

State Opportunities and Challenges in Supporting a Just Energy Transition: Incorporating Equity into Clean Energy Research, Development, and Demonstration



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Background

The National Association of State Energy Officials, the National Association of Regulatory Utility Commissioners (NARUC), and the National Governors Association hosted a State Energy Justice Roundtable (Roundtable) in April 2022. Participants included federal and state decision-makers, members of community-based organizations, and subject-matter experts. The Roundtable members explored current efforts by states to articulate and incorporate energy justice concerns into energy-related decision-making. Participants established connections with one another to better understand the current landscape of existing resources, learn about emerging efforts, and identify ongoing support opportunities for advancing energy justice.

This paper is one of five authored by the host organizations on topics that were the focus of the Roundtable. Each paper summarizes key themes, emerging efforts, and group takeaways that were discussed at the Roundtable and should assist states in developing and meeting their own goals around energy justice. The papers all include the same background so they can stand alone. Each paper is written from the perspective of one association and includes potential actions for its members to support more equitable state energy policies and programs. The five papers cover:

- Participation in decision making (NARUC)
- Customer affordability and arrearages (NARUC)
- Energy justice metrics (NARUC)
- Equity in clean energy research, development, and demonstration (NASEO)
- Equitable distributed energy resource access (NGA)

The resources and recommendations offered in these papers are not meant to be exhaustive, as this field of study continues to evolve. Although this brief is focused on electricity, energy justice considerations extend to all types of energy and services, including the impacts of energy extraction, processing, and distribution functions.

I. Introduction

The importance of greater justice, equity, diversity, and inclusion in every aspect of American life has been elevated in recent national conversations. In the energy sector, a key concern is the inequitable access and distribution of opportunities stemming from the growing clean energy economy. This report explores opportunities and challenges associated with incorporating equity into clean energy research development and demonstration (RD&D) and potential roles of State and Territory Energy Offices in supporting this process.

In the clean energy transition, RD&D plays a role in ensuring the electric grid is reliable and resilient and provides opportunities to enhance economic development and workforce opportunities. Most State Energy Offices are uniquely positioned to enable stronger state involvement in ensuring that energy justice and community engagement are an integral part of clean energy projects and the transition to a clean energy economy. State Energy Offices interested in supporting innovative projects could take several pathways, such as:

- Facilitating access to capital for new companies before and during the seed stage of development;
- Providing technical assistance at all stages of the RD&D process including support for assessing the feasibility of certain technologies, ideas for exploration through federal funding opportunities, site readiness evaluations, capacity building strategies, and connections to researchers with engineering backgrounds from local universities, national laboratories, and others;
- Providing support for entrepreneurs such as by identifying sustainable funding sources and assisting with capacity building to maintain momentum and ensure completion of clean energy R&D projects;
- Developing and measuring equity outcomes to inform future efforts;
- Developing metrics and mapping tools to evaluate and identify disadvantaged communities and indicators of program success;
- Supporting stakeholder engagement and community convenings for community-based innovators and citizens to share ideas, ask questions, and develop an understanding of and become vested in projects;
- Establishing partnerships and advisory groups to provide insights and perspectives from multiple groups including communities, Tribes, industry, and universities; and
- Supporting entrepreneurs through workforce development and assistance in program application.

The first section of this report provides an overview of clean energy RD&D. The next section outlines some of the opportunities and challenges associated with incorporating equity into clean energy RD&D. The report concludes with a discussion of key considerations for State Energy Offices to explore as they work to integrate equity into clean energy RD&D programs.

Overview – Clean Energy RD&D

Clean energy RD&D is critical to supporting a reliable and clean electric grid. Innovative clean energy projects will help states and the federal government meet environmental, decarbonization, economic development, energy reliability and resilience, and other goals. This section provides an overview of the different stages of the RD&D process, followed by a deeper dive into the role State Energy Offices play in developing programs and policies and engaging with the private sector and research institutions such as universities and national laboratories.

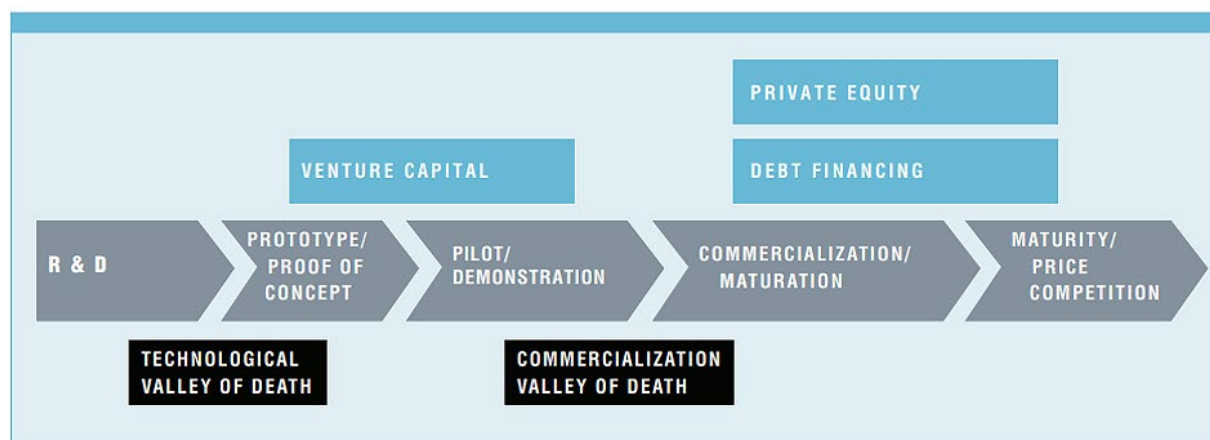
What is RD&D?

The RD&D process is not linear, but rather complex and iterative. According to a NASEO primer on technology, innovation can take many different forms and may focus on improving existing products, bringing existing technology to new markets, or using a new technology in an existing market.¹ The innovation process involves interplay among a variety of different entities and stakeholders, and technology developments can arise from research, customer insights, experimentation, and more.² This means that the pathway to demonstration and deployment will not always be the same for every product.

R&D in particular provides opportunities to identify the most cost-effective and innovative models available to address a certain need (e.g., improving the capacity of an electric vehicle battery). According to research by McKinsey & Company, in 2019 organizations spent \$2.3 trillion on R&D globally, and annual investments continue to grow. Of that \$2.3 trillion, 3% was in the electric power sector.³ In the United States, many states are looking for innovative clean energy projects that support decarbonization efforts and increase the reliability and resilience of the electric grid. Clean energy RD&D can help states reach their energy goals faster and more efficiently. Research can focus on larger projects like solar plus storage microgrids, advanced nuclear reactors, or clean hydrogen. Alternatively, RD&D can center around specific issues such as improving the performance of solar panels during extreme weather events or extending the battery life of an energy storage system.

