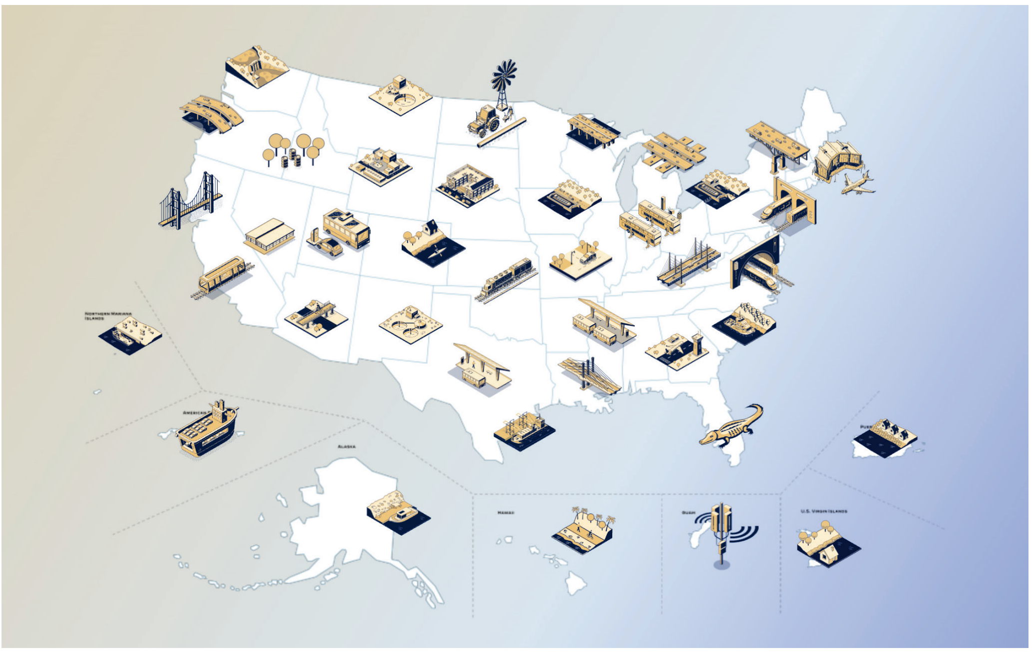

Figure 9-1. Illustration of IIJA-Funded Projects Across the U.S.

Both pieces of legislation provide significant funding for investments, many of which are explicitly targeted at reducing emissions that contribute to climate change and improving climate resilience. Other investments are focused on related areas that also result in reduced emissions. States are securing funding to support their own goals, including:

- Planning for and tracking funding opportunities
- Securing grid resilience funding
- Improving safety and efficiency of homes, schools, and other buildings
- Seeking funding for transportation systems, deployment of American-made technologies, and ecosystem restoration

This chapter highlights ways that states have used IIJA and IRA funding to support their priorities while also reducing emissions. States can draw on these examples to identify priority funding opportunities or to deploy their own programs in these areas.

9.1 Planning for and Tracking Funding Opportunities

Many different entities can apply for and receive funding through the IIJA and IRA. State agencies can increase awareness of funding opportunities, encourage stakeholders to apply for funding, foster coordination of applications across stakeholders, and ensure that related plans and programs account for the new federal funding and resulting programs and projects.

For example, utilities can re-evaluate electricity planning assumptions to account for the impacts of these federal incentives on technology costs and adoption as well as load forecasts. They can evaluate opportunities for retirement or conversion of fossil-fuel power plants and incorporate additional policy considerations such as deployment of energy technologies for low-income households. Regulators can consider requiring consideration of federal funding opportunities in utility plans. State energy offices can contribute their knowledge of how programs will be deployed across the state and apply for federal funding opportunities themselves.[74] These steps help ensure that plans are based on the most current information and that planners are making investment decisions considering all relevant information, avoiding unnecessary investments and accelerating deployment where warranted.

Utah – *Data visualization and transparent tracking of opportunities and awards*. In Utah, the Governor's Office of Planning and Budget provides a public repository of IIJA and IRA opportunities as well as awards—individual projects, by category, and totals. The state anticipates receiving over $5 billion in funding from the IIJA alone through fiscal year 2026 (Table 9-1).

Table 9-1. Utah's Anticipated IIJA Funding by Category for FY 22-26

ANTICIPATED FUNDING CATEGORY TOTALS ($ in thousands)	
$56,106	Resiliency
$2,901,360	Roads and Highways
$751,503	Public Transit
$212,951	Rail and Airports
$43,959	Environmental Remediation
$71,508	Energy
$407,445	Broadband and Cybersecurity
$583,099	Water
$5,027,931	**TOTAL ANTICIPATED**

The tracker provides detailed information on funding opportunities such as federal notices, eligible project locations, responsible agencies, funding amount, and whether the program is competitive or formula funding. Data visualization options include what types of entities are eligible for each opportunity, grant timelines, whether the state is pursuing the grant, and application requirements.

[74] Fitch, Gold, Wilson, Stephan, Shwisberg, and Wilson (2024).

