



Policy Options to Enable an Equitable Energy Transition

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About the Project

This report presents proposals to support an equitable energy transition with a focus on energy-producing communities, along with communities that have experienced a history of environmental and energy injustice. It is not intended to be comprehensive, but instead refines existing policy proposals and offers new ideas, drawing from the best available evidence on benefits, costs, and employment.

The views expressed here are those of the authors and do not necessarily reflect the views of their respective institutions or affiliations. The authors of each proposal are responsible for the analysis contained therein.

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The views expressed here are those of the individual authors and may differ from those of other RFF experts, its officers, or its directors.

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Contents

1. Introduction	1
1.1. Key Principles	1
1.2. Scope of This Analysis	2
1.3. Limitations	3
1.4. Programs Examined	3
2. Energy Infrastructure and Resilience	6
2.1. Residential Energy Affordability and Security	6
2.1.1. Weatherization Assistance Program	7
2.1.2. Low Income Home Energy Assistance Program	8
2.2. Investment in Rural Electric Utilities	9
2.3. Advanced Metering Infrastructure (Smart Meters)	10
2.4. Grid Modernization for At-Risk Communities	11
2.5. Hydropower Reinvestment	12
2.6. Energy Efficiency in Public Housing	13
2.7. Federal Energy-Efficiency Fund	14
2.8. Energy Efficiency: Race to the Top	15
2.9. Electric Vehicle Charging Infrastructure	16
2.10. 30C Alternative Fuel Infrastructure Tax Credit	17
3. Environmental Remediation	18
3.1. Superfund and Brownfields	18
3.2. Abandoned Mines	20
3.3. Underground Storage Tanks	21
3.4. Orphaned Oil and Gas Wells	22
3.5. Natural Gas Infrastructure	23
3.5.1. Downstream Methane Emissions Mitigation	23
3.5.2. Upstream Methane Emissions Mitigation	24
4. Economic Development	25
4.1. Rural Housing and Energy Resilience	26
4.2. Rural Broadband Expansion	27
4.3. Local Public Finances	28

4.4. Community Development Financial Institutions Funds	29
4.5. Expansion of Assistance to Coal Communities Program	30
5. Workforce	32
5.1. Energy Transition Adjustment Assistance Program	32
5.2. Energy Star Certification for Residential and Commercial Construction	33
5.3. Preapprenticeship Programs	34
5.4. Energy and Advanced Manufacturing Workforce Initiative	35
5.5. Retirement Benefits	36
6. Manufacturing and Innovation	38
6.1. 48C Advanced Energy Manufacturing Tax Credit	38
6.2. Department of Energy Loan Program Office	39
6.3. Advanced Research Projects Agency–Energy	41
6.4. Research in Carbon Capture, Utilization, and Storage and Direct Air Capture	42
6.5. Buy Clean Standard	43
6.6. USMCA Border Adjustments for Energy-Intensive, Trade-Exposed Industries	44
7. Other Topics	46
7.1. Revenue from Carbon Pricing	46
7.2. Coordination of Regional Policy Implementation	47
8. Footnotes	49

1. Introduction

Daniel Raimi, Resources for the Future

As the United States undergoes an unprecedented¹ shift away from carbon-intensive energy sources and towards a clean energy future, federal policy will play a major role in supporting workers and regions that are affected, including low-income, rural, and minority communities. The transition to clean energy will have particularly significant implications for people and places where coal, oil, and natural gas serve as a major driver of jobs and economic activity, and where consumers may be especially burdened by changes in the energy system.

This report lays out a variety of proposals to help enable an equitable energy transition. It is not intended to be a comprehensive strategy, but instead offers a menu of options that policymakers can choose among to enable this transition while enhancing energy equity and resilience, reducing environmental damages, spurring clean energy innovation, and supporting economic and workforce development in vulnerable communities.

1.1. Key Principles

In the weeks, months, and years ahead, policymakers in the United States and around the world will make decisions about which policies to implement to support an equitable energy transition. The following principles will be essential to guide any successful transition strategy, regardless of the specific policies that are ultimately chosen²:

1. There is no silver bullet or one-size-fits-all solution

Because of the required scale and speed of the energy transition, multiple policy types will be needed to adequately support communities affected by a shift away from coal, oil, and natural gas. What's more, affected communities differ widely in their histories, demographics, geographies, politics, and more. As a result, the federal government will need to use different tools in different contexts: the solutions that make sense for coal mining communities in Appalachia will differ from those in southwestern oil communities, low-income rural communities, environmental justice communities, and others.

2. Two-way engagement with communities and intergovernmental coordination will be critical

Because solutions will vary widely, and because local stakeholders have the best understanding of what their communities need, federal policy must engage early and often with local leaders, businesses, civil society, and other stakeholders. This engagement will need to be a true dialogue, where federal policy is guided by local priorities, and local stakeholders in turn have a clear understanding

of federal capabilities. In addition, deep and consistent engagement with local communities will be essential to overcome any distrust that stakeholders may feel toward federal intervention.

To accomplish this crucial task, the federal government will need to coordinate across multiple agencies and with local, state, and tribal governments. Multiple options exist for structuring this engagement, but regardless of the mechanisms employed, federal efforts will need to be guided by local priorities, with substantive involvement from local communities, and also be perceived as guided by those priorities.

3. Adaptive management, informed by research, will be needed

It is not possible to anticipate every aspect of how an energy transition will affect different workers and communities in the decades ahead. To effectively address new challenges and to seize new opportunities, policy efforts will need to adapt as new information becomes available. To facilitate this adaptation, federal funding for applied research, including data gathering and socioeconomic analysis, will be a critical input to guide policy changes over time.

1.2. Scope of This Analysis

This analysis recognizes that a transition to clean energy will affect the entire nation (and world) but focuses on four groups for whom the transition will have significant implications:

- those in communities whose economies have relied heavily on coal, oil, and natural gas as drivers of employment, prosperity, and public revenue;
- those who face challenges accessing reliable, affordable energy, both today and in the future;
- those who have faced historical environmental and energy injustices; and
- those who, absent policy intervention, may not benefit from the rise of cleaner and more efficient energy technologies.

As noted above, this analysis is not intended to be comprehensive. Instead, it offers a menu of options that policymakers may choose from to reduce greenhouse gas and other emissions while supporting an equitable energy transition. The specific proposals were selected by the authors and organized by the editor.

For each policy proposal, authors draw from the available evidence to assess policy design and estimate policy outcomes. These outcomes are focused on implementation costs and timeline, along with estimates of benefits, including environmental, employment, economic, and other effects. Where relevant, we reference the relevant sections of US Code to identify which proposals are authorized under current law and which would require new legislative authority. Finally, we reference recently proposed (and in some cases, enacted) legislation that would implement some version of the policy under consideration.

1.3. Limitations

This analysis has several limitations. First—as noted above—it is not intended to be comprehensive. To ensure an equitable energy transition, additional policies will likely be needed, and careful consideration would need to be paid to the timing, sequencing, and interactions of multiple policies.

Second, because it is broad in scope, it does not provide granular detail on policy design or implementation in most cases. Effective implementation and administration of the proposals included here would require careful consideration by policymakers in coordination with the relevant executive branch agencies.

Third, for some programs, evidence on the likely employment, economic, environmental, or other outcomes is limited. In these cases, we provide directional and qualitative assessments on the policy outcomes, based on the judgments of the authors.

Finally, because many of the proposals included here are currently under consideration in Congress and may be the subject of legislation in the weeks ahead, the authors believe it is valuable to share this analysis before it has undergone formal peer review. The document has been reviewed by all the authors, but each proposal is the product of the authors listed and is not necessarily endorsed by all authors.

1.4. Programs Examined

In the sections that follow, we discuss 35 policy proposals (Table 1) spanning six major categories:

- energy infrastructure and resilience;
- environmental remediation;
- economic development;
- workforce;
- manufacturing and innovation; and
- other topics.

Each section is introduced by one or more authors with expertise on the relevant topic, who provide context for how each policy type can play a useful role in supporting an equitable transition to a clean energy future.

For brevity's sake, we use abbreviations for major federal agencies and offices:

DOC	Department of Commerce
DOE	Department of Energy
DOI	Department of Interior
DOL	Department of Labor
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FERC	Federal Energy Regulatory Commission
GAO	Government Accountability Office
GSA	General Services Administration
HUD	Housing and Urban Development
HHS	Health and Human Services
IRS	Internal Revenue Service
USDA	US Department of Agriculture

Table 1. Programs to Help Enable an Equitable Energy Transition

Policy area	Program	Annual cost (billions)	Annual direct job-years (thousands)	Number of years
Energy infrastructure and resilience	Residential energy affordability and security: WAP	\$17.1	79	15
	Residential energy affordability and security: LIHEAP	\$7.6	33	5
	Investment in rural electric utilities	\$6.3	20	5
	Advanced Metering Infrastructure (Smart Meters)	\$3.2	11	5
	Grid modernization for at-risk communities	\$2.0	6	10
	Hydropower reinvestment	\$1.0	9	15
	Energy efficiency in public housing	\$0.7	5	10
	Federal energy-efficiency fund	\$0.5	2.4	10
	Energy efficiency: race to the top	\$0.1	not assessed	2
	Electric vehicle charging infrastructure	not assessed	not assessed	not assessed
30C alternative fuel infrastructure tax credit	not assessed	not assessed	not assessed	
Environmental remediation	Superfund and Brownfields	\$3.5	14	10
	Abandoned mines	\$1.1	5	10
	Underground storage tanks	\$1.0	5	10
	Orphaned oil and gas wells	\$0.9	6	5
	Natural gas infrastructure	\$0.03	0.3	10
Economic development	Rural housing and energy resilience	\$6.0	42	3
	Rural broadband expansion	\$3.5	53	10
	Local public finances	\$1.6	not assessed	10
	Community development financial institutions fund	\$0.1	not assessed	1
	Expanding the Assistance to Coal Communities program	\$0.06	not assessed	5
Workforce	Energy transition adjustment assistance program	\$2.0	not assessed	10
	Energy Star certification for residential & commercial construction	\$0.1	not assessed	10
	Preapprenticeship programs	\$0.1	not assessed	10
	Energy and advanced manufacturing workforce initiative	\$0.01	not assessed	10
	Retirement benefits	not assessed	not assessed	not assessed
Manufacturing and innovation	48C advanced energy manufacturing tax credit	\$9.0	68	5
	Department of Energy Loan Program Office	\$4.0	not assessed	1
	Advanced Research Projects Agency - Energy	\$1.0	not assessed	10
	Research carbon capture, utilization, and storage and direct air capture	\$1.0	not assessed	10
	Buy clean standard	not assessed	not assessed	not assessed
Other topics	USMCA Border adjustments for energy-intensive, trade-exposed industries	not assessed	not assessed	not assessed
	Revenue from carbon pricing	-\$250.0	not assessed	not assessed
	Coordination of regional policy implementation	\$0.3	not assessed	10

Note: For some programs, particularly loan programs, some or all spending would be recouped. Negative costs indicate additional revenue.