While RD&D is critical to achieving commercial success of a clean energy project, according to a November 2022 study by the National Renewable Energy Laboratory (NREL), the industry is dealing with a variety of challenges. Clean energy technologies are at different levels of development — the wind and solar industry is more mature than development of carbon capture and utilization technologies, for example. For all new technologies, a large amount of time and capital needs to be invested to successfully cross over what is often referred to as the technological “valleys of death,” that is, the stage between the initial innovation and commercialization in the market.⁴ The technological “valley of death” can occur due to a combination of factors, such as a weak market structure, lack of private sector financing, and other challenges associated with bringing a project from R&D to commercialization.⁵ The clean energy innovation process is outlined in Figure 1 below by The Breakthrough Institute.

Figure 1: Clean Energy Innovation Process⁶



Source: The Breakthrough Institute

There are a variety of pathways for successful clean energy project RD&D, especially at the critical first phase. According to the NASEO primer on technology innovation,⁷ public-private partnerships are an important facilitator of project success as they encourage collaboration and can validate a business model. Investors are not as likely to risk funding a project that is unproven or that has not been validated in the market. These partnerships can support different critical elements of a project, such as funding streams, and reduce the risk of project failure. Partnerships, especially those that are community driven, can also strengthen policies and regulations that are key drivers, along with the influence of government and industry.⁸ Tax and financial policies are important for driving market acceptance and spurring RD&D. The patent system, which provides certain rights to entrepreneurs working on innovative projects, can spur technological innovation by encouraging competition and providing a financial incentive for entrepreneurs.

Funding for clean energy RD&D can come from different entities including the private sector, federal government, state government, or a combination of these groups. According to the National Center for Science and Engineering Statistics, a branch of the National Science Foundation, state governments spent \$327,115,797 on energy R&D in fiscal year 2022.⁹ State Energy Offices are often key distributors of these funds and develop and run programs, make policy recommendations, and support project development. Additionally, State Energy Offices can address the challenges and opportunities associated with clean energy RD&D by considering how states can help entrepreneurs find success by connecting them to funding, providing technical assistance, facilitating stakeholder and community engagement convenings, and supporting workforce development and other training.

Addressing equity in clean energy RD&D remains challenging; however, many states such as Washington, California, and Maryland have begun to emphasize equity implications in their programs. For example, the Clean Energy Fund led by the Washington Department of Commerce supports R&D of new and emerging clean energy technologies. Equity is incorporated into many dimensions of the program, including the application scoring criteria that looks at whether the applicant established partnerships with Tribes or organizations serving overburdened or underserved communities, whether a community benefits plan was developed or not, and other considerations relative to equity.¹⁰

Basic and Applied R&D

According to the National Science Foundation (NSF), basic research is that which is experimental or theoretical to gain knowledge without plans to necessarily apply or use the information. Applied research considers a specific aim or objective and the production of new technology or improvement of existing technology to that end.¹¹ The U.S. Department of Energy Office of Science has a multi-billion-dollar budget, and conducts and sponsors research in various scientific fields, including energy. Specifically, the Office looks at advancing the next generation of energy technologies through different initiatives such as the 104 Energy Frontiers Research Centers (EFRC). EFRC brings together researchers from universities, national laboratories, nonprofits, the private sector, and others to address research needs. Much of the work has spurred innovation related to energy storage, nuclear energy, and other energy related technologies.¹² The Office of Science also manages the Small Business Innovation Research and Small Business Technology Transfer programs. These programs are intended to help small businesses conduct R&D on projects that have the potential for commercialization. These programs cut across DOE and support research on nuclear energy, energy efficiency, renewable energy, energy storage, and more.¹³

Additionally, many universities and national laboratories are partnering with State Energy Offices. For example, the Rochester Institute of Technology Battery Prototyping Center, partially funded by the New York State Energy Research and Development Authority (NYSERDA), is doing innovative R&D of emerging battery storage technologies including improving performance, increasing density, and modifying designs.¹⁴

Clean Energy Demonstration

As mentioned above, RD&D is not always linear, but this report section outlines the technology innovation process in a typical order. Clean energy demonstration provides real performance data and experience and gives confidence to potential customers, investors, regulators, and the public that a technology works. If a demonstration is not successful, it has the benefit of providing lessons learned to inform future RD&D. Box 1 below outlines the Technology Readiness Level (TRL) and Adoption Readiness Level (ARL) processes utilized by the U.S. Department of Energy that capture some of the technical risks that may prevent a project from getting to this stage.

Clean energy demonstration is a culmination of the R&D phase and focuses on the deployment and use of a new technology. This is the time when a project is ready to enter the market and be commercialized. This may also be the time when more investment is needed to avoid project failure.¹⁵ The U.S. Department of Energy Loan Programs Office (LPO) can address this potential disruption. For example, the Title 17 Clean Energy Financing Program helps accelerate deployment of clean energy technologies by providing loan guarantees. These loans help with the construction of clean energy projects.¹⁶ LPO also acknowledges the important role transmission upgrades and build-out will play in ensuring clean energy projects can connect to the grid. Some of the key opportunities include reconductoring, high voltage direct current lines, and grid enhancing technologies. For more information, see NASEO's report, Innovative Transmission Technology Solutions: A Guide for State Energy Offices. In 2023, the U.S. Department of Energy Office of Electricity announced significant funding to support grid-enhancing technologies (GETs) to increase the capacity and efficiency of the transmission system. One of the projects, in Georgia, will involve the development of tools to model and optimize different GETs including Advanced Power Flow Control and Dynamic Line Rating solutions.¹⁷ This research will advance opportunities to use GETs that, in turn, support other clean energy deployment efforts.

Technology Readiness Levels and Adoption Readiness Levels

The U.S. Department of Energy Office of Technology Transitions (OTT) supports DOE commercialization activities through the development and utilization of different tools, programs, and funding. To ensure a technology is completely de-risked and economically viable, DOE utilizes the Technology Readiness Level (TRL) and Adoption Readiness Level (ARL) frameworks. The TRL framework captures technical risks and assesses the state of a technology's development. The levels range from TRL 1 (basic technology research) to TRL 9 (the technology is in its final form and operated under the full range of operating mission conditions).¹⁸ The ARL framework was developed by OTT to assess the adoption risks of a technology and look at different key factors related to technology readiness including value proposition, market acceptance, resource maturity, and license to operate.¹⁹

II. Opportunities and Challenges with Equitable Clean Energy RD&D

It is critical for equity to be incorporated into all phases of the clean energy development process. This section reviews opportunities and challenges including accessing capital, providing technical assistance and long-term support for innovators, and developing and measuring outcomes.