South Carolina – *Utility reporting on IIJA and IRA funding.* The South Carolina PSC ordered that regulated utilities provide semi-annual reports on their efforts to secure IIJA funding and IRA funding, how the PSC can reduce any regulatory obstacles to receipt of funding, and net benefits accrued to customers from these federal funds. For example, Dominion Energy describes the following anticipated benefits:

- Improved service quality and reduced downtime from enhanced resilience and reliability
- Operational efficiencies and cost savings from modernizing equipment
- Reduced carbon emissions and improved sustainability from increased renewable energy
- Job creation and economic growth

Missouri – *Gathering information on IIJA funding for regulatory proceedings.* In 2022, the PSC established a repository to gather information, comments, and other documents on applicability of the IIJA and IRA to the state's investor-owned utilities. The proceeding kicked off with a workshop where organizations representing state and federal government agencies, environmental organizations, community groups, utilities, and industry offered presentations on opportunities and priorities for IIJA funding, including the utilities' grant review process (Figure 9-2).[75] Presentations covered topics such as siting renewable energy projects, supporting senior citizens to pay their utility bills, and planning for EV charging infrastructure. The PSC ultimately adopted reporting requirements for the covered utilities, and utilities provided status reports in 2023.

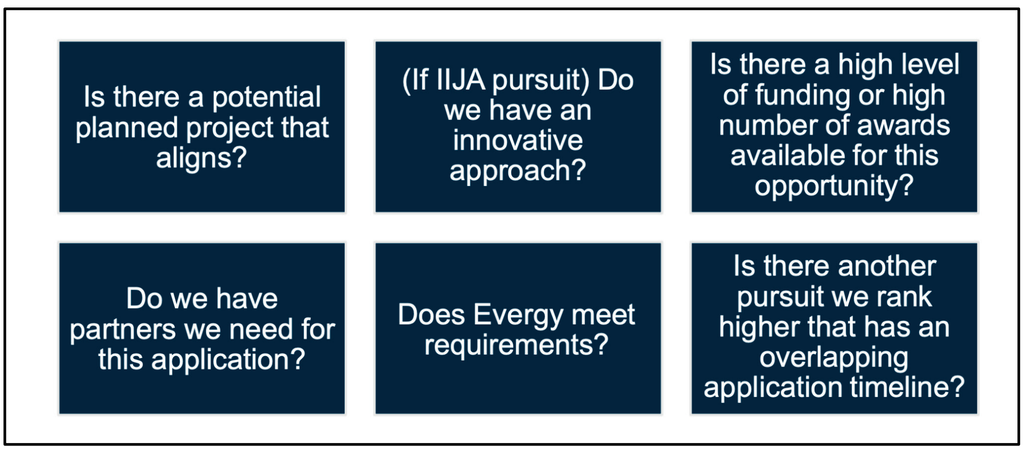

Figure 9-2. Guiding Questions for the Evergy Missouri's IIJA and IRA Grant Review Process

9.2 Securing Grid Resilience Funding

DOE's Grid Deployment Office is issuing IIJA funding under multiple programs that finance and invest in grid modernization, transmission deployment, energy generation, and resilience. Together, the Grid Resilience State/Tribal Formula Grant Program and the Grid Resilience and Innovation Partnership

[75] See Docket No. AW-2023-0156 at https://efis.psc.mo.gov/Case.

(GRIP) Program are providing more than $12 billion to support projects that will improve the ability of electric grids to withstand and recover from severe weather and improve grid flexibility and reliability.

Indiana – *Coordinated hazard mitigation to prevent power outages.* DOE's Grid Deployment Office awarded $9.2 million to the Indiana Office of Energy Development under the Grid Resilience State/Tribal Formula Grant Program to improve the grid's resilience to natural hazards.[76] Importantly, Indiana's program is designed to support the State's Energy Security Plan (SESP), which is embedded in the overall State Emergency Operations Plan. The plan describes that, "Alignment with the SESP will ensure critical investments are made to protect from and withstand higher probability threats that are more specific to Indiana's environment (i.e., tornadoes and severe thunderstorms are a much higher probability to occur in Indiana than a widespread wildfire, for example). This will, in turn, ensure communities are receiving the greatest possible benefits from these investments." The program outlines three key objectives and metrics to track progress (Table 9-2).

Table 9-2. Indiana's Grid Resilience Program Objectives and Indicators of Success

Objective	Metrics
Improve electric reliability by reducing service interruptions	Number of customers impacted by investments ● Baseline and post-investment outage duration and frequency measurements at the system, feeder, and customer levels
Ensure availability of power to critical services (public safety, communications, medical, and transportation systems) during disasters	● Baseline and post-investment, critical customer measurements of: ○ Hours of outages ○ Percentage of critical customers experiencing outages ○ Time to restoration ○ Cost of restoration
Attract, train, and retain a diverse, highly skilled, and well-paid workforce	Number of jobs from the program ● Labor standards used for employees and contractors (e.g., local hiring agreements) ● Average hourly wage ● Potential training partners, including those that will support inclusion of underrepresented or historically excluded workers and those displaced by the energy transition

Natural disasters have an immense impact on communities when they affect the ability of first responders to do their jobs and when power availability is the limiting factor for survivability and restoration. Indiana's program aims to address those root causes and improve overall community resilience by investing in the grid. Eligible investments include power line relocation and

[76] This is funded through section 40101(d) of the IIJA.

reconductoring, fire prevention systems, undergrounding of electrical equipment, hardening of lines and substations, use of DERs to improve system adaptation during events, and advanced modeling technologies. The program favors investments in communities where outages have historically been more frequent or sustained, equipment maintenance will be prioritized, the project will result in sustained workforce development, and the project will directly impact critical infrastructure.