2. Energy Infrastructure and Resilience

Sanya Carley and David Konisky, Paul H. O'Neil School of Public and Environmental Affairs, Indiana University

The US energy transition will require massive deployment of energy efficiency and renewable energy technologies to homes, businesses, and communities; a nationwide modernization and expansion of the electricity grid; and the broadening of accessibility and affordability of clean energy technologies. Hastening the shift to cleaner, lower-carbon sources of energy requires changes in every sector of the economy and every corner of the country. This immense task will necessitate significant and sustained investment of financial resources, as well as human capital and ingenuity to ensure effective implementation.

To accomplish all that in an equitable and just way requires directing energy infrastructure and resilience investments to individuals and communities that are on the front lines of the energy transition. The adverse environmental and health effects of the United States' historical reliance on fossil fuels has been disproportionately borne by people of color, low-income people, and other vulnerable groups, and the transition to cleaner sources of energy may also create hardships for many of these same people. To avoid further burdening these individuals and communities, and to create opportunities for everyone to experience the benefits of the energy transition, it is imperative that policies and programs be designed and implemented in an inclusive and equitable way.

This section contains a portfolio of policy options that can help achieve important energy infrastructure and resilience goals. Some proposals involve creating new programs; others would expand existing programs. Each proposal is designed to meet the goals of addressing the climate crisis and other environmental problems while simultaneously investing in the well-being of individuals and the resilience of communities. Most of the proposed policies specifically target communities of color, low-income communities, and those on the front lines of the energy transition.

2.1. Residential Energy Affordability and Security

Sanya Carley and David Konisky, Paul H. O'Neil School of Public and Environmental Affairs, Indiana University

Tony Reames, University of Michigan School for Environment and Sustainability

Ensuring a just transition and enhancing energy system resilience include accounting for those who may struggle to pay higher energy bills. Energy insecurity—the inability to pay for energy bills or avoid utility disconnection—is already a widespread problem in the United States.³ In 2015, 17 million households were unable to pay their energy bills and 2 million were disconnected from the electric grid,⁴ an issue exacerbated by the Covid-19 pandemic.⁵ Two existing programs can help energy-insecure families: the Weatherization Assistance Program (WAP), which helps households insulate

energy-inefficient homes; and the Low-Income Home Energy Assistance Program (LIHEAP), which provides energy bill and weatherization assistance. Both programs are significantly underfunded relative to the need. In 2019, for example, LIHEAP served only 17 percent of eligible households.⁶

2.1.1. Weatherization Assistance Program

In 2019, there were 39.5 million WAP-eligible households and the program weatherized 85,422 homes: 31,174 units using \$262,500,000 in DOE funds, 26,794 units using LIHEAP, and 27,276 units using other funds.⁷ That means only 0.2 percent of eligible homes were weatherized in 2019.⁸ Since 1976, WAP has weatherized more than 8 million homes. If Congress were to increase spending to cover the 39.5 million WAP-eligible homes through 2035, aligning with the goal of achieving a net-zero-emissions power sector by that year, we estimate the following:

Costs

- Approximately \$17.1 billion annually over 15 years. This would involve considerable scale-up of administrative capacity in the WAP program.

Benefits

- *Energy justice.* Household energy bills for 2.6 million additional homes would be reduced each year for 15 years, assuming an average \$6,500 per unit cost.
- Emissions reductions. By reducing aggregate demand for energy, weatherization helps lower greenhouse gas emissions, reduce local air pollution, and increase energy system resilience.
- *Jobs.* 78,660 direct jobs annually, based on 4.6 direct job-years per \$1 million in spending.⁹

Geographic scope

- Nationwide. States with the largest potential savings for low-income households are concentrated in the Southeast—Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia—plus Kentucky, Michigan, Missouri, Ohio, and Tennessee.¹⁰

Existing authority. [42 USC § 6861](#) et seq.

Agency. DOE.

Relevant legislation. [HR 7516](#) (116th, Rep. DeGette, D-CO), increases funding to \$1 billion per year by 2025; [HR 4447](#) (116th, Rep. O'Halleran, D-AZ) increases funding to \$450 million by 2025.

2.1.2. Low Income Home Energy Assistance Program

In 2019, the LIHEAP program was funded at \$3.7 billion and served 5.8 million homes.⁶ If Congress were to increase LIHEAP funding to cover the approximately 17 million households in need, based on historical LIHEAP data, we project that it would cost approximately \$11 billion in the first year (2020 LIHEAP funding was \$4.6 billion,¹¹ and the [American Rescue Plan \(§ 3302\)](#) authorized an additional \$4.5 billion in 2021). Over time, as 2.6 million homes are weatherized under the WAP program (Section 2.1.1) each year, this cost should come down, since weatherization will help households reduce their energy bills. Thus, spending would presumably fall by \$1.7 billion annually until the program returns to its 2019 funding rate of \$3.7 billion in the sixth year after the program begins.

Costs

- \$38 billion over 5 years (\$19.5 billion above the 2019 baseline of \$3.7 billion per year).

Benefits

- *Energy justice.* The program would help 17 million households and prevent 4.7 million from being disconnected from service.
- *Jobs.* 32,700 direct jobs annually, based on 4.3 direct job-years per \$1 million in spending.⁹

Geographic scope

- Nationwide. The states with the highest proportions of energy burden are mostly in the Southeast, led by Mississippi, Missouri, Alabama, Georgia, South Carolina, and West Virginia.¹⁰

Existing authority. [42 USC § 8621](#) et seq.

Agency. HHS.

Relevant legislation. [HR 1319](#) (117th, Rep. Yarmuth, D-KY) authorizes additional funds in 2021; [S 3276](#) (116th, Sen. Coons, D-DE) eliminates asset limits; [HR 7516](#) (116th, Rep. DeGette, D-CO) extends the program through 2030.

2.2. Investment in Rural Electric Utilities

Emily Grubert, School of Civil and Environmental Engineering, Georgia Institute of Technology

Jake Higdon, Environmental Defense Fund

Many rural areas are challenged by lack of capital investment, inefficient utility systems, and in some cases, particularly on tribal lands, lack of access to electricity. Investing in new energy infrastructure in rural America can create long-term access to clean and reliable energy while creating jobs in regions that might have limited alternative opportunities. We propose doubling loan authority and funding levels for USDA Rural Utilities Service (RUS) electrification programs over FY2021 levels¹² and maintaining them for five years, as well as funding the rural and remote communities electrification grant program at \$50 million per year for five years for communities with 20,000 or fewer inhabitants.

Costs

- \$31.25 billion over 5 years. This amount would enable RUS to issue an additional \$5.5 billion in direct loans and \$750 million in loan guarantees for electrification per year, or \$31 billion over 5 years above the 2021 loan authority level, as well as an additional \$250 million in grants over 5 years.

Benefits

- *Energy access.* Improved electricity facilities would benefit an estimated 1 million rural residents per \$1 billion of investment,¹³ such that the new level of loan authority would serve roughly the full rural population of ~55 million people over 5 years.
- *Jobs.* Roughly 20,000 direct job-years annually over 5 years, assuming 3.2 job-years per \$1 million in electricity system investment.⁹

Geographic scope

- Nationwide. RUS programs target the most underserved rural regions.

Existing authority. The Rural Utilities Service can carry out authorized functions under **7 USC § 6942**, including grants and loans in rural communities with high energy costs (**7 USC § 918a**) or for electrification in rural and remote communities, with preference for renewable energy (**7 USC § 918c**). Authority exists under **7 USC § 8107** for loan financing and grant funding for energy efficiency and renewable energy for agricultural producers and rural small businesses.

Agencies. USDA Rural Utilities Service, lead, with DOI Bureau of Indian Affairs.

Relevant legislation. **HR 4447, § 12617** (116th, Rep. O'Halleran, D-AZ); **S 486** (117th, Sen. Gillibrand, D-NY).

2.3. Advanced Metering Infrastructure (Smart Meters)

Emily Grubert, School of Civil and Environmental Engineering, Georgia Institute of Technology

Advanced metering infrastructure (AMI, sometimes called smart meters) enables two-way communication between electric utilities and customers. When implemented well, AMI can facilitate time-of-use pricing, demand response, and communication about grid needs (e.g., a need to conserve to prevent power outages) in near real time. These attributes are expected to gain relevance as the share of variable renewable electricity generation increases because power grids are easier to manage when both supply and demand are at least somewhat responsive. Nationwide, AMI penetration is about 60 percent for residential and commercial meters, but it is markedly lower in some states.¹⁴ The American Recovery and Reinvestment Act of 2009 included \$4.5 billion for similar investments, resulting in \$8 billion in total leveraged investment.¹⁵ We propose funding to achieve full residential AMI penetration, replacing 54 million residential meters.

Costs

- Roughly \$16 billion over 5 years (shared with utilities), based on Smart Grid Investment Grant program estimates associated with deployment of about 16 million smart meters and all-in costs of ~\$300 per meter.¹⁶

Benefits

- *Grid management and emissions reductions.* AMI would enable time-of-use pricing and demand response across the country, facilitating grid management as decarbonization proceeds (thereby reducing the need for backup fossil generation and investments in electricity storage).
- *Jobs.* Roughly 56,000 direct job-years over the life of the program, assuming 3.5 direct job-years per \$1 million in investment.⁹

Geographic scope

- Nationwide, with particular benefits for the following regions having low residential AMI penetration:
 - Appalachia (West Virginia, 2 percent; Virginia, 33; Ohio, 38; Kentucky, 43).
 - South (Louisiana, 35 percent; Missouri, 41; Arkansas, 45; South Carolina, 48; Mississippi, 50).
 - Intermountain West (Utah, 11 percent; New Mexico, 12; Montana, 25; North Dakota, 26; Colorado, 29; Wyoming, 33; South Dakota, 51).
 - Northeast (Rhode Island, 0 percent; New Jersey, 3; Massachusetts, 5; New York, 8; Connecticut, 18; New Hampshire, 22).¹⁴

Existing authority. Authority exists to provide federal matching grants up to 50 percent for smart grid investments ([42 USC § 17386](#)).

Agencies. DOE, lead, with HUD.

Relevant legislation. [ARRA § 1302](#); [HR 5428](#) (116th, Rep. Lamb, D-PA); [S 2333](#) (116th, Sen. Cantwell, D-WA).

2.4. Grid Modernization for At-Risk Communities

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Grid modernization programs often fare poorly in public utility commission cost-benefit analyses. Allocation of funds as cost-share for utility grid modernization efforts will enable these projects to overcome traditional cost-benefit gaps, accelerate the number and pace of project deployments, and reinforce electricity system reliability. Eligibility requirements could consider utilities in regions that are at risk of adverse climate events, traditionally underserved, experiencing high levels of unemployment, or able to document significant need for reliability improvement. Some of this effort could be covered by smart meter investments (Section 2.4).

Costs

- \$20 billion over 10 years.

Benefits

- *Reliability and energy justice.* Expected benefits include enhanced electricity reliability and a more equitable distribution of grid infrastructure.
- *Jobs.* Roughly 6,400 per year, based on 3.2 direct job-years per \$1 million in investment.⁹

Geographic scope

- Regions exposed to climate events, underserved communities, and areas with high unemployment.