Accessing Capital

Accessing capital is critical throughout the RD&D process to identify the best clean energy solutions. Funding can come from the state or federal government or from venture capital and the private sector. According to a 2020 report from the Federal Reserve Bank of Kansas City, Building Inclusive Entrepreneurship Ecosystems in Communities of Color, minorities have significant challenges accessing capital compared to nonminority groups. In 2016, 87% of the firms that received venture capital funding were white owned, 12% were Asian owned, 1% Black owned, and 1% Hispanic owned.²⁰ Without opportunity to access this significant funding stream, the challenge for a minority owned business or start-up to be successful, particularly in the early stages of development, will continue. States can help bridge the gap between these funding sources and augment private funding through their own grant programs. In fact, states may have a better understanding of what projects are the right fit for their state and communities, and have access to different funding mechanisms for different phases of a project. States looking to address underrepresented groups' lack of access to capital can create funding opportunities for community-driven RD&D led by underrepresented entrepreneurs or minority serving institutions.

The Research, Development, and Demonstration Program Clean Energy Fund led by the State Energy Office within the Washington State Department of Commerce provides support for R&D of new and emerging clean energy technologies. This program builds off language outlined in the Washington State Energy Strategy that emphasizes the importance of investment in R&D of technologies that advance Washington's climate goals.²¹ One of the projects selected to receive almost \$900,000 will be led by the Spokane Indian Housing Authority. They will develop a clean electricity microgrid that advances the energy resilience of the Tribe and provides workforce opportunities to their members as they learn how to install and maintain the microgrid.²²

Federal funding streams can be another source of support for community-based innovation. For example, the U.S. Economic Development Administration's University Center Program funds the Accelerate Montana Rural Innovation Initiative.²³ The goal of this initiative is to help rural and Indigenous entrepreneurs in the state access capital and find business partners when exploring innovative project ideas in different sectors including energy. According to program staff, these groups often struggle to access resources and foster connections with entrepreneurs located in more urban centers. The goal of the program, which also has support from the Montana Department of Commerce, is to help bridge that gap.

Some federal programs might also be replicable on the state level. For example, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy and the Office of Economic Impact and Diversity launched a program in 2021. The program, known as the Inclusive Energy Innovation Prize, "aims to build a community ... with new ideas for incubation, acceleration, and other community-based innovation services that will help enable a more just and equitable transition to a clean energy economy."²⁴ According to NREL, a partner in the project, over 85% of the applicants for the prize were first time applicants for a DOE grant and 54% were from businesses owned by women, minorities, or disadvantaged persons.²⁵ Applications were limited to community-centric organizations that have engaged successfully with disadvantaged communities, energy justice organizations, organizations that can bridge the gap between DOE and disadvantaged communities, and clean energy grassroots innovators focusing on technological advancement in disadvantaged communities.²⁶ The projects will foster community-based innovation and support the expansion of a clean energy workforce that is trained on the local level. For example, one of the projects will focus on increasing participation of disadvantaged groups in battery research and workforce development. States could promote

these opportunities to their community-based organizations or replicate them on a local level. For example, State Energy Offices can lend technical expertise at the early stage of the application process by encouraging and supporting potential applicants in brainstorming innovative ideas that may be responsive to the funding opportunities.

Long-term Support for Innovators

The April 2022 State Energy Justice Roundtable discussion raised concerns regarding the need for sustainable funding sources and capacity building to maintain momentum for and ensure completion of clean energy projects. While initial funding is critical to funnel projects through the R&D phase and past the technological “valley of death,” it is also important to continue to provide resources and engagement opportunities to both developers and communities through the deployment and operation of projects. The Texas State Energy Conservation Office Clean Energy Incubator Program is an example of how investment can be sustained without state funds. The program supports incubators in the state working on emerging clean energy technologies and ensures that a business model is developed to advance projects even in the absence of funding from the State Energy Office.²⁷ Incubators like the one in Texas and other technology accelerators are important to support growth of innovators and entrepreneurs. The U.S. Department of Energy awarded funding to 23 incubators and accelerators in April 2024 to encourage innovative ecosystems, increase local business productivity, and improve commercial success of energy startups.²⁸ One of the awardees, Launch Alaska, facilitates an eight-month deployment accelerator program that pairs climate tech startups in the state with industry experts, community leaders, and business representatives.²⁹ There are similar efforts by the national labs. For example, Lawrence Berkely Lab facilitates Incubating Market-Propelled Entrepreneurial-mindset at the Labs and Beyond (IMPEL) with funding from DOE. The goal of IMPEL is to connect innovators with key partners in the business, investment, and research sectors to support technology development and deployment. One focus is on bringing equity into the energy efficiency sector. For example, the Verital Energy initiative is intended to develop investments in efficiency that specifically benefit apartment owners and tenants.³⁰

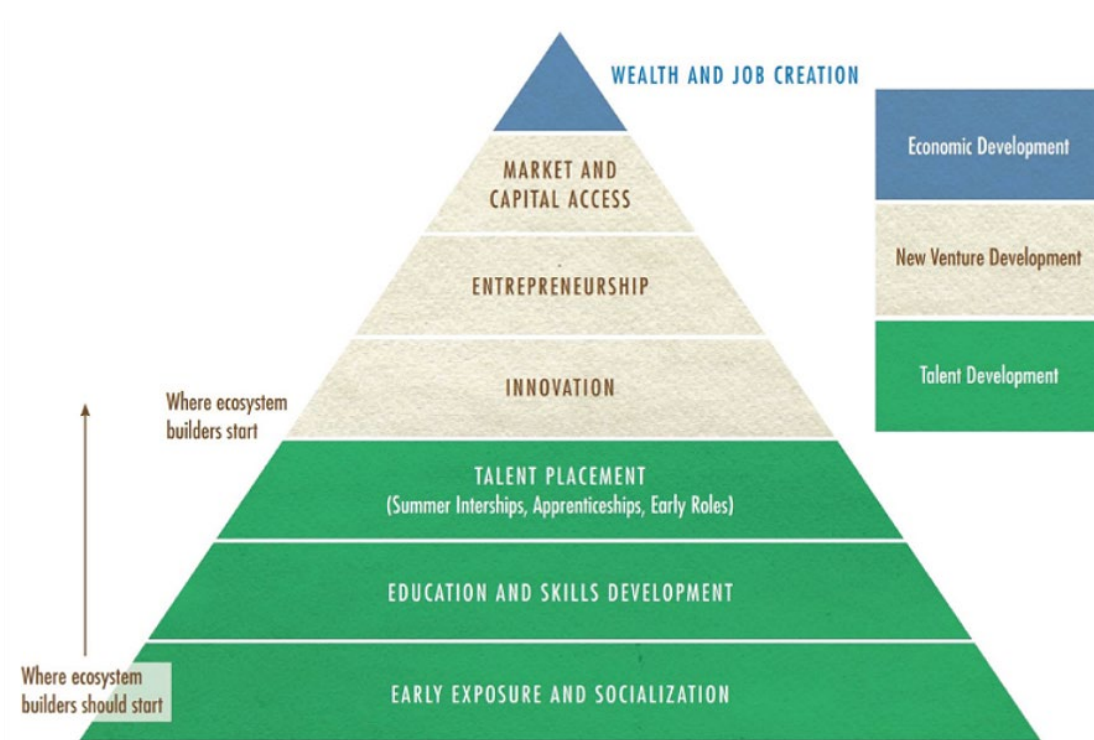
States also can provide resources on funding sources that can be accessed to continue supporting projects. Dr. Shobita Parthasarathy, a professor at the University of Michigan, outlined an approach the Indian government is taking to provide continual support to community-based innovators in India. The Indian government’s National Innovation Foundation (NIF) funds projects that benefit local communities, improve sustainability, and have strong potential for development. After a project has been funded, NIF support continues to help with commercialization such as by securing patents and supporting local communities with direct benefit-sharing provisions.³¹ This actionable support can make a difference between a project getting deployed commercially or not, and is an example of a program a State Energy Office could design.