Louisiana – *Helping disadvantaged communities withstand severe weather with microgrids.*[77] In 2023, DOE's Grid Deployment Office awarded about $55 million to Entergy New Orleans under the GRIP Utility and Industry Grants portion of the IIJA. In alignment with the utility's Operation: Gridiron effort, the project includes transmission and distribution system hardening, as well as battery backup. The utility is expecting to avoid over 10 million hours of customer outages. Almost 90% of the customers served by the project are in disadvantaged communities in New Orleans East. The utility expects these customers to see lower energy bills. Entergy New Orleans established a Community Benefits Advisory Board for the project and is engaging community partners on workforce development, including a community college and the New Orleans Career Center, a nonprofit organization working to support formerly incarcerated people. The utility will place students in paid internships, train individuals in lineworker programs, and train 1,000 students for clean energy jobs. The utility also will support diverse and local contracting by working with local chambers of commerce.[78,79]

Pennsylvania – *Improving health and resilience for underserved communities.* Pennsylvania is allocating $16.2 million of IIJA funds to reduce grid disruptions, improve community health, promote strong labor standards, and serve impacted communities (Figure 9-3). The program will competitively fund measures such as vegetation management, microgrids, line hardening, and weatherization technologies.

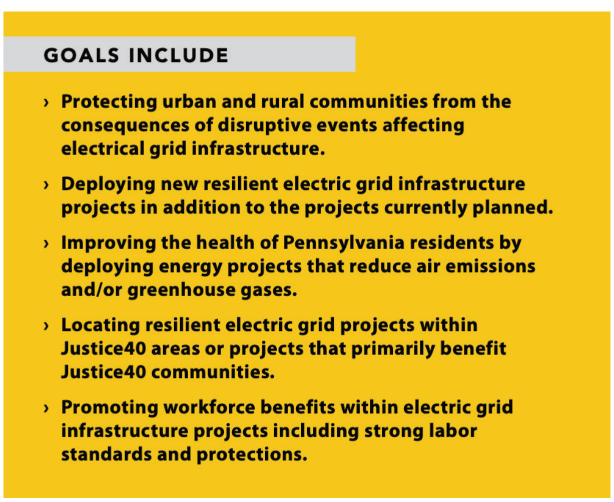

Figure 9-3. Goals for Pennsylvania's 2023 Formula Grid Resilience Grant Award

[77] Disadvantaged communities are identified using the White House Climate and Economic Justice Screening Tool. See https://www.energy.gov/justice/justice40-initiative.
[78] Grid Deployment Office (2023).
[79] Entergy New Orleans (2023).

The Department of Environmental Protection stated that it is looking for projects that are "innovative, advanced, and transformative." As of July 2024, the department awarded $15 million to electric distribution companies to improve grid resilience and reliability.

9.3 Improving Safety and Efficiency of Homes, Schools, and Other Buildings

The IIJA and IRA provide significant funding on both a competitive and formula basis to improve buildings across the country. That includes $6.5 billion under the IIJA for efficiency and weatherization.[80] The IRA includes funding and tax credits for home efficiency rebates, home electrification and appliances, contractor training, assistance to states to adopt the latest building energy codes, and green and resilient retrofits.[81] The programs reduce emissions and improve indoor air quality, occupant comfort, productivity, and learning outcomes.

States can leverage these incentives to maximize savings. For example, states may see an increase in participation in existing energy efficiency programs, enabling utilities to reach higher targets with the same level of utility customer funding. States also can adjust energy efficiency resource standards to consider IIJA and IRA funding. For example, the Colorado PUC required Public Service Company of Colorado to update or perform a new energy efficiency potential study to better understand the impact of increased funding and reduced utility costs due to IRA incentives.