Existing authority. Authority exists to provide federal matching grants up to 50 percent for smart grid investments ([42 USC § 17386](#)).

Agency. DOE.

Relevant legislation. [Energy Independence and Security Act](#) (2007); [S 1742](#) (116th, Sen. Wyden, D-OR); [HR 7516 § 129](#) (116th, Rep. DeGette, D-CO).

2.5. Hydropower Reinvestment

Emily Grubert, School of Civil and Environmental Engineering, Georgia Institute of Technology

Hydropower is a zero-carbon electricity resource that can be particularly valuable for grid operations because it can respond quickly to grid instability while protecting public and ecosystem health as water is discharged. Although we are not proposing construction of new dams, maintaining the safety and integrity of existing powered dams and adding electricity generation capabilities to nonpowered dams¹⁷ can facilitate production of clean electricity without significant additional environmental impacts. Ensuring timely reinvestment in aging dams, many of which are owned by the federal government, also has important safety and resilience implications.¹⁸ Under Docket No. AD19-7-000, FERC has developed a list of 230 federal dams with the greatest potential for nonfederal hydropower development, including 189 under 30 MW.¹⁹ The estimates below assume overnight costs of about \$2,800 per kW for power generation and a four-year lead time,¹⁷ an estimated total as-spent capital to total overnight cost ratio of 1.105²⁰ (interpolation between three- and five-year project times, based on low-risk investor-owned utility financing), and potential capacity of roughly 5 Gigawatts at dams on the FERC list.

Costs

- \$15 billion over 15 years, in addition to necessary reinvestment and rehabilitation of existing powered and nonpowered dams.

Benefits

- *Clean power.* The proposed investment would increase US hydroelectricity capacity by about 6 percent (new power) while also extending the safe, useful life of existing facilities.
- *Jobs.* 120,000 direct job-years for installation, plus 10,000 to 15,000 jobs of indefinite duration associated with operation, maintenance, and license compliance.²¹

Geographic scope

- Nationwide, with the largest projects in the Midwest and South: Alabama, Arkansas, Illinois, Iowa, Louisiana, Missouri, and Oklahoma.

Existing authority. Maintenance and repair of dams, financing water infrastructure improvements, hydropower development, and assistance for small communities is authorized in **America's Water Infrastructure Act of 2018**. Loan financing and grant funding for hydropower systems under 30 MW for agricultural producers and rural small businesses are authorized under **7 USC § 8107**. Ensuring dam safety, including via assistance for state dam safety programs, is authorized under **33 USC § 467f**.

Agencies. DOE, lead, with DOI and USDA.

Relevant legislation. **HR 7410** (116th, Rep. McMorris-Rodgers, R-WA).

2.6. Energy Efficiency in Public Housing

Aurora Barone, Environmental Defense Fund

Roughly 1.2 million households, mainly low-income families, older adults, and people with disabilities, live in public housing. On average, these buildings are more than 40 years old with utility systems that are often in disrepair.²² Existing repair needs far exceed HUD's current capacity. Sufficient funding could be provided through the Capital Fund Program to address substandard housing conditions, which would also improve energy efficiency. Recent legislation (**HR 4546**, 116th) indicates a backlog of \$70 billion in public housing capital needs, with roughly 10 percent needed for energy and water upgrades. We propose funding energy and water efficiency improvements to these buildings.

Costs

- \$7 billion over 10 years.

Benefits

- *Green buildings.* The upgrades would lower greenhouse gas emissions; reduce energy costs for HUD by more than \$1 billion,²³ with many households saving 20 to 30 percent on their utility costs²⁴; and improve indoor air quality and reduce risk of respiratory diseases, especially for children.²⁵
- *Environmental and energy justice.* The proposed measures would particularly benefit women, people of color, and people with disabilities.
- *Jobs.* Roughly 45,500 direct job-years, based on 6.5 direct job-years per \$1 million in investment.⁹

Geographic scope

- The largest numbers of public housing units are in the New York metropolitan area (177,000), Puerto Rico (54,000), Chicago (21,000), Philadelphia (13,000), Boston (11,000), and Miami (10,000).²⁶⁻²⁸

Existing authority. 42 USC **1437g(d)** and **1437z-2**.

Agency. HUD Office of Public and Indian Housing and Office of Capital Improvements, which administers the Capital Fund.

Relevant legislation. **HR 7303** (116th, Rep. Blunt Rochester, D-DE); **S 4060** (116th, Sen. Smith, D-MN); **HR 4546** (116th, Rep. Velázquez, NY-7); **HR 5187** (116th, Rep. Waters, CA-43); **HR 8021** (116th, Rep. Perlmutter, CO-7); **S 598** (117th, Sen. Warren, D-MA). **The American Recovery and Reinvestment Act of 2009** (Title XII) included a \$4 billion appropriation.

2.7. Federal Energy-Efficiency Fund

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Of the roughly 350,000 buildings owned or leased by the federal government, only 6.5 percent were classified as high-performance sustainable buildings by the Office of Federal Sustainability as of 2019.²⁹ The Federal Energy-Efficiency Fund, created in the Energy Policy Act of 1992, includes a pool of capital for grants to increase the energy efficiency of federally owned or leased facilities. Funds have not been appropriated recently but could be reconstituted at a \$500 million annual level.

Costs

- \$5 billion over 10 years.

Benefits

- *Green buildings.* Upgrading building efficiency reduces federal energy bills and emissions. Payback periods for building efficiency upgrades vary widely: full building electrification programs may take years to recoup the costs,³⁰ but retrocommissioning programs can see payback in eight or nine months from simple operation and maintenance adjustments.³¹
- *Jobs.* Roughly 2,400 direct job-years annually, based on 4.8 direct job-years per \$1 million in investment.⁹

Geographic scope

- National. The largest amounts of square footage owned by the federal government are in Washington, DC (38 million square feet), California (15 million), Maryland (15 million), New York (11 million), Texas (11 million), Missouri (8 million), Illinois (6 million), Colorado (6 million), Virginia (6 million), Pennsylvania (5 million), Florida (5 million), and Georgia (5 million).³²

Existing authority. **42 USC § 8256.**

Agency. GSA.

Relevant legislation. **HR 5650** (116th, Rep. Welch, D-VT); **S 2137** § 423 (116th, Sen. Portman, R-OH); **S 1857** (116th, Sen. Murkowski, R-AK); **S 5001** (116th, Sen. Cardin, D-MD).

2.8. Energy Efficiency: Race to the Top

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Establish a competitive grant program to spur state, territory, and tribal energy efficiency programs, which would reduce emissions, enhance energy resilience, and provide jobs. Public entities would submit initial plans to implement new or expanded energy efficiency programs, and technical assistance from DOE would be available to support entities with limited government capacity. In Phase (or Year) 1, 25 states would be granted initial funding to further develop those programs. In Phase (or Year) 2, four to six entities would be awarded larger grants to implement their plans. A race-to-the-top design would incentivize not only jurisdictions with strong existing energy efficiency programs but also those with less robust programs. Early-stage energy efficiency programs can be low-cost options to reduce carbon dioxide emissions, and they have additional benefits for improving system resilience and lowering customer bills. The programs would create jobs in the fastest-growing sector of the energy industry.

Costs

- \$224 million over 2 years. A similar proposal, offered as an amendment to the proposed Energy Savings and Industrial Competitiveness Act (2011/2013) included ~\$67 million in Phase 1, \$135 million in Phase 2, and \$22 million operational. The funding levels are inflation-adjusted figures based on S 1218 (see below).

Benefits

- *Energy efficiency.* The programs would lower energy bills and reduce emissions.
- *Jobs.* 1,840 direct job-years, based on 4.6 direct job-years per \$1 million in spending, assuming the job creation estimates for the WAP program (Section 2.1.1).⁹

Geographic scope

- All US states, territories, and tribes would be eligible. The states with the highest energy intensities (energy use per unit of GDP) in 2018 were Louisiana (18,500 British thermal units per dollar of 2012 GDP), Wyoming (14,700), North Dakota (12,500), West Virginia (11,700), Mississippi (11,600), Alaska (11,500), Alabama (9,900), and Arkansas (9,600).³³

Existing authority. This would require new authority.

Agency. DOE.

Relevant legislation. [S 1218](#) (113th, Sen. Warner, D-VA); [HR 7849](#) (116th, Rep. Ruiz, D-CA).

2.9. Electric Vehicle Charging Infrastructure

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Electric vehicle (EV) charging stations continue to proliferate, but as EV sales increase, demand for charging stations risks outpacing existing infrastructure. At the same time, lack of widespread charging infrastructure has the potential to slow EV sales.³⁴ Creating a network of standardized EV chargers along highways and public roads will encourage EV adoption by increasing access to electric charging infrastructure. We propose that DOE and DOT convene stakeholders to develop a plan for a national network, then establish a competitive grant program to fund private entities whose projects align with the plan. This program would need to coordinate with the EV tax credit program (Section 2.11) to avoid overlap between tax credits and grants.

Costs

- Not assessed. Timeline 2021–2030.
- See Nicholas³⁵ for recent estimates. In general, constructing charging stations with more chargers provides economies of scale and substantially reduces per unit costs. One recent estimate shows that costs for installing 350 kW DC fast chargers declines from \$66,000 per charger for a one-charger station to \$26,000 per charger for a six- to 10-charger station.³⁵

Benefits

- *Emissions reductions.* Rapid EV adoption could reduce the transport sector's carbon dioxide emissions by roughly 1 billion metric tons by 2050 from 2018 levels, also reducing other air emissions and benefiting public health.³⁶
- *Jobs.* Not assessed.

Geographic scope

- National. Under a deep decarbonization scenario, the largest investments in public charging stations are needed in California, Texas, Florida, Ohio, Pennsylvania, New York, Illinois, and North Carolina.³⁷

Existing authority. This would require new authority.

Agencies. DOE and DOT.

Relevant legislation. **HR 5770** (116th, Rep. Levin, D-MI); **HR 1221** (117th, Rep. Clarke, D-NY); **HR 5393** (116th, Rep. Speier, D-CA); **HR 2012** (117th, Rep. DeSaulnier, D-CA); **S 507** (117th, Sen. Cortez Masto, D-NV).

2.10. 30C Alternative Fuel Infrastructure Tax Credit

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

The Alternative Fuel Infrastructure Tax Credit (30C) makes certain fueling equipment for alternative-fuel and electric vehicles eligible for a 30 percent tax credit through December 2021. The tax credit could be renewed through at least 2025 to ensure continued federal support of individual and business charging station buildout. As of 2019, the United States hosted roughly 88,000 alternative fueling stations, 89 percent of which were electric vehicle chargers.³⁸ Meeting the Biden administration's goal of 500,000 charging stations by 2030³⁹ requires consistent policy to incentivize additional investment. This program would need to coordinate with the EV grant program (Section 2.10) to avoid overlap between tax credits and grants.