To initiate projects as well as track progress over time, innovators and project funders should develop and maintain connections with trusted community-based organizations (CBOs). CBOs can serve as liaisons for the community to provide input in project development and then share feedback with the developer and/or State Energy Office on how a project is impacting residents and the local environment. This is critically important as local activity and concerns, if not addressed, could derail a project. Having a direct line of communication with a party responsible for a project provides community members with a sense of stability and reassurance that if something goes wrong it will be addressed. These partnerships can strengthen relationships resulting in more honest communication and mutually beneficial results to project owners/developers and the community. Once a trusted relationship has been established, a community may be willing to engage in future projects or serve as a speaker, advisor, or advocate at other stakeholder engagement events across a state, which helps build credibility in owners/developers and the benefits to be gained from the technology involved, achieving a multiplier effect.

Providing Technical Assistance

Notwithstanding the availability of capital, the development of clean energy projects is often hampered by challenges in the research phase. State Energy Offices are well positioned to provide technical assistance to communities or other early-stage project developers to ensure that innovation meets community needs and has the support to be completed. One approach to ensuring that technical assistance leads to the development of a long-term community and entrepreneurial ecosystem is the Brookings Institution Economic Development Pyramid (see Figure 2), which provides guidance on technical assistance needed to build equity into RD&D programs. All levels of the pyramid need to be working together (talent development, new venture development, and economic development) to achieve economic growth and increase wealth equity and access to capital. States can work with entrepreneurs, communities, and other key groups to design programs and policies that address these needs and opportunities.

Figure 2: Economic Development Opportunities³²



Source: The Brookings Institution

The Brookings Institution also outlines some potential strategies to assist community-based innovators.³³ These strategies, as articulated below, have been modified slightly to apply to the clean energy technology industry to improve equity in the RD&D process. State Energy Offices can look for ways to incorporate them into their own program models and structures.

- Provide early exposure to the emerging technologies, skills, and careers that are driving the future of work in clean energy innovation. This requires funded outreach, marketing, advertising, and public relations resources to ensure that all Americans — particularly Black and Latino or Hispanic Americans — are informed about workforce and training opportunities available. This will better prepare future entrepreneurs to make pitches to potential investors and provide them with tools to advocate for themselves and their ideas.
- Create the opportunity to reskill all Americans — particularly Black and Latino or Hispanic Americans — with skills that lead to in-demand, upwardly mobile career paths. Reskilling or providing new job training is a key part of increasing capacity and will provide entrepreneurs with pathways not only to develop innovative projects, but make connections and facilitate relationships with potential investors and capital providers.
- Incentivize venture-backed companies, large corporations, research institutions, and governmental agencies to hire this newly skilled workforce and compensate them with equitable salary, benefits, and, as appropriate, equity ownership.
- Prepare small business owners and start-up entrepreneurs to become skilled in the science of company-building. This will help enable them to engage with potential funders and maintain and grow their ventures.

Technical assistance from State Energy Offices also may include support for assessing the feasibility of certain technologies, ideas for exploration in federally funded competitions, site readiness evaluations, capacity-building strategies, and connections to researchers with engineering backgrounds from local universities or the national laboratories. One model is LabStart, a program that supports diverse entrepreneurs in launching innovative climate and clean energy projects. LabStart begins by recruiting and discovering entrepreneurs from nontraditional backgrounds. They then provide these entrepreneurs with access to expertise and resources from the national laboratories, and provide funding, training, and mentorship.³⁴ Access to national laboratory intellectual property and researchers offers valuable expertise and can be a critical first step in helping entrepreneurs overcome typical barriers such as accessing financing and technical assistance. In their pilot program from 2020-2021, LabStart helped four entrepreneurs from underrepresented groups reach commercialization with their technologies to reduce carbon dioxide emissions in the atmosphere.

In addition, communities might not be aware of the full array of potential technologies and the accompanying benefits and challenges. For example, a community may be considering transitioning their bus fleet to hydrogen fuel cell vehicles or electric. By connecting the community with a national laboratory or other experts working in this space, communities would be able to outline their goals for the vehicles and learn about the challenges and benefits associated with each option. This kind of technical assistance can reduce the risk of a community investing in a project that might experience the technological “valley of death” or other challenges.

There are additional federal and state programs that can serve as examples for states interested in providing technical assistance. For example, in March 2022, DOE’s Office of Electricity’s Energy Storage Program announced the selection of 14 communities to receive technical assistance from Pacific Northwest National Laboratory (PNNL) through their Energy Storage for Social Equity Initiative. The goal of the initiative is to improve the reliability of the energy system and lower costs for disadvantaged communities.³⁵ A subset of the selected communities will be eligible to receive funding to develop storage projects based on the results of the feasibility assessments conducted with the technical assistance of PNNL.

At the state level, the Mississippi Development Authority (MDA) Energy and Natural Resources Division (the State Energy Office) ran a pilot program known as Virtual-Quad. Virtual-Quad provided new technology companies with resources to research, develop, and deploy energy projects. Grants were awarded to address technical concerns applicants may have had with the R&D of their project proposals. Applicants included high school or college students, university or community college faculty, for-profit businesses, nonprofit businesses, nonprofit organizations, and public sector employees. The \$25,000 grants were awarded as vouchers to be used for receiving technical assistance from local universities. MDA paired winning project teams with local universities, one of which is a Historically Black College or University (HBCU), to address their technical needs.³⁶ Capacity building of this nature can support entrepreneurs, especially in the early stages of program development, and equip them with the tools needed to operate independently in the future. Funding opportunities often require an applicant to conduct a feasibility study or provide their own technical assistance, so if these skills have already been transferred to the community, business, or group, accessing funding and getting projects to the development stage are much easier. Capacity building on writing grant proposals, navigating state systems to support grant writing, and effectively managing grant funding would also make clean energy R&D programs more accessible to disadvantaged communities and the organizations that support them.