States also can consider how the Home Efficiency Rebates and Home Electrification and Appliance Rebates, collectively called the Home Energy Rebate, can be leveraged with existing efficiency programs to amplify benefits and reduce costs. State implementation began in mid-2024. DOE has announced programs in several states, including Arizona and Georgia. States can explore opportunities to leverage IRA funding (Missouri, South Carolina) and educate customers and contractors on how to take advantage of the incentives and tax credits to maximize participation in efficiency programs.[82]

Ohio – *Stacking incentives to boost adoption.* States can use federal funds to supplement existing programs to reduce barriers to participation and improve the reach and impact of programs. The Ohio Office of Energy and the Environment, under the Department of Development, is pursuing this type of "stacking" of funds while ensuring that benefits accrue to disadvantaged communities. The office offers a suite of energy efficiency programs. The Brightening Ohio's Communities Grant Program, funded through the IIJA's Energy Efficiency and Conservation Block Grant program, provides funding to projects that will improve energy efficiency of lighting in public spaces like community center parking lots, ball fields, and roadways. Projects are expected to result in utility savings of between 16% and 77%. Governor DeWine stated, "By doing something as simple as replacing old streetlights, we're helping free up resources that can be redirected to vital community services like education and public safety."[83]

80 The White House (2022).
81 Glassman, Hill, and Jaglom-Kurtz (2023).
82 As Wisconsin has done.
83 DeWine (2024a).

Ohio offers multiple grant programs and financing for building efficiency upgrades funded through the state's Advanced Energy Fund, DOE's State Energy Program, and IIJA's Energy Efficiency Revolving Loan Fund Capitalization Grant Program.[84] The Advanced Energy Fund provides grants for projects that will save energy, avoid emissions, and create jobs. Eligible projects include energy management controls, weatherization measures, lighting improvements, combined heat and power systems, heating and cooling upgrades, and other measures that result in at least a 15% reduction in energy use or have no more than a 15-year simple payback period. The program awarded $8.5 million for a range of projects, including transforming a vacant building into a 116-unit housing development with healthcare resources. Expected utility savings under the program range from about 19% to 94%.[85,86]

The Energy Loan Fund provides low-interest financing of up to $2.5 million for businesses, colleges and universities, school districts, and others to install efficiency measures, which can be bundled with renewable energy technologies. The Ohio Nonprofit Hospitals and Schools Energy Efficiency Grant focuses on hospitals and schools that serve low-income and disadvantaged populations. Ohio was also awarded over $3 million in 2024 to capitalize a revolving loan fund for such entities.

Missouri – *Achieving multiple benefits from upgrading schools.* The Renew America's Schools Program, funded through the IIJA, provides grants and prizes for infrastructure upgrades and energy management at high-need public K–12 schools (Figure 9-4). When it launched, the program offered $500 million for energy efficiency and renewable energy programs at schools to decrease energy costs and improve learning environments. After receiving over 1,000 concept papers and $1.62 billion in funding requests in the first round, DOE increased funding for the program. The program has funded improvements at 410 facilities and benefited almost 200,000 students.

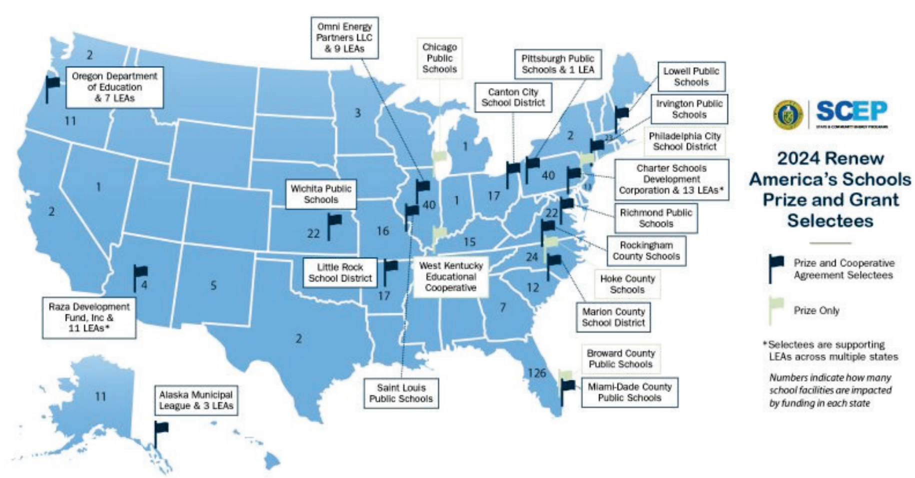

Figure 9-4. 2024 Renew America's Schools Prize and Grant Selectees

[84] Ohio Department of Development (2023).
[85] DeWine (2024b).
[86] DeWine (2024c).

St. Louis Public Schools was selected for a $300,000 prize for upgrading buildings to create meaningful benefits for students. In August 2024, the district was selected to move on to the second and third phases of the program (Figure 9-5). The district will receive over $11 million to address critical deferred maintenance at school buildings that serve as community shelters, offer career and technical education, and have a majority minority district.[87]

Figure 9-5. 2024 Renew America's Schools Prize and Grant Structure

9.4 Securing Funding for Transportation Systems, Deployment of American-Made Technologies, and Ecosystem Restoration

As of September 2024, the IIJA and IRA provided over $2 billion for projects that will strengthen domestic clean energy supply chains, out of $13 billion available for that sector. Another $1.3 billion is available for methane reduction, one type of environmental remediation and monitoring program funded by the IIJA and IRA.[88] Following are a few examples of how states are leveraging these federal dollars across various sectors to support a variety of objectives.