Costs

- Not assessed.
- See Nicholas³⁵ for recent estimates. In general, constructing charging stations with more chargers provides economies of scale and substantially reduces per unit costs. One recent estimate shows that costs for installing 350 kW DC fast chargers declines from \$66,000 per charger for a one-charger station to \$26,000 per charger for a six- to 10-charger station.³⁵

Benefits

- *Technology deployment.* The 30C tax credit incentivizes individual and private construction of EV charging infrastructure.
- *Jobs.* Not assessed.

Geographic scope

- National.

Existing authority. [26 USC § 30C](#).

Agency. IRS.

Relevant legislation. [HR 848](#) § 405 (117th, Rep. Thompson, D-CA); [HR 698](#) (117th, Rep. Doggett, D-TX); [HR 2025](#) (116th, Rep. Casten, D-IL).

3. Environmental Remediation

Daniel Raimi, Resources for the Future

Energy-intensive and industrial activities have created a legacy of pollution across hundreds of thousands, perhaps millions, of sites in the United States. The harms of this pollution, which include health effects, impaired ecosystem services, and lower property values, are borne disproportionately by communities of color.^{40,41} In addition, many energy-producing communities face environmental challenges associated with the legacy pollution of coal mining, coal consumption, oil and gas production, and oil consumption.⁴²

Along with addressing historical inequities and reducing the burden of pollution for affected communities, cleaning up polluted sites offers near-term employment opportunities that, in some cases, match the skills of fossil energy workers who may be displaced during an energy transition. Remediation activities, such as reclaiming abandoned mines, decommissioning orphaned oil and gas wells, and remediating Superfund sites, also help create the conditions for future economic growth by improving water and soil quality, reducing blight, and establishing the basis for a service- or amenity-based economy.

The following proposals describe a set of environmental remediation activities that can help achieve those interrelated goals: reducing historical injustices, improving local environments, providing near-term employment opportunities, and laying the groundwork for future prosperity.

Most involve ramping up the current small scale of many remediation activities. To enable this scaling up, funds will need to be flexible and allow federal, tribal, state, and local decisionmakers to increase their administrative capacity for overseeing bidding, contracting, and project oversight. In addition, project prioritization should take into account the cumulative burdens that some regions, particularly environmental justice communities,⁴³ face to ensure that remediation activities can address the legacy of injustice.

3.1. Superfund and Brownfields

Daniel Raimi, Resources for the Future

Superfund and brownfields site remediation reduces local pollution and blight, raises local property values, and can provide short-term employment.⁴² Recent estimates for job creation from these programs range from 4.5 to 7.5 direct job-years per \$1 million in spending.^{9,44} As of late 2020, there were 1,335 sites on the National Priorities List, the official register of Superfund sites to be remediated. In 2020, Congress appropriated \$1.2 billion for Superfund and \$73 million for the Brownfields program, with additional tax credits on the order of \$20 million per year.⁴² According to a 2010 GAO report,⁴⁵ Superfund cleanup needs have regularly exceeded appropriations, suggesting the

need for additional funding. In addition, the characteristics and costs of remediation at certain sites will change, and in many cases be exacerbated, by the effects of climate change.⁴⁶ However, because sites vary widely and the extent of contamination is often poorly understood, it is not possible to produce a reliable estimate of long-term costs. The following figures are therefore tentative.

Costs

- Roughly \$35 billion over 10 years, including unrestricted funding for administrative costs: \$33 billion for Superfund and \$2 billion for the Brownfields program.
- Seek to recoup expense from responsible parties via [42 USC § 9607](#) et seq.
- Consider reinstating expired excise taxes on petroleum and chemicals products, which could raise more than \$1.5 billion per year.

Benefits

- *Human and environmental health.* Site mitigation would reduce local environmental and health risks.⁴⁷⁻⁴⁹
- *Climate resilience.* Cleanups would help avoid future pollution as climate change exacerbates risks at certain sites.
- *Property values.* Remediation can raise local property values by up to 15 percent,⁵⁰ potentially creating new business and job opportunities nearby.⁵¹
- *Jobs.* 104,000 to 173,000 direct job-years over the lifetime of the program, assuming 4.5 to 7.5 direct job-year per \$1 million in investment.^{9,44}

Geographic scope

- National. Superfund sites are found in every US state, led by New Jersey (114 sites), California (97), Pennsylvania (91), New York (85), Michigan (65), Texas (55), and Florida (53).

Existing authority. [42 USC § 9601](#) et seq.

Agency. EPA.

Relevant legislation. [HR 2703](#) (Rep. Pallone, D-NJ); [HR 2674](#) (Rep. Blumenauer, D-OR); [S 2893](#) (116th, Sen. (now Vice-President) Harris, D-CA); [HR 8915](#) (116th, Rep. Cleaver, D-MO); [S 1669](#) (115th, Sen. Booker, D-NJ).

3.2. Abandoned Mines

Daniel Raimi, Resources for the Future

Tens of thousands of abandoned mines are scattered across the United States, posing local environmental and health risks from acid mine drainage and other kinds of pollution. The federal Office of Surface Mining, Reclamation, and Enforcement (OSMRE) categorizes roughly 43,000 abandoned mines as high priority^a and estimates roughly \$10.5 billion of unfunded cleanup needs for these sites⁵²; that may be a substantial underestimate of the ultimate costs.⁵³ Recent analyses estimate that each \$1 million in spending for abandoned mine cleanup generates roughly five job-years.^{9,54} In addition, reducing acid mine drainage can boost property values for proximate property owners and improve ecosystem services.^{55,56} We propose addressing all high-priority abandoned mines.

Costs

- Roughly \$10.5 billion over 10 years, including unrestricted funds to ensure administrative capacity.
- Costs may be offset by extending DOI's authority to collect reclamation fees on coal mining at the current level or higher.

Benefits

- *Water quality.* Mitigation of acid mine drainage and other environmental harms would improve water quality and reduce public health risks
- *Jobs.* Roughly 53,000 direct job-years over the life of the program, assuming 5 direct job-years per \$1 million in investment.^{9,54}

Geographic scope

- Appalachia, the Mountain West, and parts of the Midwest and Southwest. According to OSMRE, the largest unfunded cleanups are in Pennsylvania (\$3.9 billion), West Virginia (\$3.5 billion), Kansas (\$800 million), Ohio (\$400 million), Kentucky (\$360 million), Montana (\$220 million), Alabama (\$210 million), Wyoming (\$180 million), Indiana (\$170 million), Illinois (\$120 million), and Montana (\$110 million).

Existing authority. Partial authority exists under **30 USC § 1231 et seq.** Legislation such as the RECLAIM Act would give additional authorizations—for example, by providing additional flexibility in the use of funds for economic development.

Agencies. DOI Office of Surface Mining Reclamation and Enforcement and EPA Superfund and Brownfields programs.

Relevant legislation. **HR 1733** and **HR 1734** (117th, Rep. Cartwright, D-PA); **S 1232** and **S 1193** (116th, Sen. Manchin, D-WV); **S 4306**, Title III (116th, Sen. Duckworth, D-IL).

a OSMRE's Priority 1 and Priority 2 sites.

3.3. Underground Storage Tanks

Daniel Raimi, Resources for the Future

Both above- and below-ground tanks that store crude oil and refined petroleum products (e.g., gasoline, kerosene, diesel) can leak and damage nearby soil and water resources. EPA's Underground Storage Tank (UST) program, which began in 1984, requires tank owners and operators to install and operate equipment to certain standards, including the installation of leak detection equipment. EPA provides annual grants to states and tribes to prevent and clean up releases, funded by a \$0.001 tax per gallon on all motor fuel sales. In 2019, roughly 192 billion gallons of motor gasoline and ultra-low-sulfur diesel fuel were sold in the United States,⁵⁷ meaning that an increase in the tax to \$0.005 per gallon would raise an additional \$768 million per year. In 2020, Congress appropriated \$92 million for the UST program, and the trust fund held a balance of roughly \$850 million.⁴² As of late 2020, EPA identified roughly 63,000 releases that had not been cleaned up, with 5,000 new releases identified in FY2020.⁵⁸ EPA estimates that average cleanup costs are roughly \$130,000,⁵⁹ but actual costs range widely, based on local factors and the extent of pollution.

Costs

- \$10 billion to clean up roughly 77,000 sites and prevent future releases over 10 years, including unrestricted funding for administrative costs.
- Costs could be offset by raising the motor fuel excise tax to \$0.005 to generate an additional \$768 million per year.
- Extending the Superfund definition to include petroleum product releases would enable EPA to seek reimbursement.

Benefits

- *Environmental and human health.* Preventing and cleaning up releases would reduce local environmental and health risks.⁶⁰
- *Property values.* Mitigation may increase local property values by up to 11 percent.⁶¹
- *Jobs.* Roughly 50,000 direct job-years^b over 10 years.

Geographic scope

- USTs are distributed widely across the country. Known leaks are most prevalent in Florida (~10,000), Michigan (~8,000), Illinois (~5,000), New Jersey (~5,000), North Carolina (~3,000), Washington (3,000), California (~3,000), South Carolina (~2,000), Ohio (~2,000), and Pennsylvania (~2,000).⁵⁸

b Jobs estimates are not available for UST cleanup. We use a rough estimate of 5 job-years per \$1 million in spending, similar to other environmental remediation programs that involve underground pollution mitigation.

Existing authority. Authority to carry out the UST program can be found at [42 USC § 6991 et seq.](#) Increasing the motor fuel tax rate to \$0.005 per gallon would require new legislation.

Agency. EPA.

Relevant legislation. [HR 2673](#) (117th, Rep. Blumenauer, D-OR); [HR 7608](#) Title II (116th, Rep. Lowey, D-NY).

3.4. Orphaned Oil and Gas Wells

Daniel Raimi, Resources for the Future

There are hundreds of thousands of orphaned oil and gas wells in the United States—those with no solvent owner—which emit methane that contributes to global warming and pose other environmental and health hazards. The Interstate Oil and Gas Compact Commission documented roughly 57,000 orphaned wells as of 2018, but many more remain unaccounted for in current inventories.⁶² Recent research from RFF finds that decommissioning one orphaned well, which involves plugging it with cement and restoring the surface, costs roughly \$76,000⁶³ and reduces methane emissions by 0.13 metric tons per year.⁶⁴ We propose decommissioning the known inventory of roughly 57,000 wells and carrying out new research to better characterize environmental and health risks.

Costs

- \$4.9 billion over 5 years: roughly \$4.3 billion for decommissioning, plus an estimated \$500 for administrative costs and \$50 million to support new research.

Benefits

- *Emissions reductions.* Plugging these wells would reduce methane emissions by roughly 7,400 metric tons (MT) per year, equal to 250,000 MT of CO² using a 100-year global warming potential of 34, or 630,000 MT of CO² using a 100-year global warming potential of 86.
- *Ecosystem services.* Surface restoration would be worth roughly \$2.8 billion, assuming benefits of \$49,000 per well.⁶⁵
- *Jobs.* Roughly 28,400 direct job-years over 5 years, based on 7.1 direct job-years per \$1 million in investment.⁹

Geographic scope

- As of 2018, the largest numbers of documented orphaned wells were in Kentucky, Pennsylvania, Texas, Kansas, West Virginia, Illinois, Louisiana, Wyoming, New York, Oklahoma, and Indiana, with more than 1,000 each.⁶²

Existing authority. Authority exists to plug wells on federal lands only ([42 USC § 15907 et seq.](#)). New authorization would be needed to provide funds for private and state lands.