Developing and Measuring Outcomes

Measuring the outcomes of clean energy projects is essential to learning and improvement. By analyzing outcomes, researchers can learn from successes and failures and apply the knowledge to enhance future projects. Early community engagement in developing measurable outcomes is critical to build trust and enhance credibility.

A 2018 discussion on developing and measuring outcomes at the Urban Institute highlighted the importance of evaluating the impact of a project on a community through all phases, including after the project completion. At the event, Rayid Ghani, director of the Center for Data Science and Public Policy at the University of Chicago, emphasized the criticality of equity audits and gathering accurate data on an innovative new project. He questioned “how do we break [a project] down into different components of equity, measure each component, identify gaps in equity, and be more efficient about it? We need to use data to provide more effective services and more equitable services.”³⁷ Being able to collect data and analyze it will provide valuable information to a state looking to determine the impact of a project in their communities. Potential data points of interest include the economic impact on the local community, environmental impacts such as changes in air quality, and employment growth. However, when using data, it is important to understand the source of the data and to ensure the information is considered with proper historical context.

States are using different methods to track program progress and success. For example, the Maryland Energy Administration (MEA) requests that grant recipients submit monthly progress reports that include a milestone completion checklist, description of progress on the project, hours worked, and schedule progress. By collecting these reports monthly, it allows MEA to see potential challenges that have arisen and the plan to address them before the project has gotten too far along.³⁸ MEA awardees also report on greenhouse gas impacts, among other things. This method of collecting progress updates throughout the development of a project is particularly helpful when tracking impacts on communities and mitigating any issues early in the process.

III. State Energy Office Considerations

State Energy Office RD&D programs should be designed with equity in mind, considering both the entrepreneurs who will be interested in applying for funding and communities where potential clean energy R&D efforts and eventual demonstration would take place. Projects should include community input, a strong commitment to value communities' priorities, and the incorporation of equity into the entire RD&D process. These steps are often overlooked when RD&D considerations focus on technology feasibility and economic viability, with inequities only addressed retrospectively.³⁹

While considering the steps that should be taken during the clean energy RD&D process and potential challenges and opportunities that may arise at each step, efforts should be made to ensure that inequalities that may exist with fossil-fuel projects are not being reinforced and that equity and community engagement are prioritized.⁴⁰

State Energy Offices can share best practices on how to design equitable and inclusive clean energy RD&D programs. For example, lessons learned from the private sector, such as the previously mentioned LabStart program, can be applied to future projects to make them more equitable. State Energy Offices also may consider developing a database of existing state clean energy RD&D programs that explicitly incorporate equity. Such a database would provide a valuable resource and strengthen peer-to-peer engagement.⁴¹ While incorporating an equity focus into state work can be a challenge, taking time to properly record and analyze successes and failures can help mitigate the potential challenges associated with equitable clean energy RD&D.

RD&D programs can be framed to include an equity impact assessment to consider equity in design, distribution, process, and historical legacy including the specific needs of a particular community where a project is being contemplated (see Figure 3). State Energy Offices leading programs are encouraged to consider questions such as:

- How is inequality defined in relation to the community and the technology contemplated?
- Does the new technology reinforce inequalities?
- Is the new technology easily accessible to disadvantaged communities?
- Has the relevant community in the development of new technology been consulted?
- How have disadvantaged communities perceived similar technologies used in the past?⁴²

These questions will be especially important during the R&D phase to minimize the potential for developing a project that will bring additional or new harm to a community.

Figure 3: Equity Impact Assessment Tool⁴³

Equity Impact Assessment for Energy Innovation	
Theme	Types of Impacts Considered
Equity in Design	<ul style="list-style-type: none"> To what extent did innovators critically examine the impacts for inequity, and adjust the Technology accordingly? What measures did innovators take to ensure that the technology’s design does not reinforce social or economic marginalization, and even ameliorates it?
Equity in Distribution and Siting	<ul style="list-style-type: none"> To what extent do innovators try to ensure that the technology is easily accessible to underserved communities? What additional mechanisms might the public, private or nonprofit sector take to ensure its just distribution?
Equity In Process	<ul style="list-style-type: none"> Were potentially affected communities consulted in the technology’s development and siting? To what extent did publics, particularly those who have been historically voiceless in the development of science and technology, influence the innovation?
Historical Legacy	<ul style="list-style-type: none"> How have similar previous technologies (in terms of function or predicted implications) influenced inequality? Have marginalized communities resisted these types of technologies in the past? How? What was the outcome?

Source: Congressional Testimony

Clean energy R&D programs will require different considerations than programs focusing purely on deployment and projects that are shovel ready. Applicants to a deployment centered program will be thinking about siting, permitting, construction costs, and other items that will have a more immediate impact on a project that is shovel ready. Applicants may also come from established or trusted companies that have expertise and experience in deploying projects of a similar nature, which reduces some of the concerns around viability and commercial success. A project in the deployment phase most likely will have had other funding sources and may have proven market success. These projects may be viewed as less risky and more likely to avoid the technological “valley of death.”

It is important for projects to have credibility within a community, but it can be a challenge to develop credibility when dealing with innovative, first of its kind projects. By studying and incorporating relevant policy, regulatory, financial, and other considerations, the applicability of a potential project to the community can be demonstrated early. States can support the process of determining whether a project is suited for a community by consulting community members prior to investing and securing community support and input. For example, Hawai’i is implementing a new program “to advance Hawai’i’s clean energy goals through addressing inequities in vulnerable communities by creating jobs that launch a new generation of clean energy leaders.”⁴⁴ The Clean Energy Wayfinders program is designed to identify community needs and concerns and increase the understanding of Hawai’i’s energy ecosystem and opportunities.⁴⁵ The Wayfinders are recruited from targeted communities and receive training to be a strong resource regarding clean energy options, clean transportation, energy efficiency, workforce, and funding opportunities. They serve as an intermediary between the community, the State Energy Office, and other key stakeholders. As a result, communities have a better understanding of their needs and are more prepared to understand how a potential new technology could support a communities’ priorities — reducing the overall potential risk of a project. This community buy-in and support is particularly valuable during the R&D phase.