Arizona – *Improved mobility for underserved communities.* The U.S. Department of Transportation's Rebuilding American Infrastructure with Sustainability and Equity grant program, funded through the IIJA, provides opportunities to build and repair critical elements of the country's transportation network. In 2022, the Phoenix Street Transportation Department was awarded $25 million through for a bike and pedestrian bridge that will connect residents to economic opportunities across Phoenix, Tempe, and Mesa.
The 3rd Street Rio Salado Bike/Pedestrian Project (Figure 9-7) aims to provide a multi-use bridge with

[87] A majority-minority district is an electoral district, such as a U.S. congressional district, in which the majority of the constituents in the district are racial or ethnic minorities. Wikipedia, n.d.
[88] U.S. Department of Energy Office of the Under Secretary for Infrastructure (2024).

improved lighting to connect residents to educational, economic, and lifestyle opportunities. The project is in a high-priority area where more than 20% of households do not have a personal vehicle. The project also will provide ecosystem restoration benefits to the river. Providing safe and efficient opportunities for pedestrians and bikers enables residents to use non-emitting transportation options in their daily lives.

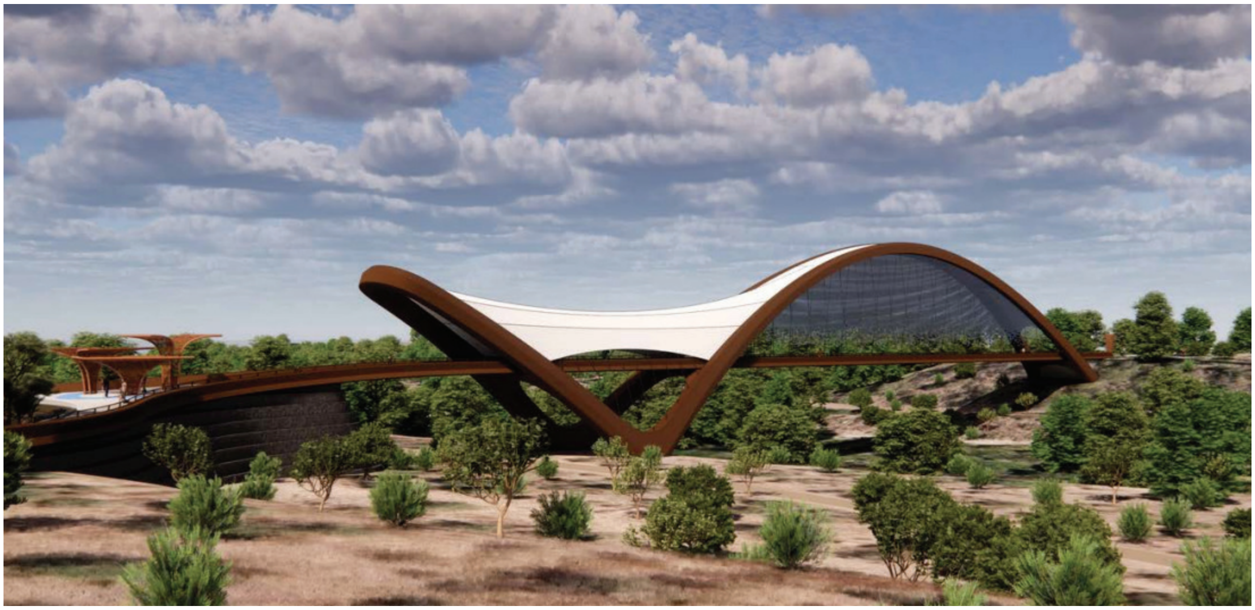

Figure 9-7. One of the Conceptual Designs for the 3rd Street Rio Salado Bicycle/Pedestrian Bridge

Kentucky – *Clean manufacturing spurred by federal investments.* DOE's Office of Manufacturing and Energy Supply Chains oversees many funding opportunities to enhance clean energy manufacturing in the country (for example, see Figure 9-8). In August 2024, Kentucky was selected as one of six states eligible for funding to adapt its significant automotive industry to support a domestic supply chain for EVs. The Domestic Automotive Manufacturing Conversion Grant Program, funded by the IRA, supports small- and medium-sized suppliers in adapting manufacturing facilities to maintain gainful jobs. In addition, a private company in Kentucky, Anthro Energy, was selected to receive almost $25 million to retrofit a manufacturing facility to produce advanced electrolytes for lithium ion batteries.