Agencies. DOI, lead, with DOE and EPA.

Relevant legislation. **S 4642** (116th, Sen. Bennet D-CO); **HR 8332** (116th, Rep. Thompson, R-PA); **HR 2** (116th, Rep. DeFazio, D-NY); **HR 2415** (117th, Rep. Leger Fernandez, D-NM); **S 1076** (117th, Sen. Lujan, D-NM).

3.5. Natural Gas Infrastructure

Daniel Raimi, Resources for the Future

The methane emitted from oil and natural gas infrastructure contributes to climate change, exacerbates ozone pollution, and in rare cases, can pose an acute health and safety risk. Although energy companies have some financial incentive to capture the leaking methane and sell it, the private returns are well below the costs of these emissions' climate damages.⁶⁶ Finding and repairing these leaks can be a cost-effective approach to reducing greenhouse gas emissions, particularly in the upstream segment of oil and natural gas production,⁶⁷⁻⁶⁹ while also providing jobs for workers in energy-producing communities. We propose reducing methane leaks both upstream and downstream.

3.5.1. Downstream Methane Emissions Mitigation

In some US cities, methane emissions from local natural gas distribution lines are well above EPA estimates.⁷⁰⁻⁷² Two recent proposals have suggested that DOE provide grants to incentivize local natural gas distributors to repair their leakiest pipelines (unprotected steel and cast-iron pipes). These investments would reduce methane emissions, provide jobs, and include provisions to prevent energy cost increases for low-income households.

Costs

- \$2.5 billion over 10 years.

Benefits

- *Emissions reductions.* A mitigation program could cut cumulative methane emissions by roughly 434,000 MT, equivalent to roughly 14 million MT of carbon dioxide.^c This assumes a cost of \$103 per 1,000 cubic feet of methane abated.⁷⁴
- *Jobs.* 2,475 direct jobs per year over 10 years, assuming 9.9 direct job-years per \$1 million in investment.⁹

Geographic scope

- Nationwide.

c Assuming a 100-year global warming potential of 32.⁷³

Existing authority. None.

Agency. DOE.

Relevant legislation. **HR 2741** (116th, § 33201, Rep. Pallone, D-NJ); **HR 5542** (116th, Rep. Sherrill, D-NJ). **HR 2** (116th, § 33121, Rep. DeFazio, D-OR) would authorize \$250 million annually for this program and prevent cost increases for low income households.

3.5.2. Upstream Methane Emissions Mitigation

Most methane emissions occur upstream, at and around oil and gas well sites.⁷⁵ Addressing these sources generally provides the most cost-effective methane mitigation.⁷⁶ The Obama administration's methane regulations were promulgated by EPA but rolled back during the Trump administration; new and revised rules may be forthcoming from the Biden administration. Incentives to further reduce methane emissions could accelerate mitigation and boost jobs in oil and gas communities. What's more, federal policy can help incentivize the deployment of new, more cost-effective tools for detecting and eliminating methane emissions. We propose a new federal matching grant worth up to \$5 million per project for up to 10 projects that deploy innovative technologies to detect and repair methane leaks in oil- and gas-producing regions. These technologies could include aerial, remote sensing, and satellite-based tools to detect leaks so that on-site workers can precisely target their repairs. DOE's Office of Fossil Energy could administer the program in consultation with EPA and external experts, evaluating grant proposals and tracking progress.

Costs

- Up to \$250 million over 5 years.

Benefits

- *Emissions reductions.* Mitigation would reduce methane emissions at low cost and support the deployment of new, more cost-effective tools to further reduce emissions in the future.
- *Jobs.* Not assessed. Existing leak detection and repair programs are managed by small firms that employ workers with a wide range of training, from high school graduates to PhDs.⁷⁷

Geographic scope

- Most activities would occur in oil- and gas-producing regions, including parts of Colorado, Louisiana, Oklahoma, Ohio, Pennsylvania, Texas, West Virginia, and Wyoming.

Existing authority. None.

Agencies. DOE Office of Fossil Energy, lead, with EPA.

Relevant legislation. **HR 4447** (116th, § 3111, Rep. O'Halleran, D-AZ); **HR 3607** (116th, § 12, Rep. Veasey, D-TX).

4. Economic Development

Gilbert Michaud, Voinovich School of Leadership and Public Affairs, Ohio University

The energy sector has been an influential driver of economic development in the United States through historic investments in generation assets and grid infrastructure,⁷⁸ but it has also created inequalities and new challenges worth addressing.⁷⁹ For example, as traditional energy sources decline, some communities have suffered from lost tax revenues and workers have been displaced.^{80,81} Conversely, as new energy assets (e.g., solar, wind, green hydrogen, battery storage) are deployed, both opportunities (e.g., fiscal effects) and obstacles (e.g., workforce misalignment) associated with these technologies may emerge. Thus, economic development strategies have become an increasingly important component of energy planning, as governments develop policies, programs, and sources of funding to support just, sustainable, and equitable energy transitions across the United States.

Across all transitioning energy communities, ensuring adequate physical, labor, and financial resources remains fundamental for enabling local economic growth. For instance, communities with abundant and quality housing, as well as access to high-speed broadband will be better prepared for energy-related economic transitions, particularly in rural areas. Access to capital and financial services will be another component of sustaining and diversifying economies, especially those in transition. The federal government has played a central role in supporting such efforts by encouraging entrepreneurship through small business lending, as well as funding infrastructure upgrades. This financial support is becoming more urgent because of the accelerating climate crisis, our aging and deteriorating infrastructure, and many other factors that could inhibit long-term economic growth and resilience.

Given the idiosyncratic differences in assets and barriers across communities, flexibility in federal grant administration remains vital, especially because the mandates of granting agencies do not always match local priorities. In many ways, local and regional practitioners, with the financial and programmatic support of the federal government, are better equipped to address the needs of their communities through place-based economic development.^{82,83} Ultimately, the goal of economic development policy is to improve the well-being of regions through infrastructure, workforce, and capital investments that, in turn, lead to higher living standards for all. In a rapidly changing energy economy, that means emphasizing sustainability, resiliency, and diversification while incorporating lessons learned from the past.

4.1. Rural Housing and Energy Resilience

Gilbert Michaud, Voinovich School of Leadership and Public Affairs, Ohio University

Rural areas are disproportionately affected by limited and low-quality housing. Substandard housing makes it difficult to attract skilled workers to rural and transitioning communities, ultimately suppressing economic activity. More than 1.5 million homes in rural America (roughly 6 percent of total rural homes) are classified as either severely or moderately substandard. Larger proportions of rural houses lack hot and cold piped water and basic plumbing.⁸⁴ The challenge is even greater for rental units. Years of underinvestment in the renovation or construction of housing in rural America has resulted in a severe housing deficit, both in quality and in stock. We estimate that improving substandard rural housing through the USDA Rural Housing Service Section 504 Home Repair program grants would:

Costs

- \$18 billion^{85,86} over 3 years.

Benefits

- *Economic development.* We estimate \$13 billion in annual benefits to regional GDP (e.g., via increased wages).⁸⁷
- *Jobs.* More than 126,000 direct, one-time renovation and construction jobs.⁸⁸

Geographic scope

- Regions with the largest proportions of substandard rural housing are along the southwestern border (California, Arizona, New Mexico, and Texas), in central Appalachia (Ohio, West Virginia, Virginia, Kentucky, Tennessee, and North Carolina), and in the lower Mississippi valley (Louisiana, Mississippi, and Arkansas). Tribal lands would also benefit.⁸⁴

Existing authority. Authority exists to improve rural housing through repair and revitalization via **7 CFR § 2.49**. Eligibility could be expanded to allow additional participants and/or other types of repairs.

Agencies. USDA Rural Housing Service, lead, with HUD and the Federal Housing Finance Agency.

Relevant legislation. **S 232** (117th, Sen. Paul, R-KY); **HR 816** (117th, Rep. Kaptur, D-OH).

4.2. Rural Broadband Expansion

Gilbert Michaud, Voinovich School of Leadership and Public Affairs, Ohio University

Despite efforts to close the digital divide, more than 14.5 million Americans still lack access to adequate broadband.⁸⁹ This problem is most acute in rural areas (affecting 11 million people, or 17 percent of the total rural population) and on tribal lands (affecting 846,929 people, or 21 percent of the total tribal population), with consequences for health, education, entrepreneurship, and other outcomes.⁸⁹ Often, broadband deployment in rural and tribal areas has higher costs, which vary with geographical, technological (e.g., along aerial lines vs. underground), and other factors.^{90,91} To close this digital divide, the National Telecommunications and Information Administration provides grants (through the Broadband Technology Opportunities Program and the State Broadband Initiative) to eligible state and nonprofit organizations that would partially cover the cost of rural deployment. We propose expanding broadband access to 14.5 million underserved Americans.

Costs

- Roughly \$35 billion over 10 years.⁹²

Benefits

- *Economic development.* Expanding rural broadband would provide \$12 billion of annual benefits for individuals in the form of improved telehealth, K–12 learning, higher education, and small business e-commerce.^{90,93}
- *Jobs.* Thousands of jobs during construction and nearly 53,000 ongoing operations jobs in IT support, networking and monitoring, and equipment repair.⁹²

Geographic scope

- The states with the largest underserved broadband populations are Texas (>1.2 million people), Florida (>800,000), and Georgia (>650,000), followed by Alabama, California, Mississippi, Arkansas, Louisiana, and Pennsylvania (all >500,000).⁸⁹

Existing authority. Authority exists to fund and deploy broadband through state initiatives via [47 USC § 1304](#).

Agencies. DOC National Telecommunications and Information Administration, with USDA and FCC.

Relevant legislation. [HR 1047](#) (117th, Rep. Curtis, R-UT); [S 1046](#) (116th, Sen. Cortez Masto, D-NV); [HR 205](#) (117th, Rep. Kelly, R-MS).