States can request direct feedback before initiating programs. Responses to a June 2021 DOE Request for Information (RFI)⁴⁶ on Inclusive Innovation and Entrepreneurship in Climate Technology highlighted

several barriers for disadvantaged communities to participate in DOE-funded grant opportunities, which also applies to research and development programs more generally. Responses to the RFI were requested from environmental justice and community-based organizations; incubators and accelerators; developers; investors and funders; state, local, and Tribal governments; researchers; and other stakeholders.⁴⁷ RFI respondents stressed the high cost-share and administrative burdens of applying to funding opportunities for R&D. They also highlighted the need for DOE to support entrepreneurship-focused organizations that provide opportunities for early-stage innovators and companies. Respondents suggested that partnerships between DOE and strong, trusted, community-based organizations can enable an inclusive clean energy ecosystem. Through meaningful stakeholder engagement, R&D funding programs can examine, identify, and incorporate community needs and fund projects that were developed and designed with equity considerations from the beginning. By taking into account these barriers, DOE is striving to make future applications more inclusive and accessible.

Supporting Entrepreneurs

Beyond incorporating equity into actual program designs, State Energy Offices developing innovative clean energy RD&D programs should consider tools they have available for entrepreneurs who will be applying for potential funding opportunities.

Workforce Development

While the U.S. moves to decarbonize, enhance resilience, and foster economic development, it is critical to boost workforce opportunities and establish partnerships with different stakeholders to support disadvantaged communities. Driving talent development provides entrepreneurs with the skills and resources to facilitate clean energy RD&D. Entrepreneurs from disadvantaged communities may not have access to the same resources and training programs that other clean energy innovators do, which makes it more challenging to understand the technical components of a clean energy project, as well as the funding and regulatory components of RD&D.

State Energy Offices play an important role in supporting and expanding energy, workforce, and economic development policies and programs in their states and regions and can leverage private sector, local government, and other partners to support these efforts. They can develop roadmaps or frameworks to better understand the challenges and opportunities regarding workforce capacity, gaps, and education/training needs in the clean energy RD&D space. State-led RD&D programs also can look at how projects can support potential future entrepreneurs through training or other educational opportunities. For example, the Maryland Energy Administration's Resilient Maryland program provides grant support for designing clean energy distributed energy resources that enhance equity in Maryland's communities. One of the projects funded through the first round of applications at Frostburg State University is an example of how State Energy Office funding can support RD&D of clean energy projects with workforce implications. The microgrid that will be installed at Frostburg State University will be utilized to develop an entire curriculum. Students will be trained to work on the microgrid, which will help facilitate a new generation workforce with the skills to develop future projects.

Workforce development can begin at any stage starting with the K-12 level. The Florida Department of Agriculture and Community Services, Office of Energy Programs, offers Energy Education Kits to K-12 public schools to support early interest and understanding of solar energy technologies. The kits include a variety of items such as thermometers, watt meters, and photovoltaic panels. This encourages students to explore careers in clean energy and provides an educational baseline that will last a lifetime. The Utah Governor's Office of Economic Development offers Energy Workforce Scholarships to university and college students in the state pursuing science, technology, engineering, or math degrees and energy-

related trade degrees or certification.⁴⁸ Workforce opportunities that support Tribal communities are also important. North Dakota, in partnership with the North Dakota Tribal College System (NDTCS) launched an apprenticeship program that will serve to expand workforce opportunities for Tribal youth across the state.⁴⁹ The program is being developed with several energy companies and participants will receive direct training that can ultimately lead to a college degree or technical certificate, a possible precursor to sparking an interest in clean energy RD&D. The Hawai'i State Energy Office is the clean energy sector lead under Good Jobs Hawai'i; a partnership of local employers, educators, and organizations working together to identify and address workforce needs funded by the U.S. Economic Development Administration's Good Jobs Challenge.

State Energy Offices can support work being done at HBCUs to support clean energy research and development as well. Established in the early 19th century to provide undergraduate and graduate level educational opportunities to people of African descent, HBCUs are located in 19 states, the U.S. Virgin Islands, and the District of Columbia. HBCUs have the credibility to effectively elicit participation to understand what level of awareness communities may have of State Energy Offices, their programs, and clean energy technologies generally. These factors make HBCUs distinctly equipped to lead research and development activities, from providing thought leadership to serving as primary investigators.

Similarly, Hispanic serving Institutions and Tribal colleges and universities can play a key role in developing the workforce needed to support commercialization of new technology and industries with a diverse talent pool of students. There are 569 Hispanic serving institutions and 35 accredited Tribal colleges and universities in the United States. Through collaboration with industry labor organizations and State Energy Offices, along with technical assistance and targeted capacity building, these institutions can address workforce shortages, diversity, curriculum development, and training. Many minority serving institutions are two-year colleges with the potential to deliver industry certification programs and provide an alternative to four-year degree granting programs that may require significant financial commitments. Minority serving institutions can design cross-cutting and innovative training in collaboration with private industry and labor organizations that support students pursuing four and two-year degrees. As principal investigators leading research projects, faculty can train students on practical research, data gathering, and analysis to support commercialization of new technologies.

The National Energy Technology Laboratory has invested millions of dollars in strengthening relationships between minority serving institutions and DOE's Office of Fossil Energy and Carbon Management through a university training and research program (UTR). The UTR program made 122 R&D awards from 2010 to 2021 to support students working on innovative R&D projects related to carbon capture, hydrogen, and more.⁵⁰

Program Application Process

While State Energy Offices often lead program development and implementation to support clean energy RD&D, entrepreneurs apply for the funding and facilitate the RD&D. There are inequities that can arise in the application process, and when designing a state program to support RD&D it is important to consider how to widen the grant applicant pool and provide equitable access to the application. States could create a database of community-based organizations, minority serving institutions, and other known entrepreneurs who may be interested in funding to support clean energy RD&D. States also may reach out directly to share information on a potential opportunity and provide support in the application process. Technical support can include providing access to data, providing connections to national laboratories or local universities, and providing other tools as outlined in the technical assistance section above.

Technical support for applicants, no or low-cost matches, and application processes that have low hurdles for participation (for example through a pass/fail and scoring phase) can all further the inclusion of entrepreneurs from disadvantaged communities in RD&D projects. State Energy Offices could continue to gather input from

potential applicants through surveys, websites, or by scheduling dedicated time with residents or resident representatives to encourage participation. Because initial outreach can serve to encourage and increase long-term engagement, it is important not only to utilize appropriate communication mediums during the initial contact phase, but to maintain contact throughout the process.