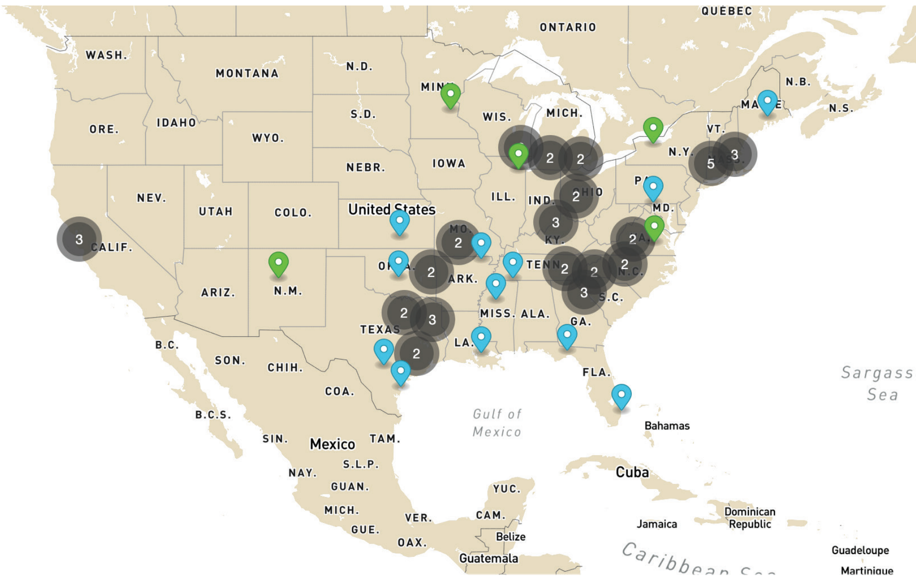

Figure 9-8. Snapshot of Investments in Manufacturing

Heat pumps and clean HVAC - blue; hydrogen electrolyzers and fuel cells - green

Florida – *Ecosystem restoration for improved drinking water quality.* The IIJA provides $1.1 billion for aquatic ecosystem restoration construction in the Everglades through the Comprehensive Everglades Restoration Plan and the South Florida Ecosystem Restoration program. The Everglades wetland is over 2 million acres. It provides critical habitat for threatened endangered species, is the source of drinking water for one-third of Florida's population, and acts as a carbon sink that helps to mitigate the impacts of climate change.

Human development has significantly impacted water flows in the Everglades (Figure 9-9).T U.S. Army Corps of Engineers administers a restoration plan in partnership with the South Florida Water Management Agency to restore and protect the region’s water resources.

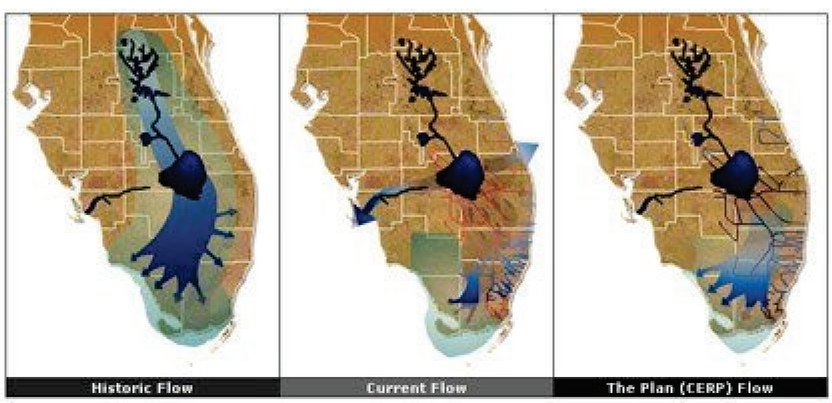

Figure 9-9. Historic and Future Flow of Water in South Florida

The significant increase in funding for the project will expedite restoration progress and expand its scope (Figure 9-10).[89] The U.S. Army Corps of Engineers planned to complete 15 feasibility studies, preconstruction and design for five projects, and 19 construction projects in fiscal year 2022, while also funding 22 construction projects in future years.

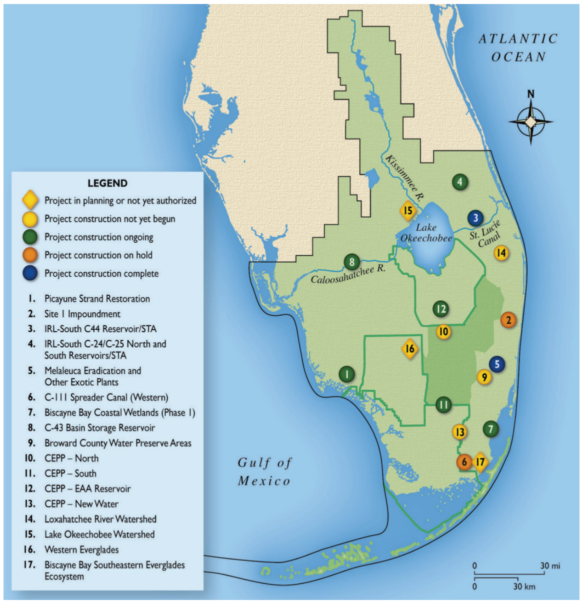

Figure 9-10. Comprehensive Everglades Restoration Plan Projects[90]

While the focus of the plan is to restore wetlands and improve drinking water quality and quantity, rather than reducing air emissions, restoration of marshes and bogs increases the ability of the soil and ecosystem to retain carbon. Other ecosystem restoration projects funded by the IIJA and IRA also could lead to reduced carbon emissions.[91]

[89] National Academies of Sciences, Engineering, and Medicine (2023).
[90] National Academies of Sciences, Engineering, and Medicine (2023).
[91] Congressional Research Service (2022).