4.3. Local Public Finances

Daniel Raimi, Resources for the Future

Jake Higdon, Environmental Defense Fund

Reduced demand for fossil fuels and falling production of coal, oil, and natural gas will reduce revenues for local, state, tribal, and national governments.^{94–96} In the longer-term, these entities will need to identify new revenue sources to support essential services such as education, transportation, and public safety. In the short- and medium-term, however, federal support will be needed. Falling coal mining and employment has reduced public revenues from coal in recent decades, and the Biden administration's moratorium on oil and gas leasing on federal lands will reduce revenues for some regions through reductions in federal disbursements, state severance taxes, and local property tax collections. We propose that the federal government provide annual grants to states and localities to fully replace lost revenues for two years, with the amount declining by 3 percent each year thereafter. These lost revenues would be calculated by subtracting the actual revenues to states from the average level of revenues over the previous 10 years. For example, if a state received \$10 million on average each year between 2010 and 2020 but received \$9 million in 2021, the federal government would provide a grant worth \$1 million.^d

Costs

- Up to \$16 billion over 10 years:
 - Up to \$7 billion to compensate for reduced federal lands revenue⁹⁷:
 - \$2.5 billion, coal
 - \$4.5 billion, oil and gas
 - Up to \$5.6 billion to compensate for reduced severance taxes from federal lands⁹⁷:
 - \$1.3 billion, coal
 - \$4.3 billion, oil and gas
 - Up to \$3.4 billion to compensate for reduced property taxes from federal lands⁹⁷:
 - \$1.2 billion, coal
 - \$2.2 billion, oil and gas

d Assuming the Biden administration's oil and gas leasing moratorium becomes permanent and that coal production on federal lands declines at a rate consistent with the past 10 years.

Benefits

- *Economic stability.* The funding will stabilize state and local public finances, protecting education, transportation, public safety, and other public services.
- *Jobs.* Would support teachers, public safety officers, and other public sector workers.

Geographic scope

- The most affected states would be, in order, Wyoming, New Mexico, Utah, Colorado, North Dakota, Louisiana, Montana, Texas, Alaska, Alabama, and Mississippi.

Existing authority. None. **16 USC § 7101** et seq. could be modified.

Agency. DOI.

Relevant legislation. Proposed **Amendment** to 2021 budget (Barrasso, R-WY).

4.4. Community Development Financial Institutions Funds

Aurora Barone, Environmental Defense Fund

Daniel Raimi, Resources for the Future

A community development financial institution (CDFI) is a private entity, such as a bank or a credit union, that helps low- and moderate-income communities gain access to financial services that might otherwise not be available. More than 1,000 certified CDFIs provide small business lending in underserved areas, including communities affected by energy transition and environmental injustice; the Appalachian Community Capital⁹⁸ is one example. Since small businesses drive more than half of all new job creation,⁹⁹ well-funded CDFIs can play an integral role in revitalizing and diversifying local economies, including communities in transition.

Costs

- One-time allocation of \$100 million to CDFIs that specifically support communities facing shutdowns of coal plants or mines.

Benefits

- *Economic development.* CDFIs promote economic development and diversification, create jobs, develop commercial real estate, develop affordable housing and promote homeownership, and provide financial services.¹⁰⁰
- *Economic justice.* CDFIs support financial literacy programs and alternatives to predatory lending.¹⁰⁰
- *Jobs.* Not assessed.

Geographic scope

- The states with the most CDFIs per capita are New York (8.5 per 100,000), Mississippi (6.7), Texas (6.2), Pennsylvania (4.7), Louisiana (4.7), Washington (4.5), Tennessee (4.0), Ohio (3.8), Wisconsin (3.5), and Virginia (3.2)¹⁰¹

Existing authority. **PL 103-325** created a CDFI fund (see Sec.102(b); **PL 95-128** encourages financial institutions to help meet local credit needs, including low- and moderate-income neighborhoods.

Agency. Treasury.

Relevant legislation. **S3702** (116th, Sen. Markey, D-MA); **HR 6830** (116th, Rep. Phillips, D-MN); **HR 7993** (116th, Rep. Waters, CA-43); **HR 1319** § 3301 (117th, Rep. Yarmuth, D-KY).

4.5. Expansion of Assistance to Coal Communities Program

Molly Robertson, Resources for the Future

The Assistance to Coal Communities (ACC) program is a subset of the economic adjustment assistance activities at DOC's Economic Development Administration. Governments, labor unions, and planning organizations that can demonstrate how the shifting coal economy has caused economic losses are eligible for grants to promote economic development, capital investment, and workforce development¹⁰² The Economic Development Administration has issued the full \$30 million per year in ACC grants in recent years, and we believe that substantial additional funds are needed¹⁰³ as the coal industry continues to decline. Doubling the ACC program would, by itself, be insufficient to support the current and future challenges for coal communities; expansion could be supplemented by complementary efforts such as those described elsewhere in this report. Our estimates:

Costs

- Roughly \$300 million over 5 years.

Benefits

- *Economic development.* This effort would support economic development and workforce development for coal workers and communities by roughly doubling the level of grants compared with 2019.
- *Jobs:* Not assessed.

Geographic scope

- In 2019, coal production was led by, in order, Wyoming, West Virginia, Pennsylvania, Illinois, Kentucky, Indiana, Montana, North Dakota, and Texas.¹⁰⁴

Existing authority. See **PL 115-31** Title I, using authority under **29 USC § 3101** et seq.
Agency. DOC Economic Development Administration.
Relevant legislation. None identified.

5. Workforce

Jake Higdon, Environmental Defense Fund

Energy jobs—and their associated wages, benefits, and skill sets—have changed dramatically over time with the transformation of the energy system. These shifts have largely been driven by new and evolving technologies, volatility in commodity prices, and in more recent years, state and federal public policies. For instance, US coal mining jobs have declined from roughly 175,000 in the 1970s to fewer than 50,000 today¹⁰⁵ because of increased mechanization, low-cost natural gas, and environmental protections. As the transition to a clean economy accelerates, we are likely to see both an increase in job opportunities in low-carbon resources, such as wind, solar, and energy efficiency, and a long-term decline in oil, gas, and coal production.

One recent analysis estimates that the share of the US labor force that works in energy could grow from 1.5 percent today to 2 to 4.5 percent by 2050 across a range of deep decarbonization pathways. However, the energy jobs of tomorrow will not necessarily be in the same places, have the same features, or leverage the same skills as the energy jobs of today.³⁷ Federal workforce programs can play a role in supporting energy workers through this transition by helping displaced workers find new opportunities through training and career services; providing transition assistance, like financial support for families; protecting workers' pensions and other benefits; and seeking to ensure that jobs in emerging sectors are of high quality.

The selected policy options below are not a comprehensive solution to the multiple workforce challenges posed by the energy transition, nor do they include all federal workforce programs. However, each proposal is intended to support workers in the energy transition by either (1) ensuring that oil, gas, and coal workers retain their benefits and move forward in secure, family-sustaining jobs; or (2) promoting the development of new, high-quality jobs in emerging energy-related industries.

5.1. Energy Transition Adjustment Assistance Program

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

One element of a successful transition program will be providing retraining and reemployment programs for affected workers. Fossil fuel resources are concentrated in certain parts of the country and do not necessarily coincide geographically with new jobs in clean energy. Response programs can (1) provide new economic development opportunities in affected areas; and (2) provide retraining resources to provide access to new job opportunities and relocation assistance if new job creation is unlikely in a certain location. An energy transition adjustment assistance program could correct

some of the flaws of the existing Trade Adjustment Assistance Program by creating incentives for energy, utility, construction, and infrastructure companies to retain and retrain existing employees, providing income replacement instead of enhanced unemployment benefits, offering support services, coordinating with economic development programs, and providing adequate relocation benefits where necessary. Apprenticeship programs would be an important component of this effort.

Costs

- \$20 billion over 10 years.

Benefits

- *Jobs.* The proposed program would help support up to 1.6 million Americans¹⁰⁶ who may be directly affected by the energy transition.

Geographic scope

- An estimated 88 percent of fossil fuel production jobs are in Texas, Louisiana, California, Oklahoma, Pennsylvania, Colorado, Illinois, West Virginia, New Mexico, and Wyoming.¹⁰⁶

Existing authority. Additional authority to carry out these activities would likely be needed, although existing authority for other retraining programs can be found at [29 USC § 3225](#); with the definition of a “dislocated worker” at [29 USC § 3102](#) (15).

Agency. DOL.

Relevant legislation. [HR 4447](#), Title XXII (116th, Rep. O’Halloran, D-AZ).

5.2. Energy Star Certification for Residential and Commercial Construction

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

EPA’s Energy Star certification program for residential and commercial construction has certified firms that employ 3 to 5 percent of all construction workers in the United States.¹⁰⁶ Significantly expanding this program in partnership with the 1,600 apprenticeship training programs run by the North American Building Trades Unions would ramp up energy efficiency in the United States. DOL could create a competitive grant program for registered apprenticeship programs and construction contractors to achieve Energy Star certification. Introducing these grants would help encourage a race to the top in the industry.

Costs

- \$1.1 billion over 10 years:
 - \$100 million per year for DOL competitive grants
 - \$10 million per year increase (20 percent) in EPA's Energy Star budget

Benefits

- *Emissions reductions.* Increased deployment of energy-efficient appliances, lighting systems, building materials, and standardization of energy efficiency work skills and practices would reduce greenhouse gas emissions and local air pollution.
- *Energy security and resilience.* Energy efficiency reduces exposure to volatile energy prices and can reduce demand on the energy system during critical peak periods.
- *Jobs.* Enhance the skills base of domestic construction workers.

Geographic scope

- National. Energy efficiency improvements would particularly benefit low-income rural and urban households facing high energy costs.

Existing authority. DOL currently provides oversight to the registered apprenticeship programs, ensuring consistency and training requirements.

Agencies. DOL, lead, with EPA.

Relevant legislation. None identified.

5.3. Preapprenticeship Programs

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Apprenticeship and workforce training programs in the energy sector have ample training capacity but struggle to find applicants.¹⁰⁷ Limited pools of applicants with the right qualifications create a gap in some workforce training programs. Preapprenticeship programs help bridge this gap by giving high school students paid work experience while introducing them to future opportunities. Preapprenticeship program enrollment is linked to entrance in union apprenticeship training as well as more equitable access to high-quality, family-sustaining jobs.^{108,109}

Costs

- \$1 billion over 10 years.

Benefits

- *Workforce skills.* Preapprenticeship programs strengthen the union workforce pipeline, increase middle and high school students' exposure to clean energy jobs, increase job access for underrepresented minorities, and fill energy workers' skill gaps.
- *Jobs.* Not assessed.

Geographic scope

- National.

Existing authority. [29 USC § 50](#) et seq.

Agency. DOL.

Relevant legislation. [HR 447](#) (117th, Rep. Scott, D-VA); [HR 594](#) (116th, Rep. Ryan, D-OH).

5.4. Energy and Advanced Manufacturing Workforce Initiative

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

After the Workforce Innovation and Opportunity Act (WIOA) was passed in 2014, the Obama administration created the Skills Working Group, an interagency effort to implement the legislation. The Energy and Advanced Manufacturing Workforce Initiative (EAMWI) was designated as one of its official subcommittees, coordinated by DOE and including DOL, Education, DOC, Defense, and the National Science Foundation. The purpose of EAMWI was to provide technical assistance to enable a coordinated workforce response to the energy transition and its related manufacturing technologies. Activities included prioritizing certain energy sectors and geographies, developing curricula and federal workforce training grant requirements, and gathering and publishing critical data. EAMWI could also be expanded to include a K-12 energy transition awareness program that would give public schoolteachers age-appropriate educational materials.

Costs

- \$100 million over 10 years.

Benefits

- *Efficiency.* Coordination of intergovernmental planning and delivery of services would create efficiencies and enhance effectiveness while providing valuable guidance to both the legislative and administrative branches of government.
- *Jobs.* Not assessed.