The California Energy Commission funds an initiative known as CalSEED that provides funding and professional development assistance to diverse early-stage clean energy entrepreneurs. CalSEED provides funding at two levels: \$200,000 for Concept Awards and \$500,000 for Prototype Awards. A comprehensive award application manual is available for potential applicants that highlights their impartial selection process, social impact, and energy equity selection criteria, and inclusive outreach process to applicants from early-stage businesses and communities that are underrepresented in the climate tech industry. According to the guidance, some of the key questions that potential applicants for CalSEED should consider include (1) Why is your proposed solution innovative and not simply an incremental improvement on existing solutions already in the market? (2) Are there unique technical features of your innovation that advance energy equity? (3) Who will benefit from the proposed innovation? (4) To what extent will the innovation create opportunities for job creation, contracting, supplier diversity, and economic diversity? and (5) Why will your team have continued success after CalSEED?⁵¹ It is helpful to outline these items for potential applicants to better understand what the funder is looking for and encourage thinking beyond their initial project idea. As of the end of 2023, CalSEED has provided over \$22 million in funding, supporting over 140 clean energy start-ups. Those companies have attracted over \$800 million in follow-on private investments. Nearly 30 percent of CalSEED awardees are led by women, and nearly 50 percent of awardees are minority-led firms.

Additionally, technical support for applicants, no or low-cost matches, and application processes that are clear and straightforward are critical for participation. The description of a grant should be plain and clearly lay out the social, economic, and environmental benefits to disadvantaged communities. There should be a clear path to participation including a pass/fail phase (which is clearly defined) and then a scoring phase. Those conducting the scoring should include representatives from a disadvantaged community and incorporate DEI principles in selecting the broader review committee or group. State Energy Offices can nominate individuals to serve on these grant committees, working groups, and other boards that will help with the selection process and advance equity in their respective states and regions. During the stakeholder engagement process, efforts should be made to understand application hurdles perceived by members or businesses located in or representing disadvantaged communities. There could also be efforts to engage with minority-serving institutions and other community-based innovators to inform them of the R&D program and what is needed to successfully apply.

The Washington Department of Commerce's Clean Energy Fund provides competitive grants for the development of clean energy technologies. The fund allocates money to a Rural Clean Energy Innovation Program that focuses on projects in rural communities across the state. The program began accepting applications in December 2022, and has been hosting stakeholder engagement sessions to garner insight into the program and application process from potential applicants. A virtual information session was hosted for Tribes who will be eligible for over \$900,000 in funds with a match required of \$1 for every \$10 provided by the State Energy Office. At the listening session staff specifically sought feedback from the Tribes on how to make the application process more accessible and on challenges that have been experienced with applying for other Washington Department of Commerce grants in the past.⁵²

Partnerships are key when there are low-cost match requirements, but a no-cost match requirement makes it even more accessible to low-income or other disadvantaged groups as they can then focus on developing projects that will be funded in their entirety. On the flip side, providing some cost match can be an opportunity for a project team to gain fiscal agency and develop partnerships and capacity.

A competitive grant program may also lead to challenges for groups with limited resources. Being clear on match requirements and other criteria from the onset will make it easier for groups to prepare for these hurdles in advance. Other criteria included in an application can specify resilience benefits, energy efficiency, decreased emissions, increased access, location in disadvantaged communities, support of critical facilities, and workforce/economic benefits. This can help ensure grant programs are providing funds to projects that support communities during high-risk events such as a natural disaster or localized power outage.

Information on the application should be provided in non-technical terms to ensure access to a wider range of applicants, and support should be provided to applicants with limited resources. For example, applications should be available in multiple languages and training should be available for applications requiring online access. Frequently asked questions should be updated and shared on the application website, with efforts made to address as many questions as possible. If an application is turned away, efforts could be made to provide a detailed response on how to improve future applications, with support offered to that end.

Metrics and Mapping Tools

State Energy Offices can develop metrics to evaluate equitable RD&D programs and processes. Metrics can be indicators of success such as how many people have access to electric vehicle chargers or a clean energy microgrid, or they can track the impact of a program or process in specific categories such as income, race, ethnicity, immigration status, health, gender, family size, education level, or age. Along with metrics, many State Energy Offices have developed mapping tools to identify communities that are experiencing disproportional environmental burdens. These communities may have already faced decades of burdens from pollution, lack of resources, inefficient home energy systems, or contaminated air and water that have contributed to poor health and work performance. Examples of disadvantaged communities can include low-income households, indigenous people, people of color, and remote or rural communities.⁵³

Many State Energy Offices have developed tools to map disadvantaged communities that provide models for other states. For example, the Michigan Department of Environment, Great Lakes, and Energy's MiEJScreen is a mapping tool that identifies communities carrying disproportionate environmental burdens. The tool analyzes environmental exposures, environmental effects, sensitive populations, and socioeconomic factors to understand the injustices being felt by different communities across the state. The California Environmental Protection Agency also manages a tool, CalEnviroScreen, to identify disadvantaged communities using geographic, environmental hazard, public health, and socioeconomic criteria. In a more specific example, the D.C. Department of Energy and Environment's (DOEE) is focused on developing an equity and environmental justice index that will identify at-risk and disadvantaged communities using local and national data at the census-tract level. In tandem, DOEE is analyzing regular power outage data to highlight spatial dependencies of outages and equity and environmental justice burdens across the city. This will help identify optimal locations for resilience investments and infrastructure. The work is initially focused on deployment of distributed energy resources such as a solar and battery storage resilience hub. The exercise could be used to identify additional R&D projects that would benefit at-risk and disadvantaged communities.

Stakeholder Engagement and Convenings

It is important to involve stakeholders in the development of clean energy RD&D programs. Convening stakeholders provides an opportunity for community-based innovators and concerned citizens to share ideas, ask questions, and develop an understanding of and become vested in projects. Convenings on potential project design and funding streams offer an opportunity to connect innovators of emerging technologies with information about markets, public priorities, funding opportunities, regulations, and community concerns and priorities. In addition to sharing details on targeted investment and potential grant support of cleantech innovation, State Energy Offices can facilitate information sharing, communication, and coordination on potential innovation ecosystems, bringing together both private and public partners and helping to bridge federal, regional, state, and local stakeholders. For example, in states with a designated Tribal liaison, states can utilize the liaison to share information on clean energy R&D priorities and projects affecting the Tribes as well as share resources on economic development, workforce, and funding opportunities.

Convenings focused on clean energy RD&D should also offer the opportunity for all interested parties to challenge the experts in the room. The information sessions should consider factors such as when sessions are held (flexible hours outside of business hours), language access to those for whom English is not the primary language, and provision of on-site childcare and meals. In addition, organizers may need to provide access to resources for community members who are unable to participate in virtual meetings due to a lack of internet access.⁵⁴ A community liaison could support access to funding by working with states to help design the application, provide insight on how to make it more accessible, establish criteria for evaluation, and facilitate information sharing to increase stakeholder participation.