10. References

Abinah, E. 2022. *Revised Staff Report and Proposed Order*. Docket No. E-00000A-21-0010, Filed September 28, 2022. https://docket.images.azcc.gov/E000021888.pdf?i=1669847644315.

Bird, Lori, and Katrina McLaughlin. 2023. "US Clean Energy Goals Hinge on Faster Permitting." *World Resource Institute*. February 9. https://www.wri.org/insights/clean-energy-permitting-reform-us.

Clean Investment Monitor. n.d. *Overview of Clean Investment in the U.S, Actual Manufacturing Investment by Technology*. https://www.cleaninvestmentmonitor.org/database. Accessed July 26, 2024.

Congressional Research Service. 2022. *Ecosystem Restoration in the Infrastructure Investment and Jobs Act: Overview and Issues for Congress.* https://crsreports.congress.gov/product/pdf/R/R47263.

Delaware Department of Transportation. n.d. Integrated Transportation Management Program. Innovative Transportation Management Projects. https://deldot.gov/Programs/itms/index.shtml?dc=projects.

DeWine, Mike. 2024a. G*overnor DeWine Announces $3.1 Million in Energy Efficiency Grants to Brighten Ohio Communities*. Press Release. https://governor.ohio.gov/media/news-and-media/governor-dewine-announces-3-million-in-energy-efficiency-grants-to-brighten-ohio-communities.

DeWine, Mike. 2024b. Governor DeWine Announces $3.1 Million in Grants to Support Energy Efficiency Projects Across Ohio. Press Release. *https://governor.ohio.gov/media/news-and-media/governor-dewine-announces-3.1-million-in-grants-to-support-energy-efficiency-projects-across-ohio*.

DeWine, Mike. 2024c. Governor DeWine Announces Additional $5.4 Million in Grants Toward Energy Efficiency Projects in 5 Counties. Press Release. *https://governor.ohio.gov/media/news-and-media/governor-dewine-announces-additional+-5.4-million-in-grants-toward-energy-efficiency-projects-in-5-counties*.

Driscoll, William. 2018. "U.S. utilities test distributed energy management." *pv magazine.* December 14. https://pv-magazine-usa.com/2018/12/14/u-s-utilities-test-distributed-energy-management/

Drive Electric Tennessee. n.d. *Working Groups and Participants.* https://www.driveelectrictn.org/working-groups-2/#Awareness. Accessed July 26, 2024.

Entergy New Orleans. 2023. *Entergy New Orleans Selected for $55M Federal Grant from Department of Energy*. Press Release. https://www.entergynewsroom.com/news/entergy-new-orleans-selected-for-55-million-federal-grant-from-department-energy/.

Fitch, T., R. Gold, Wilson, K. Stephan, L. Shwisberg, and G. Wilson. 2024. *Planning to Harness the Inflation Reduction Act: A Toolkit for Regulators to Ensure Resource Plans Optimize Federal Funding*. RMI. https://rmi.org/insight/planning-to-harness-the-inflation-reduction-act/.

Frick, N., A. Long, T. Light, G. Relf, A. Sandonato. 2025. *Reimagining energy efficiency resource standards.* https://emp.lbl.gov/efficiency-electrification-flexibility.

Glassman, J., S. Hill, and W. Jaglom-Kurtz. 2023. *IRA Program and Tax Incentive Summary*. RMI. https://rmi.org/breaking-down-the-inflation-reduction-act-program-by-program-incentive-by-incentive/.

Grid Deployment Office. 2023. *Fact Sheet: Improving New Orleans Community Resilience.* https://www.energy.gov/sites/default/files/2023-12/DOE_GRIP_1120_Entergy%20New%20Orleans%2C%20LLC_v4_RELEASE_508.pdf.

Hegedus, S. 2023. *Statewide Survey of Delaware's Electric Utility Grid Modernization Status: Current Activities and Future Readiness*. University of Delaware Institute of Energy Conversion. June 19.

Kentucky Energy and Environment Cabinet. 2021a. *Governor Beshear Outlines Kentucky E3 Strategy.* https://eec.ky.gov/Energy/Pages/KYE3.aspx.

Kentucky Energy and Environment Cabinet. 2021b. *KYE3: Designs for a Resilience Economy.* https://eec.ky.gov/Energy/Documents/KYE3_Final_10.18.2021.pdf (page 9).

Kentucky Office of Energy Policy. 2023. *Report to the Kentucky Legislative Research Commission Pursuant to 2023RS SJR 79*. https://eec.ky.gov/Energy/Documents/Final%20Report%20SJR79_11.17.23.pdf.

Kline, K. 2024. *Mitigating Stranded Asset Risks to Utility Customers: An Exploration of Securitization and Retiring Coal Generation.* National Association of Utility Regulatory Commissioners (NARUC). https://pubs.naruc.org/pub/D41DAF2A-9425-50CD-C1E2-70B694AAC1A4.

National Academies of Sciences, Engineering, and Medicine. 2023. *Progress Toward Restoring the Everglades: The Ninth Biennial Review – 2022*. The National Academies Press. https://doi.org/10.17226/26706.