Geographic scope

- National. The program would primarily benefit regions and communities affected by the energy transition.

Existing authority. **29 USC § 3101** et seq.

Agencies. DOE, lead, with DOL, DOC, Education, Defense, and National Science Foundation.

Relevant legislation. **HR 156** (117th, Rep. Rush, D-IL); **HR 579** (117th, Rep. Norcross, D-NJ); **S 2993** (116th, Sen. Heinrich, D-NM); **S 2334** (116th, Sen. Cantwell, D-WA).

5.5. Retirement Benefits

Jake Higdon, Environmental Defense Fund

Daniel Raimi, Resources for the Future

Multiemployer retirement benefits for coal miners (i.e., the UMWA Retirement Fund) and other workers are insured by the federal Pension Benefit Guaranty Corporation (PBGC). The Multiemployer Pension Program at PBGC is under severe stress, however, and is likely to run out of money by 2027 under all scenarios PBGC has analyzed.¹¹⁰ The shortfalls arise when plans covered by the program become insolvent: PBGC offers financial assistance in the form of loans, which are rarely repaid, rather than taking over the program directly, as would be the case of single-employer pension programs. PBGC insolvency could mean that the benefits for participants in insolvent plans could be cut by as much as 90 percent.¹¹¹

In 2020, legislation passed to increase the allowable federal transfers to the UMWA pension program, shoring up its finances and—since it accounts for a significant portion of the risk held by the Multiemployer Pension Program—pushing back PBGC’s expected date of insolvency.¹¹² The American Rescue Plan also provides special assistance (§ 9701 et seq.) to distressed pension plans in response to the coronavirus pandemic.¹¹³ Although we are not able to propose a single option, and further analysis and consultations are needed to better refine policy options, several recent proposals warrant consideration:

Option 1. The federal government creates a trust fund or dedicated authority that, similar to the UMWA pension cap, guarantees fossil fuel workers’ pensions by backfilling revenue so that they are not threatened by—nor do they cause—overall PBGC insolvency.

Option 2. As suggested by Pollin and Callaci,¹¹⁴ the federal government could do the following:

- use authority under **PL 109-280** (Pension Protection Act) to require companies to bring funding for pension plans to full levels before authorizing dividends or share buybacks; and

- cover the current cost of unfunded fossil fuel pension liabilities (with the exception of UMWA), including an estimated \$14.2 billion for the largest oil and gas companies and \$1.1 billion for the largest firms that support mining activities.

Option 3. Similar to Option 2, with coverage regularly adjusted based on the current and projected path of coal, oil, and gas production, private sector revenue, and expected solvency of affected pension plans.

Option 4. Bankruptcy reform to allow unfunded pension liabilities to be considered administrative expenses and given priority in bankruptcy proceedings (cf. the Protecting Our Workers Act).

Existing authority. Pension Protection Act (**PL 109-280**); financial assistance for multiemployer pensions (**29 USC 1431**) and special financial assistance authorized under the American Rescue Plan Act of 2021 (**§ 9704**); authority to require rehabilitation of multiemployer pension plans (**26 USC 432**) and extension of rehabilitation plans under the American Rescue Plan Act of 2021 (**§ 9702**); SECURE Act (**PL 116-94**).

Agency. DOL Pension Benefit Guaranty Corporation.

Relevant legislation. **HR 2619** (116th, Rep. Ryan, D-OH).

6. Manufacturing and Innovation

Dave Foster, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

The growth of America's economy in much of the 20th century was based in domestic manufacturing and the innovation that projected it onto the world stage. Until the late 1980s, when it was displaced by the financial, real estate, and insurance sectors, manufacturing made the largest contribution to US GDP.¹¹⁵ Nonetheless, manufacturing's contribution to GDP has continued to grow from \$1.2 trillion in 1987 to \$2.4 trillion in 2019 (in real 2019 dollars), and the United States follows only China as the world's largest manufacturer.^{116,117} However, US manufacturing employment shrank as a result of automation and globalization from its high point in 1979, more than 19.5 million jobs, to its current 12.2 million.¹¹⁸

In 2020, Covid-19 exposed the vulnerability of global supply chains and underscored national security concerns over US reliance on foreign suppliers for new energy technologies. These concerns have elevated the importance of rebuilding manufacturing supply chains in a range of critical areas, as underscored in President Biden's executive order of February 24, 2021.¹¹⁹ Equally critical is rebuilding the innovation capacity that drives manufacturing forward into the next generation.

In this section, we identify several representative measures that can encourage the reshoring of critical manufacturing supply chains and other proposals that could strengthen the critical innovation resources and institutions on which manufacturing depends.

Manufacturing supply chains could be bolstered by restoring such support such as the 48C Advanced Energy Manufacturing Tax Credit, Buy Clean procurement policies, and environmentally based trade policies, such as border adjustments for energy-intensive, trade-exposed industries. On the innovation side, several critical technologies and innovation support systems have been identified, including carbon capture and direct air capture, ARPA-E, and the DOE Loan Program. Each requires additional support to rise to the multifaceted challenge before us.

6.1. 48C Advanced Energy Manufacturing Tax Credit

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

The 48C Advanced Energy Manufacturing Tax Credit was originally included in the American Recovery and Reinvestment Act; it supported more than 17,000 direct jobs.¹²⁰ Renewal and increase of the credit to \$8 billion to \$10 billion annually would incentivize

both the adoption of new energy technology manufacturing and the reshoring of critical supply chains in both energy and advanced manufacturing. Among the critical industries that 48C could focus on are plug-in hybrid and battery electric components for vehicles, including medium- and heavy-duty vehicles; long-duration storage or innovative batteries; carbon capture and sequestration; carbon utilization; wind and solar generation equipment; clean hydrogen production and transportation; rare earth mineral recovery; and direct air capture. Some of these technologies would require expanding 48C eligibility criteria.

Costs

- Estimated tax expenditures of roughly \$8 billion to \$10 billion annually for 5 years, with periodic review and renewal as appropriate.

Benefits

- *Emissions reductions.* This program would incentivize lower-emissions manufacturing, reducing domestic greenhouse gas and other energy-related emissions.
- *Economic development.* Expanding domestic advanced manufacturing will provide strategic benefits for the United States as global powers vie for leadership in clean energy manufacturing and intellectual property.¹²¹
- *Jobs.* More than 68,000 ongoing production jobs and thousands of additional construction jobs, based on the estimates from the American Recovery and Reinvestment Act.¹²⁰

Geographic scope

- National. At least 50 percent of tax credits would be reserved for states especially affected by the energy transition—among them, Wyoming, West Virginia, New Mexico, and Colorado.

Existing authority. Renewal would require new legislation. Relevant section of US Code is **26 USC § 48C**.

Agencies. Treasury and DOE.

Relevant legislation. **S 622** (117th, Sen. Manchin, D-WV); **HR 848** § 501 (117th, Rep. Thompson, D-CA); **HR 507** (117th, Rep. Boyle, D-PA).

6.2. Department of Energy Loan Program Office

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Updating the focus of DOE's Loan Program Office (LPO) can help meet the demands of a changing energy industry. We propose the following three adjustments: (1) expand

the set of eligible technology areas to include energy storage, hydrogen production, and medium- and heavy-duty vehicles; (2) lower application costs to incentivize small projects (e.g., by removing the requirement that applicants pay the credit subsidy cost that accompanies a loan guarantee); and (3) overhaul the Advanced Technology Vehicles Manufacturing program, shifting its focus from supporting the relocation of companies toward repurposing existing motor vehicle plants and related supply chain facilities, with the goal of incentivizing continued growth in their original communities. Together, these adjustments should encourage LPO to accept higher levels of risk associated with early-stage, innovative technologies and give the office the flexibility to support technology areas at its discretion.

Costs

- \$4 billion. LPO currently has a \$40 billion authorization in loans and loan guarantees, but an additional direct \$4 billion appropriation (assuming 10 percent credit subsidy cost per project) to cover the credit subsidy cost for all projects would rapidly encourage new projects to apply (as was done in LPO's 1705 program, funded under the American Recovery and Reinvestment Act).¹²²

Benefits

- *Emissions reductions.* The changes would pull more clean technologies through private sector financing gaps and into commercialization.
- *Economic development.* New projects would help create well-paid jobs and focus opportunities in communities at risk in the energy transition.
- *Energy security and resilience.* Loans could support emerging technologies to enhance energy security and resilience. The opportunity exists to anchor major new industries (batteries, carbon capture, hydrogen) in the United States.
- *Jobs.* Not assessed. Employment effects depend on the technologies deployed and their commercial success.

Geographic scope

- National. An expanded LPO would have particular benefits for vehicle manufacturing regions in the Midwest.

Existing authority. LPO has authority for item (1) of this proposal, established in **HR 133** § 9010 (116th), amending **42 USC § 16513**.

Agency. DOE.

Relevant legislation. **HR 133** § 9010 (116th, Rep. Cueller, D-TX); **HR 4447** § 9501 (116th, Rep. O'Halleran, D-AZ).

6.3. Advanced Research Projects Agency–Energy

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

As initially proposed by the National Academies,¹²³ the Advanced Research Projects Agency–Energy (ARPA-E) was intended to have a budget of \$1 billion. This idea was reinforced in the National Academies review of ARPA-E in 2017, which concluded that the agency was making progress in fulfilling its statutory mission and goals.¹²⁴ However, the agency has been funded at roughly one-third of that level since 2009. Expanding ARPA-E’s budget is critical to nurturing the technologies that can help enable deep decarbonization. Moreover, in 2020, ARPA-E ran its first program (SCALE UP) to provide capital for technology scale-up activities of existing ARPA-E startup grant recipients. Scale-up awards could be carved out in the legislation for up to \$250 million annually.

Costs

- \$10 billion over 10 years.

Benefits

- *Energy innovation.* The benefits of energy innovation are wide, and include climate, health, energy security, and economic gains.¹²⁴
- *Jobs.* Not assessed.

Geographic scope

- National. ARPA-E grants are made to universities, national laboratories, businesses, and research institutions and have been awarded in 47 states.¹²⁵ In 2018, research projects in California received the most grant money (\$14.3 million), followed by recipients in New York (\$12.9 million), Massachusetts (\$8.9 million), Connecticut (\$8.1 million), Colorado (\$7.8 million), Ohio (\$5.1 million), Tennessee (\$5.1 million), and Pennsylvania (\$5 million).¹²⁶

Existing authority. **42 USC § 16538.**

Agency. DOE.

Relevant legislation. **S 2714** (116th, Sen. Van Hollen, D-MD); **HR 4091** (116th, Rep. Johnson, D-TX).

6.4. Research in Carbon Capture, Utilization, and Storage and Direct Air Capture

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Virtually all of the integrated assessment models used in the Intergovernmental Panel on Climate Change process and elsewhere suggest that deploying carbon capture, utilization, and storage (CCUS) and direct air capture (DAC) technologies at large scale will be an essential component of achieving long-term temperature targets such as 1.5° or 2°C.¹²⁷ In FY2021, the DOE research budget for CCUS was \$228 million.¹² Expanding DOE funding for CCUS and DAC research, development, and demonstration programs to \$1 billion would accelerate these crucial technologies.