Stakeholder engagement sessions are essential to establishing trust and project buy-in. The meetings can help community members better understand a potential project and what the actual impact would be on their land, health, and neighborhood. The meetings also may provide an opportunity for developers or innovators to showcase data they have and discuss data that is missing or unavailable. Stakeholder engagement sessions can explore how production of certain clean energy technologies may impact disadvantaged communities.⁵⁵ The sessions may determine if community members have the resources to connect with the state, project developer, and/or utility for the entire lifecycle of the project. If feasible, the process should allow for a feedback loop. State Energy Offices can continuously engage and inform residents and community stakeholders about the state's role in developing and deploying energy projects, available state and federal resources, and information on how disadvantaged communities can engage with state agencies. In the long run, these activities may yield dividends when introducing new technologies in the community. State Energy Offices can share information on available tangible benefits and seek to understand the community's experience in accessing existing technologies, including barriers that prevent access, while identifying opportunities for the community to participate in the RD&D process.

One way to manage the process is through a Community Benefit Agreement (CBA). The CBA could be led by a community liaison responsible for maintaining dialogue between relevant stakeholders, and/or an allocation of staff and financial resources to maintain engagement and provide technical support. CBAs offer a mechanism to ensure community trust and buy-in by tracking promises made around workforce and other project benefits. CBAs are strategic vehicles for community engagement and when properly developed can benefit the private sector as well as state and local governments. CBAs may establish training programs in the community or establish hiring agreements with local unions. Training programs can be established through partnerships with local universities, community centers, trade schools, and more. Efforts can center around prioritizing RD&D projects that utilize local hire, apprenticeship, and job quality protections along with supporting community-based innovators. Community members should be aware of the long-term potential of a workforce opportunity and how existing skills can be utilized or enhanced.

A potential model to ensure a strong stakeholder engagement process includes (1) introduction of the project, stakeholder identification, and community impacts; (2) information-sharing and desired outcomes of both parties; (3) formal engagement and partnership; (4) implementing the agreed outcome and grievance management; and (5) stakeholder monitoring.⁵⁶ Following this strategy can help minimize conflict and ensure that developers are aware of and considering issues such as potential impacts to cultural heritage sites. The process should also allow disadvantaged communities to take the time needed to fully understand the project and potential impacts and to express their concerns in a safe and respectful environment. This can be done through direct stakeholder engagement meetings or a more coordinated effort such as a task force or working group with local community members or organizations.

The Hawai'i State Energy Office released a playbook on equitable community engagement in October 2022 known as Energize Kākou. Energize Kākou provides a framework for the Hawai'i State Energy Office to follow, along with other key stakeholders supporting the decarbonization process. The best practices include valuing people's time and reducing barriers to entry; considering the time, resources, and staffing available to carry out the engagement; cultivating relationships within the community; building community ownership and empowerment into the engagement process; and being intentional with the type of questions asked.⁵⁷ Other State Energy Offices could develop a similar playbook (with foundational elements of time, needed resources, partnership development, and stakeholder engagement/community involvement) that addresses the unique needs of the communities within their states and regions. The model could be used by State Energy Offices when they engage with communities regarding the development of clean energy RD&D programs. State Energy Offices could share the model with entrepreneurs who are awarded funds for RD&D to utilize throughout the process. Early and dedicated community engagement will help determine what innovative technologies would best meet community needs and priorities.

Partnerships and Advisory Committees

An RD&D program designed to address equity could work to identify key partnerships to strengthen the program and establish an advisory committee to provide insights and perspectives from multiple groups including communities, Tribes, industry, and universities. Such partnerships and outside support can help a state to demonstrate a serious commitment to equitable RD&D. State Energy Offices can look at directing funding to a community-based organization to manage and distribute to local entrepreneurs. Working with a community-based organization can build credibility and trust between State Energy Offices and the community as they understand the look of successful innovation and potential obstacles to deployment. It also may give the community a sense of ownership of the project and spur more interest in investing in the project over the long-term, which further enhances economic development and long-term resilience potential. Another approach is to develop strategic partnerships with philanthropy, industry, and academia. Philanthropy has long played a critical role in research, especially in areas that government may not undertake. In fact, philanthropic organizations contribute support for 44% of basic science research at universities and nonprofit research institutes and have been complementary to government sponsored research.⁵⁸ Other partners with whom State Energy Offices can engage include state economic development or energy assistance offices, universities and their extension programs, nonprofits, green banks, and municipal utilities or electric cooperatives.

For State Energy Offices that do not have the resources to identify and build relationships with communities across the state, there are organizations that can help. For example, the Institute for Sustainable Communities (ISC) can assist with community engagement and identify innovative ways for state governments to effectively reach and provide support on a grassroots level. ISC launched an initiative known as the Partnership for Resilient Communities that expands opportunities for community groups by ensuring that grants are provided to leaders and organizations serving people of color so they are better involved in resilience planning and decision-making.⁵⁹

Several state examples demonstrate additional ways to incorporate partnerships and/or an advisory committee to support a program's implementation. In New Jersey, a partnership between the New Jersey Board of Public Utilities and the New Jersey Economic Development Agency facilitated a state Clean Tech Seed Grant Program, which helps early-stage clean energy companies move projects forward, and a Clean Tech R&D Voucher Program, which helps those early-stage clean energy companies access facilities, equipment, and other resources at state universities and laboratories.⁶⁰ The Michigan Department of Environment, Great Lakes, and Energy (EGLE) launched a Smart City Roadmap Pilot Program in July 2022 to support three cities in developing strategies to reduce their greenhouse gas emissions. EGLE, along with partners NextEnergy and Public Sector Consultants, will provide support to the cities in several ways including establishing community-based project teams to set goals and objectives for potential projects including the research and development of microgrids and other distributed energy resources.⁶¹

IV. Conclusion

Clean energy research development and demonstration will continue to be a priority as states explore innovative decarbonization, resilience, and efficiency solutions to support their communities. While there are a variety of opportunities and challenges associated with the process, it is invaluable to incorporate equity into all stages of clean energy innovation to ensure projects have community support and are targeted to community needs and priorities. Allowing meaningful involvement in RD&D by disadvantaged communities provides people with technologies that best meet their specific needs through increased awareness, meaningful participation, pride in ownership and familiarity, and inclusiveness and equity. It is also crucial to ensure applications and technical assistance for entrepreneurs are accessible and targeted to a diverse spectrum of individuals and organizations. State Energy Offices are well positioned to support many of these goals including by providing capital, supporting technical assistance, facilitating partnerships, convening stakeholders, and encouraging workforce and economic development. State Energy Offices are key players in ensuring a just and equitable process.

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