Norris, T. 2023. *Beyond FERC Order 2023: Considerations on Deep Interconnection Reform*, Duke Nicholas Institute for Energy, Environment, and Sustainability. https://nicholasinstitute.duke.edu/sites/default/files/publications/beyond-ferc-order-2023-considerations-deep-interconnection-reform.pdf.

Ohio Department of Development. 2023. Energy Loan Fund: Program Guidelines and Application Process Fiscal Years 2024 and 2025, 2023. *https://dam.assets.ohio.gov/image/upload/development.ohio.gov/community/redevelopment/09282023-2024-25-ELF-GUIDELINES.pdf*.

Pennsylvania Department of Environmental Protection. 2024. Alternative Fuels Incentive Grant Program *2024 Grant Program.* https://greenport.pa.gov/elibrary/GetDocument?docId=8360804&DocName=ALTERNATIVE%20FUELS%20INCENTIVE%20GRANT%20PROGRAM%202024.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%28NEW%29%3c/span%3e%204/29/2026.

Pennsylvania Department of Environmental Protection. 2022. Alternative Fuels Incentive Grant Fund 2021-22 Annual Report to the Pennsylvania Legislature. https://greenport.pa.gov/elibrary/GetDocument?docId=4906768&DocName=ALTERNATIVE%20FUELS%20INCENTIVE%20ACT%20PROGRAM%20ANNUAL%20REPORT%202021-2022.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%3c/span%3e

Pennsylvania Department of Environmental Protection and ICF Incorporated, L.L.C. 2020. *Pennsylvania RGGI Modeling Report.*

Pennsylvania Department of Environmental Protection Newsroom. 2022. *Wolf Administration Celebrates Driving PA Forward Grant Impact on Franklin County's Air Quality.* https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=22084&typeid=1.

Pennsylvania Public Utilities Commission. 2023. *Joint Statement of Vice Chairman Stephen M. Defrank and Commissioner Kathryn L. Zerfuss*. https://www.puc.pa.gov/pcdocs/1785651.pdf.

PNNL et al. 2023. *Enhancing Resilience in Buildings Through Energy Efficiency.* PNNL-32737, Rev. 1. Appendix A 1.0. July. https://www.energycodes.gov/sites/default/files/2023-07/Efficiency_for_Building_Resilience_PNNL-32727_Rev1.pdf.

Homer, J.S. et al. 2022. Considerations for Resilience Guidelines for Clean Energy Plans for the Oregon Public Utility Commission and Oregon Electricity Stakeholders. Pacific Northwest National Laboratory. https://edocs.puc.state.or.us/efdocs/HAH/um2225hah113046.pdf.

Quigley, J. 2024. *Heat Beneath Our Feet: Pennsylvania's Prospects for Geothermal Energy*. University of Pennsylvania's Kleinman Center for Energy Policy. https://kleinmanenergy.upenn.edu/news-insights/heat-beneath-our-feet-pennsylvanias-prospects-for-geothermal-energy/.

Ramasamy et al. 2023. U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2023. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy23osti/87303.pdf.

Schellenberg, J., and L. Schwartz. 2024. Grid Resilience Plans: State Requirements, Utility Practices, and Utility Plan Template. Lawrence Berkeley National Laboratory. https://emp.lbl.gov/publications/grid-resilience-plans-state.

State of Delaware. 2018. *Final Report of the Advisory Council on Connected and Autonomous Vehicles.* https://deldot.gov/Programs/autonomous-vehicles/pdfs/EO-14-Final-Report.pdf?cache=1722036561633.

The White House. 2022. Building a Better America. A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners. https://www.whitehouse.gov/wp-content/uploads/2022/05/BUILDING-A-BETTER-AMERICA-V2.pdf.

U.S. Department of Energy Alternative Fuels Data Center. n.d. *Electric Vehicle Benefits and Considerations*. https://afdc.energy.gov/fuels/electricity-benefits.

U.S. Department of Energy Alternative Fuels Data Center. n.d. *Electric Vehicle Benefits and Considerations*. https://afdc.energy.gov/fuels/electricity-benefits.

U.S. Department of Energy. 2014. *The History of the Electric Car.* https://www.energy.gov/articles/history-electric-car.

U.S. Department of Energy. 2023. *United States Energy and Employment Report 2023.* https://www.energy.gov/sites/default/files/2023-06/2023%20USEER%20REPORT-v2.pdf.

U.S. Department of Energy Office of the Under Secretary for Infrastructure. 2024. *Progress Update; Summer 2024 U.S. Department of Energy Bipartisan Infrastructure Law & Inflation Reduction Act Funding*. https://www.energy.gov/sites/default/files/2024-07/Summer%202024%20Progress%20Snapshot%20-%20Department%20of%20Energy%E2%80%99s%20Bipartisan%20Infrastructure%20Law%20and%20Inflation%20Reduction%20Act%20Funding.pdf.

Utah Office of Energy Development. 2022. *Utah Energy and Innovation Plan*. https://energy.utah.gov/plan/.