Costs

- \$10 billion over 10 years.

Benefits

- *Emissions reductions.* The primary objective is to mitigate climate change, which will provide large health, economic, and other benefits.
- *Economic development.* The United States can become a leader in these technologies, providing additional future economic benefits.
- *Jobs.* Not assessed. CCUS would create planning, construction, operation, and maintenance employment opportunities, many of which would be well-suited to existing skills in certain fossil energy jobs.¹²⁸

Geographic scope

- Deploying these technologies will be particularly important in the industrial Midwest, Appalachia (the National Energy Technology Laboratory is in West Virginia), the Gulf Coast, and Wyoming.
- Consider distributing demonstration/pilot projects across all regions with substantial coal consumption

Existing authority. Funding for the National Energy Technology Laboratory has existing authority. Previous authorization for research and development funding for CCUS is at **USC 42 § 16293**. New authorization for pilot projects established was in 2020: **USC 42 § 16292** via **PL 116-260 § 4002**.

Agency. DOE National Energy Technology Laboratory.

Relevant legislation. **PL 116-260 § 4002**; **HR 3915** (116th, Rep. Lucas, R-OK).

6.5. Buy Clean Standard

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

Jake Higdon, Environmental Defense Fund

“Buy Clean” refers to government procurement policy that requires publicly funded projects to give preference to materials with relatively low life-cycle greenhouse gas emissions, creating a demand pull for clean industrial products. In 2018, California passed Buy Clean legislation to reduce emissions associated with state purchases of steel, glass, and mineral wool board insulation.¹²⁹ Similar legislation could govern federally funded projects, thereby reducing emissions and positioning the US manufacturing sector and workforce to capitalize on growing global demand for clean industrial products. Covered products could theoretically include all energy-intensive, trade-exposed industries. Like the California approach, a federal Buy Clean standard could be phased in with multiple steps:

1. transparency and data disclosure requirements (e.g., environmental product declarations) for federal contractors;
2. investments in domestic capacity, such as grants or loans to manufacturers to retool existing or develop new manufacturing facilities with less emissions-intensive processes;
3. declining targets for the emissions intensity of purchased goods, and possibly other air and water pollution targets; and
4. a high achievers’ market, in which the federal government could provide additional incentives for domestic manufacturers that demonstrate exceptional environmental performance.

Costs

- Costs will depend on the scope and stringency of requirements, as well as the extent of investments in domestic manufacturing capacity. Two recent analyses have estimated that standards would have modest effects on final construction costs.^{130,131}

Benefits

- *Emissions reductions.* A federal Buy Clean standard would incentivize the industrial sector to reduce emissions and, depending on the design, could reduce other pollutants.
- *Competitiveness.* A standard would help position the United States to take advantage of a growing global market for clean industrial products.
- *Jobs.* 1.7 million Americans are currently employed in metals, cement, chemicals, and other manufacturing sectors that could be covered under a standard¹³²

Geographic scope

- National, covering all federal procurement and project funding.

Existing authority. New authority, through legislation, would likely be required.

Agencies. All federal agencies. Oversight could be similar to the current Buy American provisions in effect in some federal agencies or the Buy American provisions of the American Recovery and Reinvestment Act.¹³³ Historically, compliance and administration of waivers have been handled by specific agencies.

Relevant legislation. California's **Buy Clean legislation; HR 1512** (117th, § 521 et seq., Rep. Pallone, D-NJ); **S 1864** (116th, Sen. Klobuchar, D-MN).

6.6. USMCA Border Adjustments for Energy-Intensive, Trade-Exposed Industries

Dave Foster, Michael Kearney, Sade Nabahe, and Nina Peluso, Roosevelt Project, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research

The industrial sector accounts for up roughly 20 percent of all greenhouse gas emissions¹³⁴ in the United States, 70 percent of which are attributed to a handful of energy-intensive, trade-exposed industries (EITEs): steel, aluminum, pulp and paper, chemicals, cement, and a few others.¹³⁵ Most of these industries produce globally traded commodities. Amending the United States–Mexico–Canada Agreement (USMCA) to include a border carbon adjustment (BCA) would help protect North American EITEs while encouraging enhanced environmental performance internationally. Levying a BCA equivalent to the difference between average US emissions per unit of output for each sector (potentially priced at the federally estimated social cost of carbon)¹³⁶ and the emissions per corresponding unit of imports will protect the higher environmental performance of US companies and the jobs of their employees. This proposal would also remove the Trump administration's tariffs on US imports of Canadian aluminum and steel products.

Cost

- Administrative costs of the program will be covered by the border adjustments.
- An estimation framework focused on easily measurable inputs, such as the carbon content of fuels used in production or average emissions per unit of key inputs,¹³⁷ would minimize the administrative burden.

Benefits

- *Emissions reductions.* This program will provide incentives to decarbonizing heavy industry, with attendant clean air and water benefits to surrounding communities.

- *Jobs.* 1.7 million Americans¹³² are directly employed by the five major EITE sectors identified above, which also have some of the highest job multiplier effects in the economy because of their capital intensity.¹³⁸

Geographic scope

- *National.* The program would have particularly significant benefits for the industrial Midwest, where EITEs are concentrated.

Existing authority. Existing authority rests with the US Trade Representative, Treasury, and Congress. Amending the USMCA would require renegotiations with Canada and Mexico and approval by Congress. However, amendment of an existing treaty does not require the two-thirds majority vote of a new treaty.

Agencies. US Trade Representative and Treasury.

Relevant legislation. **S 1128** § 4695 (116th, Sen. Whitehouse, D-RI).

7. Other Topics

Daniel Raimi, Resources for the Future

In this section, we discuss two topics that warrant consideration but do not fit neatly in any of the policy categories above. The first, a domestic carbon price, offers an opportunity to fund the policies proposed above as well as other priorities, and it could play a crucial role in reducing emissions cost-effectively. A carbon price could be complemented with additional policies, particularly for sectors such as transportation or heavy industry where a politically acceptable price may not be sufficient to spur deep emissions reductions.¹³⁹

The second, a proposal for coordinating regional policy implementation, offers a framework for effectively delivering federal programs across regions, states, and localities that differ across many dimensions. As noted in Section 1.1 (Key Principles), intergovernmental coordination, in close cooperation with communities, will be an essential element in effectively delivering any suite of energy transition policies. This coordination could take multiple forms, and the proposal below offers one approach, drawing from recommendations in a recent report from the National Academies of Science, Engineering, and Medicine.¹

7.1. Revenue from Carbon Pricing

Daniel Raimi, Resources for the Future

Pricing carbon is generally viewed as the most economically efficient means to reduce emissions. An additional benefit of such a policy is its ability to raise revenue that can be used to support numerous goals, including dividends to households, reductions in other taxes, and support for workers and communities in transition. A variety of recent legislative proposals price carbon, typically starting at initially modest levels that rise over time. These proposals would raise tens to hundreds of billions of dollars annually. For example, analysis from Marc Hafstead at Resources for the Future shows that a policy imposing a cost of \$50 per metric ton of carbon dioxide (rising at 5 percent per year) would initially raise roughly \$200 billion, growing to nearly \$300 billion by 2035, and at the same time reduce CO² emissions by almost 50 percent.¹⁴⁰

Revenue

- Roughly \$200 billion in year one, growing to nearly \$300 billion by 2035, based on a \$50 per metric ton carbon price, rising at 5 percent per year.¹⁴⁰

Benefits

- *Emissions reductions.* Estimates from Resources for the Future suggest that such a policy would reduce CO² emissions by almost 50 percent by 2035.
- *Revenue.* The proceeds from carbon pricing can be used to support the programs

included in this analysis, along with other priorities, such as compensating lower-income households for increased energy costs.

Geographic scope

- Nationwide. An economy-wide carbon price would affect the entire country. The 10 states with the highest carbon intensities (energy-related CO² emitted per unit of GDP) in 2018 were Wyoming (1.65 metric tons per \$1,000 GDP in 2012 dollars), West Virginia (1.25), North Dakota (1.11), Louisiana (0.90), Mississippi (0.68), Alaska (0.67), Montana (0.66), Kentucky (0.64), Arkansas (0.61), and Indiana (0.58). The 10 jurisdictions with the lowest carbon intensities of GDP were the District of Columbia (0.02), New York (0.11), Massachusetts (0.12), California (0.13), Connecticut (0.15), Washington (0.15), Maryland (0.16), Oregon (0.18), New Hampshire (0.19), and New Jersey (0.20).

Existing authority. None.

Agency. IRS.

Relevant legislation. **S 1128** (116th, Sen. Whitehouse, D-RI); **S 940** (116th, Sen. Van Hollen, D-MD); **HR 4058** (116th, Rep. Rooney, R-FL).

7.2. Coordination of Regional Policy Implementation

Julia Haggerty, Department of Earth Sciences, Montana State University

The effects of the energy transition will vary widely across geographies,⁴¹ highlighting the need to draw on local expertise and to coordinate policy at regional levels. Regional planning can strengthen the capacity of localities and communities to navigate the transition, work collaboratively with state and federal actors to implement strategic planning, and integrate energy system planning and economic development.^{141,142} As recommended by a recent National Academies report,¹⁴³ we propose the establishment of regional transition coordination offices under DOC, which would direct the coordination effort. Its goals and authorities:

- To coordinate federal agency actions at the regional scale through the secondment of federal agency and departmental staff to regional offices.
- To host a coordinating council of regional governors and mayors that meets annually to establish high-level policy goals for the transition.
- To establish mechanisms for ensuring the effective participation of low-income communities, communities of color, and other disadvantaged communities in regional dialogue and decisionmaking about the transition to a carbon-neutral economy.
- To direct regional transition impact assessment studies conducted through a network of regional research and higher education institutions. These three-year projects would provide credible, accurate information to local, state, and regional

stakeholders about social and economic vulnerability under emerging transition scenarios; build regional datasets and models; provide knowledge services; guide regional research priorities that can guide federal research investments from all agencies; and conduct research both to guide decarbonization efforts and to evaluate outcomes for diverse communities.

- To convene regional transition planning focused on coordinating, leveraging, and engaging local visions and priorities at the regional scale and ensuring the effective and efficient deployment of public and private resources.

Costs

- \$300 million per year, based on \$30 million per year per regional center, with periodic review and renewal.

Benefits

- *Cost-effectiveness.* Intergovernmental coordination would enhance efficiencies in delivering programs.
- *Equity.* Ensuring that the regional offices involve all stakeholders will promote economic and environmental justice.

Existing authority. None.

Agencies. DOC Economic Development Administration, proposed lead, with USDA, DOE, HUD, EPA, DOI, DOL, Council of Economic Advisors, Small Business Administration, and existing regional commissions (e.g., Appalachian Regional Commission, Delta Regional Authority, Denali Commission).

Relevant legislation. [HR 1512](#) (117th § 1002), Rep. Pallone (D-NJ).

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